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Index to the Electrical Review,
July 6th, 1917.

THE
ELECTRICAL REVIEW.

Vol. LXXX.

JANUARY 5 — JUNE 29, 1917.

LONDON :
H. ALABASTER, GATEHOUSE & KEMPE,
4, LUDGATE HILL, E.C. 4.

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INDEX.

List of sub-headings:—Authors, Bankruptcy Proceedings, City Notes, Contracts Closed and Open, Correspondence, Institution and Lecture Notes, Legal, Lighting and Power Notes, Liquidations, New Companies, New Electrical Devices, Fittings and Plant, Obituary, Official Returns, Prospectuses, Railway Notes, Reviews, Telegraph Notes, Telephone Notes, Tramway Notes, War Items.

Academy of Sciences, 44
Accrington, Haslingden and Rawtenstall, A linking-up scheme, 426
Accumulators, The care of, 46
A.E.G. and the Berlin Electricity Works, 701
After four years—Reflections on Chinese engineers, by Prof. Middleton Smith, 145
After the War! The good time coming, 199
Agriculture College and electricity, Irish, 630
Agricultural Electric Supply and Electric Power Committees, The, 310
Agriculture, Electricity in electro-culture, and crop production: Results in 1916, 507
Agriculture, Electricity in electro-culture at Hereford, 269, 680
Agriculture, Electricity in electro-culture at Minehead, 358.
Agriculture, Electricity in—I.M.E.A. Agricultural Electrical Development Committee, 335
Agriculture, Some considerations affecting the use of electricity in, 62, 88, 116
Aircraft, Light alloys for, 325
Air services, Training for the, 324
Alquist gearing, 159
Alternating currents, High-pressure rectified, 690
Alternating-current locomotives, The control of, 709
Aluminium, 240
Aluminium developments in France. 155
Aluminium industry, The International, 360
Aluminium production by electrolysis, by R. Seligman, 446
Amalgamated Society of Engineers and the Government, 656
Amalgamated Society of Engineers and Trade Union rules, The, 131
Amalgamated Society of Engineers' funds, 701
America at war, 493
America, The great need of promoting research in, 223
American electrical cooking conditions, 34
American electrical industry and the war, 465
American engineering societies, Council of, 481
American help for British engineers, 466
American profit-sharing, 16
American report on German electrical organisation, 229
American rural transmission lines, Cost of, 46
American Westinghouse extensions, 104, 349
America's electrical week, 22
Anthracite coal, by W. H. Booth, 646, 669
Appointments vacant, 17, 45, 75, 104, 158, 185, 213, 297, 326, 353, 409, 439, 467, 494, 521, 551, 576, 606, 630, 655, 680, 703
Ash and clinker equipment for central stations, New, 389
Ashes or dust, Coal concreted from, 702
Association of Consulting Engineers (Inc.), 650
Atmospheric nitrogen, Fixation of, 549
Australasia, British manufactures in, 652
Australia and electrical contracts, 98, 600
Australia, Brown coal deposits in, 130, 409
Australia, Preference for American cables in, 231
Australia, Technical education in, 438
Australian Association of British Manufacturers and their Representatives, The, 545
Australian coal trouble and its effects, 65
Australian factory schemes, 698
Australian electricians with the Forces, 702

Authors—
  Barham, G. Basil, on Baking by electricity, 3
  Blake, H. E., on Induction methods of fault localisation, 661
  "Booster," on Small electric motors, 23
  Booth, W. H., on Anthracite coal, 646, 669
  Bowden, J. H., on Individual interest in municipal enterprise, 692
  Bradley, L., on Precipitation of smoke and fumes—The Cotterell process in practice, 710
  Bullen, A. T., on Some notes on the electrical driving of workshops and factories, 339
  Chamen, W. A., on Wayleaves, 555
  "Commercial" on The inspection of munitions—some new methods and some old ones, 171
  Cook, W. W., and F. Gill, on Principles involved in computing the depreciation of plant, 81, 91 136, 194, 320
  Crammond, E., on British capital and foreign trade, 288
  D'Albe, E. E. Fournier, on The Optophone, 195
  Davies, A. E. Val, on Breakdowns in German plant, 124
  Davis, A. H., on Phantom circuit system for controlling street lights, 228
  Ellerd-Styles, W., on Wiring with tough rubber compound cables, 451
  Emmett, W. L. R., on Electric ship propulsion, 279
  Ewing, S. E. T., on Comparison of electric winding systems, 376
  "Experiment," on Radiators, 227
  Fleming, A. P. M., on Industrial research, 138
  "G. W. S." on Errors of direct-current ampere-hour meters, 118; on Some notes on bonding and earthing the lead sheathing of underground cables, with special reference to solid systems, 387
  Gaster, L., on The lumen as a measure of illuminating power, 401
  Gill, F., and W. W. Cook, on Principles involved in computing the depreciation of plant, 81, 91, 136, 194, 320
  Griepe, A. W. H., on An internal combustion turbine, 378
  Guy, H. L., on Steam turbines for land purposes, 14, 171
  Hall, A. S., on Rural transmission lines, 135
  Hollis, E. P., on Municipal electrical publicity, 415
  "Hot Air," on Electric fires, 368
  Jackson, P. H., on The controller drum, 285
  Juhlin, G. A., on The voltage régulation of rotary converters, 304, 333, 343, 472
  Kapp, Dr. G., on The determination of the sequence of phases from wattmeter readings, 566
  Leeming, Warrant Officer W., on The more recent applications of electricity in the present war, especially in the treatment of diseases and wounds arising therefrom, 661

Authors—*continued*
  "Legal Contributor" on Factory repairs and renewals in war time, 565; on Telephone wires in streets, 602; on Some patent and trade mark cases, 625
  Leighton, L., on Equipment of King George Dock, Hull, 341, 388
  Lever, Sir W., on Capital and Labour, 68
  Long, F. M., Presidential address to the Incorporated Municipal Electrical Association, 668
  Longridge, M., on The engineering industry, 483
  McBerty, F. R., on Machine-switching telephone gear, 399
  Marks, John, on The position of the shift engineer after the war, 43
  Matthews, R. Borlase, on Electromobile experience, 69
  Moore, A. E., on A concentric standard dynamometer watt-meter and non-inductive standards of low resistance, 637
  Otley, T. G., and V. Pickles, on Boiler house operation and maintenance, 147, 192, 206
  "P. B.," on Making do, 537
  Parnell, T., on An a.c. bridge method of comparing inductances, 664
  Peck, J. S., on The parallel operation of electrical power stations, 35, 278
  Pickles, T., and T. G. Otley, on Boiler-house operation and maintenance, 147, 192, 206
  Rawlings, W. R., on The wiring rules of the Institution of Electrical Engineers, 475
  "S. G." on Cable junction boxes, 31, 60; on High pressure cable joints, 255
  Scott, C. P., on Electrical heating and cooking, 598
  Scott, Prof. W. R., on Economic recuperation after war, 229, 277
  Seligman, R., on Aluminium production by electrolysis, 446
  Shepherd, J., on Some points in connection with engineering specifications, 248, 276, 373, 503
  Shield, R. K., on The manufacture of controller drums, 591
  Smith, Prof. C. A. Middleton, on After four years—Reflections on Chinese engineers, 145
  Stubbings, G. W., on Some notes on electric fires, 564; on Some notes on the measurement of the insulation resistance of, a live three-wire network, 620
  Tanner, G. F., on The simplification of line testing, 539
  Thornton, Dr. W. M., on Bare wire signalling in mines, 289
  Townend, R., on Frequency changers, 219, 361
  "Tramp Royal" on Hustling and team work, 563; Team work in line construction, 592
  Twiss, G. V., on High-tension overhead transmission lines, 508, 556, 585
  Vernier, C., on Wayleaves, 443, 454,
  Wardale, W. T., on Some thoughts on the capital and labour problem, 331; on The importance of canal development to the electrical man, 471
  Webber, H. W., on Recent developments in electricity supply at Keighley, 643
  Weightman, R. W., on Colonial telegraphs and telephones, 25, 51, 79

Auto-transformers, Improper use of, 7

Bachelet patents for sale, 74
Bakerloo: L. & N. W. Watford extension, The, 423, 439
Baking by electricity, by G. Basil Barham, 3
Bank Charter, Industrial, 577

Bankruptcy Proceedings—
  Alison, H. P., and J. G. S. Cunnington, 265, 515, 572
  Birkett, W. D., 322
  Bonner, G. E., 126
  Brockie, J., 515
  Brown, F., 208, 488, 626
  Cawood, W., 130
  Chamier, F. W., 349
  Coster, S. S., & Co., 349, 404
  Craig, A. B., 270, 488
  Cunnington, J. G. S. and Allison, H. P., 265, 515, 572
  Evans, C. E., 98
  Hawdon, A. F., 572
  Ogilvie, C. B., 11, 71, 126, 180, 270
  Oxley, H. H., 126, 265
  Peddie, J. T., 180
  Smith, G. A., and G. A. Smith & Co., 652
  Whitehouse, J. R., 98, 237
  Wright, E. W. Barton, 349, 488

Bare wire signalling in mines, by Dr. W. M. Thornton, 289
Batteries, Compound for use in building dry, 184
Batteries, Flash lamps without, 15
Battery combine, British, 657
Battery jars for electrical vehicles, Standard, 159
Battery patent for sale, 15
Bauxite in Hungary, 396
Belfast electricians' wages, 342
Benevolent Institution, The Electrical Trades, 422, 434
Benzol and electricity, 134
Board of Scientific Societies, The Conjoint, 700
Board of Trade Committee on Electricity Supply and the I.M.E.A., 549
Board of Trade, Departmental Committee on Electric Supply, 325, 353, 680, 700
Boiler house operation and maintenance, by T. G. Otley and V. Pickles, 147, 192, 206
Boiler purposes, Redistribution of coal available for steam, 679
Bonding and earthing the lead sheathing of underground cables, with special reference to solid systems, Some notes on by "G. W. S.," 387
Bone's electricity works, 539
Bonus system at work, A, 439
Bonuses for station staff, 702
Books for British prisoners of war, 518
Boots, Electric power and the output of, 103
Bosch magneto interests, 404, 679
Boy in industry, The, 520
Bradford fuel and food control, 680
Bread and butter machine, 75
Breakdowns in German plant, by A. E. Val. Davies, 124
Breakdowns in networks, Surge, 583
Bridge method of comparing inductances, An a.c., by T. Parnell, 664
British Association meeting, 353, 630
British capital and foreign trade, by E. Crammond, 288
British Electrical and Allied Manufacturers' Association, The work of the—The Annual Report, 139, 142, 166
British electrical industry, The need for home support, 239
British Empire Producers' organisation, 302
British Engineers' Association, 629

- British Ignition Apparatus Association, The, 675
- British Industries Fair, 98, 236
- British Industries Fair, The electrical installation at the, 227
- British manufactures, Preference for, 29
- British Science Guild, 408, 492
- British Trade Corporation, 376, 457, 520
- British Trade Corporation prospectus, The, 700
- British Westinghouse Co.'s Works, Visit of Colonial representatives, The 479
- Brittleness produced in steel springs by electro-plating, The, 185
- " 'Bus-Charging " at York, Electric, 598
- Business must go on, 590
- Business names, Registration of, 126, 236, 416, 698

- CABLE joints, High pressure, by "S. G.," 255
- Cable junction-boxes, by "S. G.," 31, 60
- Cable-Makers' Association, 38, 102
- Cable, Use solid wire in place of small stranded, 241, 296
- Cable works, The Pirelli-General, 115
- Cables: Excess Profits duty, Electrical, 520
- Cables, with special reference to solid systems, Some notes on bonding and earthing the lead sheathing of underground, by "G. W. S.," 387
- Callenders' hospital fund, 134
- Canada, Notes from; 347
- Canada, Trade statistics of, 348
- Canada, Trade with, 99, 130
- Canadian Exhibition, 652
- Canadian water-powers, 199
- Canadian Water-powers report, 550
- Canal development to the electrical man, The importance of, by W. T. Wardale, 471
- Canal system, Bavarian, 325
- Canals, Electrical power on, 450
- Canals, Our, 198, 225
- Candle-power, Lumen *versus*, 394
- Capital and Labour, by Sir W. Lever, 68
- Capital and Labour problem, Some thoughts on the, by W. T. Wardale, 331
- Car lighting and engine starting for motor cars, 56
- Car lighting Association, U.S., 439
- Carbon electrodes for arc furnaces, 134
- Carron electrical cooking installation, A large, 370
- Catalogues: Notice to manufacturers, 282
- Cell, A sensitive selenium, 688
- Census of production, The, 255
- Central station employees, 520, 550, 582
- Ceylon, Import trade of, 112
- Charging at York, 'Bus, 598
- Charging stations in Gt. Britain, Public electric, 269, 296, 368
- Cheaper electricity supply, 281
- Chemical engineering, General discussion on, 360
- Chemical industries, Mobilisation of, 519
- Chemical Manufacturers' Association, 302
- Chicken brooding, Electric, 551
- China, Electrical industries in, 529
- China, Import trade of, 24
- China, Trade with, 71

- CITY NOTES—
  - Adelaide Electric Supply Co., 188
  - Alby United & Nitrogen Products Companies, The, 327
  - Alderley & Wilmslow Electric Supply, 441
  - Allen, Edgar & Co., 707
  - Alldays & Onions Pneumatic Engineering Co., 273
  - Altrincham Electric Supply, 683
  - Aluminium Corporation, 105, 706
  - Amalgamated Wireless (Australasia), 468
  - American Telephone & Telegraph Co., 357
  - Anderston Foundry Co., 635
  - Anglo-American Telegraph Co., 49, 386, 553
  - Anglo-Argentine Tramways Co., 608
  - Anglo-Portuguese Telephone Co., 681
  - Arbroath Electric Light & Power Co., 708
  - Argentine Tramways & Power Co., 413
  - Arizona Copper Co., 244
  - Armorduct Manufacturing Co., 658
  - Auckland Electric Tramways Co. (1904), 469
  - Austrian companies, 105, 524
  - Automatic Telephone Manufacturing Co., 273, 329, 355, 658
  - Babcock & Wilcox, 534
  - Barnsley and District Electric Traction Co., 658
  - Bath Electric Tramways, 525
  - Birmingham District Power & Traction Co., 274, 469, 659, 681
  - Blackpool & Fleetwood Tramroad Co., 189, 217, 245
  - Bombay Electric Supply and Tramways Co., 413
  - Bournemouth & Poole Electricity Supply Co., 217, 301

- CITY NOTES—*continued*
  - Brazilian Traction, Light, & Power Co., 106, 245, 635
  - Brisbane City Electric Light Co., 525
  - Brisbane Electric Tramways Investment Co., 581
  - Bristol Tramways & Carriage Co., 77, 301
  - British Aluminium Co., 329, 411
  - British Columbia Electric Railway Co., 20
  - British Electric Traction Co., 610, 658, 704
  - British Electric Transformer Co., 330, 357, 411
  - British Engine Boiler & Electrical Insurance Co., 301
  - British Ever-Ready Co., 525
  - British Insulated & Helsby Cables, 274, 329, 356
  - British L. M. Ericsson Manufacturing Co., 245, 357
  - British Westinghouse Electric & Manufacturing Co., 301, 441, 495, 552, 578
  - Bromley (Kent) Electric Light & Power Co., 357
  - Brompton & Kensington Electricity Supply Co., 301, 355, 384
  - Browett, Lindley & Co., 329, 357
  - Bruce Peebles & Co., 274, 328
  - Brush Electrical Engineering Co,. 495, 523
  - Buenos Aires Lacroze Tramways Co., 553
  - Calcutta Electric Supply Corporation, 49, 161, 274, 498, 553, 609, 635, 683
  - Calcutta Tramways Co., 525, 610, 659
  - Callender's Cable & Construction Co., 580, 634
  - Cambridge Electric Supply Co., 161, 273
  - Canadian General Electric Co., 329, 441, 635
  - Cape Asbestos Co., 707
  - Castner-Kellner Alkali Co., 244, 581
  - Central Electric Supply Co., 189, 217
  - Central London Railway Co., 189, 216
  - Charing Cross, West End, & City Electricity Supply Co., 273, 384
  - Chatham & District Light Railway Co., 133
  - Chelsea Electricity Supply, 356, 412
  - China & Japan Telephone & Electric Co., 658
  - Chiswick Electric Supply Corporation, 497
  - Chloride Electrical Storage Co., 273, 581
  - City & South London Railway Co., 189, 216, 244
  - City of Buenos Aires Tramways Co. (1904), 161, 469
  - City of Carlisle Electric Tramways Co., 245
  - City of London Electric Lighting Co., 244, 300, 384
  - Clevedon, Portishead, & District Electric Supply Co., 525
  - Cleveland & Durham County Electric Power Co., 301, 355, 658
  - Clyde Valley Electrical Power Co., 441
  - Coalite, 357, 384
  - Colombo Electric Tramways & Lighting Co., 581
  - Commonwealth Edison Co., 386
  - Compagnie Madrilene d'Electricité, 188
  - Compania de Electricidad de la Provincia de Buenos Aires, 245
  - Companies struck off the register, 301
  - Cordoba Light, Power, & Traction Co., 20
  - Cork Electric Tramways & Lighting Co., 522
  - Cornwall Electric Power Co., 357
  - County of London Electric Supply Co., 245, 272, 300
  - Craigpark Electric Cable Co., 525
  - Crossley Bros., 188
  - Cuba Submarine Telegraph Co., 469
  - Davis & Timmins, 189
  - Delhi Electric Tramways & Lighting Co., 634
  - Direct Spanish Telegraph Co., 301, 356
  - Direct United States Cable Co., 49, 442, 469
  - Direct West India Cable Co., 245
  - Doulton & Co., 330, 610
  - Dublin & Lucan Electric Railway Co., 385
  - Dublin United (Electric) Tramways, 48, 161
  - East London Railway Co., 133
  - Eastern Extension, &c., Telegraph Co., 497, 707
  - Eastern Telegraph Co., 498, 707
  - Edison accumulators, Ltd., 659
  - Edison-Swan Electric Co., 161, 188, 329, 413
  - Edmundson's Electricity Corporation, 77
  - Electric Construction Co., 580, 633
  - Electric Light & Power Supply Corporation of Australia, 385
  - Electrical & Industrial Investment Co., 188
  - Electrical Distribution of Yorkshire, 217
  - Electro-Bleach & By-Products, 245, 610
  - Evered & Co., 469
  - Fairbairn, Lawson, Coombe, Barbour, 442
  - Fellows Magneto Co., 49

- CITY NOTES—*continued*
  - Fife Tramway, Light, & Power Co., 217, 245
  - Folkestone Electricity Supply Co., 356
  - French Electrical Companies, 105, 292, 682, 706
  - Gateshead & District Tramways Co., 329
  - General Electric Co. (U.S.A.), 524
  - German Electrical Companies, 20, 49, 385, 441, 580, 706
  - Globe Telegraph & Trust Co., 274, 707
  - Glover & Co. (W. T.), 441, 469
  - Great Northern Telegraph Co., of Denmark, 469, 659
  - Greenock & Port Glasgow Tramways Co., 442
  - Hadfield's, 301, 329
  - Halifax & Bermudas Cable Co., 245
  - Hart Accumulator Co., 413
  - Hawkes, O. C., 357, 707
  - Heenan & Froude, 683
  - Henley's, W. T., Telegraph Works Co., 245, 301, 356, 411
  - Holme (Huddersfield) Electricity Co., 21
  - Huelva Gas & Electricity Co., 357
  - Humphrey Pump Co., 21
  - Imperial Tramways Co., 77, 707
  - India, 49
  - Indian Electric Supply & Traction Co., 497, 522
  - Indo-European Telegraph Co., 413, 497
  - Isle of Thanet Electric Tramways & Lighting Co., 48
  - Isle of Wight Electric Light & Power Co., 330
  - Italy, 404, 553
  - Jackson, P. R., & Co., 357
  - Jarrow & District Electric Traction Co., 273
  - Johnson & Phillips, 468, 497
  - Kalgoorlie Electric Power and Lighting Corporation, 413, 442, 553, 609
  - Kaministiquia Power Co., 49, 217, 497
  - Keith, Jas, & Blackman Co., 683
  - Kensington & Knightsbridge Electric Lighting Co., 245, 272
  - Kidderminster & District Electric Lighting & Traction Co., 553
  - Kidderminster & Stourport Electric Tramway Co., 553
  - La Plata Electric Tramways Co., 442
  - Lanarkshire Tramways Co., 161
  - Lancashire United Tramways, 217
  - Launceston & District Electric Supply Co., 357
  - Lewes & District Electric Supply Co., 553
  - Lima Light, Power, & Tramways Co., 21, 469, 659
  - Lisbon Electric Tramways, 608, 658
  - Liverpool Overhead Railway Co., 189, 244, 272
  - Llandudno & Colwyn Bay Electric Railway, 161
  - Llanelly & District Electric Lighting & Traction Co., 385
  - London & Suburban Traction Co., 634, 683
  - London Electric Railway Co., 189, 216, 244
  - London Electric Supply Corporation, 217, 328
  - London United Tramways, 634, 683
  - Longford Wire Co., 658
  - Madras Electric Supply Corporation, 658
  - Madras Electric Tramways (1904), 356
  - Manila Electric Railroad & Lighting Corporation, 329, 658
  - Marconi International Marine Communications Co., 21, 705
  - Marconi Wireless Telegraph Co., of America, 441
  - Marconi's Wireless Telegraph Co., 21
  - Mather & Platt, 217
  - Melbourne Electric Supply Co., 442, 525
  - Melton Mowbray Electric Light Co., 274
  - Mersey Railway Co., 217
  - Merthyr Electric Traction & Lighting Co., 553, 581
  - Metropolitan Carriage, Wagon, & Finance Co., 581
  - Metropolitan District Railway Co., 188, 216, 244
  - Metropolitan Electric Supply Co., 272, 328
  - Metropolitan Electric Tramways, 633
  - Metropolitan Railway Co., 133, 161, 187
  - Midland Electric Corporation for Power Distribution, 441, 525
  - Minehead Electric Supply Co., 355
  - Mirrlees, Bickerton, & Day, 581
  - Mirrlees-Watson Co., 245, 330
  - Montana Power Co., 469
  - Monte Video Telephone Co., 442
  - Montreal Light, Heat, & Power Co., 469, 708
  - Nairobi Electric Power & Lighting Co., 77
  - National Electric Supply Co., 707
  - National Electric Supply Co., 189, 217
  - National Gas Engine Co., 161, 188
  - New General Traction Co., 659
  - New York Telephone Co., 274
  - Newcastle & District Electric Lighting Co., 217, 272
  - Newcastle-upon-Tyne Electric Supply Co., 245, 309, 355
  - Newmarket Electric Light Co., 413

- CITY NOTES—*continued.*
  - North Metropolitan Electric Power Supply Co., 658
  - North of Scotland Electric Light & Power Co., 497
  - Northallerton Electric Light and Power Co., 273
  - Northampton Electric Light & Power Co., 49, 105, 273, 301
  - Northern Counties Electricity Supply Co., 659
  - Northern General Transport Co., 441
  - Norway, 469
  - Notting Hill Electric Lighting Co., 243, 300
  - Oldham, Ashton, & Hyde Electric Tramways, 441
  - Oriental Telephone & Electric Co., 498, 523, 525
  - Oxford Electric Co., 217, 245, 329
  - Para Electric Railway & Lighting Co., 217, 244
  - Parsons' Marine Steam Turbine Co., 161
  - Peel-Conner Telephone Works, 553
  - Penarth Electric Lighting Co., 581
  - Pennsylvania Water & Power Co., 244
  - Peterborough Electric Traction Co., 658
  - Potteries Electric Traction Co., 580
  - Pritchett & Gold & Electrical Power Storage Co., 413
  - Ramsgate & District Electric Supply Co., 498
  - Rangoon Electric Tramways & Lighting Co., 659
  - Reduction of Capital, 610
  - Reyrolle & Co., 581
  - Richardsons, Westgarth & Co., 683
  - Rio de Janeiro Tramway, Light, & Power Co., 77, 413
  - River Plate Electricity Co., 469, 523
  - Robey & Co., 357
  - Rushden & District Electric Supply Co., 274, 301
  - Russia, 133, 386, 683
  - Ruston, Proctor & Co., 708
  - St. James' & Pall Mall Electric Light Co., 161, 217, 273
  - Salisbury Electric Light & Supply Co., 357, 385
  - Sao Paulo Tramway, Light, & Power Co., 77, 413
  - Scarborough Electric Supply Co., 301, 357
  - Shanghai Electric Construction Co., 525, 553, 581
  - Shawinigan Water & Power Co., 357
  - Shropshire, Worcestershire & Staffordshire Electric Power Co., 273
  - Siemens-Schuckert Group, 20
  - Simplex Conduits, 330
  - Singapore Electric Tramways, 683, 706
  - Slough & Datchet Electric Supply Co., 385
  - Smith, S., & Sons (Motor Accessories), 386
  - South London Electric Supply Corporation, 217, 273, 301, 356
  - South Metropolitan Electric Light & Power Co., 216, 273
  - South Metropolitan Electric Tramways & Lighting Co., 659
  - South Staffordshire Tramways Co., 217
  - South Wales Electrical Power Distribution Co., 412, 553, 682
  - Southern Brazil Electric Co., 683, 707
  - Stewart & Lloyds, 301
  - Stock Exchange Notices, 21, 49, 245, 273, 413
  - Stone, J., & Co., 708
  - Stratford-on-Avon Electricity Co., 609
  - Sunderland District Railways, 161
  - Swansea Improvements & Tramways Co., 610
  - Swiss Electrical Companies, 188, 440
  - Tata Hydro Electric Power Supply Co., 19, 77, 683
  - Taunton Electric Traction Co., 553
  - Telegraph Construction & Maintenance Co., 188, 245
  - Telephone Company of Egypt, 469
  - Tottenham District Light, Heat, & Power Co., 188
  - Traction & Power Securities Co., 245
  - Tramway & Light Railways Estates Co., 386, 658
  - Tramways, Light, & Power Co., 272
  - Tyneside Electrical Development Co., 273
  - Tyneside Tramways & Tramroads Co., 217, 273
  - Underfeed Stoker Co., 189
  - Underground Electric Railways Companies of London, 189, 244, 299
  - United Electric Tramways of Monte Video, 707
  - United River Plate Telephone Co., 610, 635, 682
  - Urban Electric Supply Co., 385, 410, 468
  - Veritys, 330
  - Vickers, 357, 386
  - Victoria Falls & Transvaal Power Co., 413, 707
  - Vulcan Boiler & General Insurance Co., 217
  - Waygood-Otis, 683
  - War Loan, 106, 188, 217
  - Waste Heat & Gas Electrical Generating Stations, 273, 330
  - West India & Panama Telegraph Co., 498, 525
  - West India Electric Co., 412
  - West London & Provincial Electric Supply Co., 580
  - Western Electric Co. (U.S.A.), 467

City Notes—*continued.*
  Western Telegraph Co., 301, 581
  Westminster Electric Supply Corporation, 133, 217, 272
  White, J. G., & Co., 708
  Willans & Robinson, 440, 496
  Windermere & District Electricity Supply Co., 329
  Windsor Electrical Installation Co., 385
  Winnipeg Electric Railway Co., 659
  Woking Electric Supply Co., 441, 497
  Wycombe (Borough) Electric Light & Power Co., 413
  Yorkshire Electric Power Co., 161, 188, 243
  Yorkshire (West Riding) Electric Tramways Co., 77, 161, 245
  Yorkshire (Woollen District) Electric Tramways, 441

Coal Advisory Board, 260
Coal, Anthracite, by W. H. Booth, 646, 669
Coal available for steam boiler purposes, Redistribution of, 679
Coal boiler furnace, Powdered, 242
Coal concreted from ashes or dusts, 702
Coal cutters, Australian judge's decision, Electric, 702
Coal deposits in Australia, Brown, 130, 409
Coal economy, 588
Coal in France, Saving, 673
Coal in U.S.A., The cost of, 269
Coal storage, Underwater, 269
Coal, The control of, 703
Coal trouble and its effects, The Australian, 65
Coal winding problems, 338
Cockerill's, The Huns and, 575
Coke as fuel, Economy of gas, 592
Colonial Premiers, The, 406
Colonial telegraphs and telephones, by R. W. Weightman, 25, 51, 79
Committee of provincial electric supply companies, A, 140
Committee on production, 492
Commutator motors, New polyphase, 32
Communications in the field, Electrical, 595
Concentric standard dynamometer-wattmeter, and non-inductive standards of low resistance, A, by A. E. Moore, 637
Concrete transmission poles, Reinforced, 639
Condensation pump, The, 41
Conductivity of air and of mica, 275
Consular reform, 104

Contracts Closed—
  Aberdeen, 14
  Aldershot, 14
  Australia, 129, 158, 268, 324, 381, 574, 678
  Aylesbury, 575
  Barnsley, 324
  Barrow, 407
  Basingstoke, 183
  Bedford, 211, 437
  Bexley, 295
  Birmingham, 628
  Blackpool, 407, 491
  Bolton, 158, 518
  Bradford, 295, 407, 518
  Bridlington, 183
  Brighton, 700
  Cape Town, 74
  Chester, 437
  Colchester, 44
  Derby, 268, 407, 491
  Dewsbury, 518
  Dover, 465
  Farnborough, 548
  Fleetwood, 700
  Gillingham, 548
  Glasgow, 15, 44, 183, 352, 491, 518, 605, 628, 679
  Government contracts, 101, 211, 324, 465, 574, 679
  Grays, 700
  Halifax, 491
  Hammersmith, 129, 575, 679
  Heckmondwike, 437
  High Wycombe, 605
  Horsham, 44
  Hull, 465
  Ilford, 129, 381
  Ireland, 101
  Johannesburg, 605
  Leeds, 158
  Leigh, 44
  Leyton, 352, 575
  London, 44, 101, 129, 158, 268, 324, 381, 437, 465, 548, 575, 605, 679
  London County Council, 101, 158, 381, 491, 548
  Malvern, 548
  Manchester, 44, 158, 268, 407, 491, 628
  Marylebone, 44, 268, 465, 679
  Metropolitan Water Board, 605
  Newcastle West (Ireland), 101
  Nuneaton, 268
  Poplar, 324, 437, 679
  Rawtenstall, 101
  Rochdale, 700
  St. Helens, 295
  St. Pancras, 575
  Salford, 15, 158, 268, 491, 628
  Sheffield, 44, 183, 518, 655
  Sleaford, 74
  Southend-on-Sea, 74, 548
  Spain, 548
  Stepney, 575, 679

Contracts Closed—*continued*
  Stoke Newington, 437
  Stretford, 655
  Sunderland, 44, 183, 548
  Surbiton, 15
  Swansea, 239, 324, 518
  Todmorden, 628
  Twickenham, 44
  Venezuela, 700
  Walthamstow, 381, 492
  War Pensions Board, 548
  West Ham, 492
  Weymouth, 211
  Wolverhampton, 183, 437, 548, 655
  Woolwich, 679

Contracts Open—
  Aberdare, 183, 211, 239, 295, 323, 351, 381, 437
  Adelaide, 101, 129, 157, 183, 211, 239, 268, 295
  Argentina, 183, 211
  Australia, 14, 44, 74, 101, 129, 157, 183, 211, 239, 268, 295, 381, 407, 464, 548, 574, 605, 628, 655, 678, 700
  Aylesbury, 351, 381, 407
  Bambridge, 44, 74, 101, 129
  Barrow, 183, 211, 239
  Battersea, 74, 101, 129
  Bedford, 74, 101, 129
  Bedwas, 211, 239
  Belfast, 211, 239, 268
  Bermondsey, 101, 129, 158, 183
  Birkenhead, 323
  Bolton, 183, 211, 239, 295
  Bootle, 14
  Bray, 323, 352
  Brighton, 211, 239
  Brisbane, 157, 183, 211
  Bristol, 295
  Burnley, 239, 268, 295
  Bury, 352
  Canada, 158, 183, 211, 239, 268, 295
  Cheltenham, 101, 129, 158
  Dublin, 574, 605
  Dundee, 295, 324, 407, 437
  Erith, 655, 678
  Exminster, 678
  Farnborough, 491
  Fleetwood, 574
  Glasgow, 14, 211, 268, 295, 324, 352, 464, 655, 678, 700
  Grenada, 183, 211, 239
  Halifax, 74, 101, 129, 158
  Hammersmith, 129, 183, 211, 407, 437
  Harrogate, 129, 158, 183, 211, 239
  Hull, 324, 352, 381
  Keighley, 101, 129, 158, 518
  Kensington, 239
  Kilmallock, 183, 211, 239
  Kingston-on-Thames, 574, 605
  Liverpool, 295
  London, 74, 101, 129, 158, 183, 211, 239, 268, 295, 324, 352, 381, 407, 437
  London County Council, 158, 211, 324
  Londonderry, 183, 211, 239, 268, 295
  Macclesfield, 183, 211, 239, 268
  Manchester, 74, 101, 129, 158, 183, 211, 239, 324, 352, 437, 464, 491, 518, 548, 574
  Melbourne, 14, 44, 101, 129, 157, 183, 211, 239, 381, 407, 437, 464, 548, 574, 605, 628, 655, 678
  Metropolitan Water Board, 183, 211
  Merthyr Tydvil, 268
  Middlesbrough, 44, 74, 101
  New Malden, 44, 74, 101
  New Zealand, 14, 44, 74
  Newport (Mon.), 605, 628, 655, 678, 700
  Pembroke, 129
  Perth, 14
  Portsmouth, 101, 129
  Redditch, 268
  Rhondda, 239, 268, 295
  St. Pancras, 268, 295, 324, 352, 381
  Salford, 74, 129, 158, 268, 295, 381, 678
  Sheffield, 464, 491
  Sleaford, 678
  South Africa, 14, 44, 74, 101, 129, 158, 407, 437
  Spain, 14, 44, 158, 183, 295, 324, 407, 491, 548, 605, 628, 655, 678, 700
  Stockton-on-Tees, 211, 239, 268
  Stoke-on-Trent, 574
  Sydney, 14, 44, 101, 157, 183, 211, 548, 574, 605, 628, 655, 700
  Warrington, 295, 324, 352, 381, 491, 518, 648, 678
  West Ham, 14
  Wigan, 14, 464
  Winchester, 548
  Wolverhampton, 465, 491, 655, 678, 700
  York, 628

Contracts, Effect of the war on construction, 310
Contracts, Pre-war, 576
Control gear for steel works, Auxiliary motors and, 685
Control of alternating current locomotives, The, 709
Controller drum, The, by P. H. Jackson, 285
Controller drums, The manufacture of, by R. K. Shield, 590
Cooking at a Y.M.C.A. canteen, Electric, 240, 312
Cooking conditions, American electric, 34
Cooking, Electrical heating and, 598
Cooking installation, A large Carron electric, 370
Cooking installation, A railway, 240
Co-operation in export trade, 170
Co-operation in the electric vehicle business, 561
Copper, German sources of, 700

Correspondence—
  Accuracy of steam-flow meters, by J. R. P. Lunn, 151
  "Alternating current work," by W. Perren Maycock, 307
  American and English research, by "W. H. B.," 204
  Appeal for calendars, by F. L. Cater, 123
  Australian agencies, by "A. H. C.," 151
  "Bauer" qualimeter, by Newton I. Wright, 336
  Boiler house operation, by C. Erith, 433
  Boiler house operation and maintenance, by C. Mancha Bennett, 232
  Books for soldiers, by (Corpl.) S. J. Knight, 67
  British v. German manufacturers, by A. Nichols Moore, 122, 177; by "Electrical Manufacturer," 178; by "L. M.," 206; by W. H. Sisson, 232
  Business as usual, by "Contractor," 623
  Business man or engineer, by "Engineer," 649
  Central station employés, by W. J. Ebben, 481
  Cheap water-power, by "Water-Power," 150
  City and Guilds' Examination, by A. P. Lundberg & Sons, 9, 66, 96, 178; by "No Energy," 124
  Combination plug and adapter, by Donovan & Co., 419
  Controller drum, by N. J. Hockley, 344
  Cross-talk and secrecy, by The Telephone Manufacturers' Association, 695
  Curious trouble with lead-sheathed cable, by G. W. Partridge, 205; by W. H. Nairn, 232; by S. M. G. Teal, 232; by J. Shepherd, 258; by A. R. Chaytor, 336
  Decimal coinage, by "G. W.," 375
  Deterioration of turbine blading, The, by The British Thomson-Houston Co., 545; by C. P. Sparks, 545
  Electric fires, by Belling & Co., 458
  Electric power in a cotton mill, by W. T. Glover & Co., 687
  Electric radiators, by C. Orme Bastian, 307; by "Mains Engineer," 307; by P. Cope, 336
  Electric vehicles, by E. P. Rowley, 481; by "Semper Ipsi Este," 531; by the Hon. Secretary of the Electric Vehicle Committee of Great Britain, 544
  Electrically operated valves for internal combustion engines, by W. P. Durtnall, 482
  Electricity supply rates and Government contracts, by "Electric Supply," 344
  Fault localisation, by A. Somerville, 345; by "R. W. H.," 419; by H. E. Blake, 433, 458
  Federal Income Tax, by the Secretary, Australian Association of British Manufacturers and their representatives, 151
  Fuse failures, by H. W. Berry, 178; by "W. H. B.," 205; by The British Central Electrical Co., 232; by Berry, Skinner, & Co., 258
  Homogenous Lead Coating Co., by Sherard Cowper Coles, 232
  Industrial fatigue and maximum output, by "Producer," 695
  Inspection of munitions, by "Albion," 231, 307; by "Commercial," 258
  Institution of Electrical Engineers' Nominations, by L. L. Robinson, 433; by E. Calvert, 434; by W. J. H. Wood, 458; by "Member," 482
  Institution of Electrical Engineers' Wiring Rules and the E.C.A., by H. Marryat, 576
  Institution of Electrical Engineers' Wiring Rules, The, by "Wiring Rules," 544
  Insulating the lead sheathing of cables, by "A. R. C.," 418
  Johannesburg cable trouble, by "Afrikander," 433
  Kilowatt Publishing Co., by Lieut. F. C. Raphael, 179
  Linking up with waste heat stations, by "Central Station," 345
  Localising a fault, by "Mains Assistant," 96; by P. Wardle, 131; by H. Pavn, 151; by W. Leighton Chubb, 151; by J. A. Beckett, 204
  Meirowsky insulating tubes, by G. Schultz, 233
  Municipal electrical publicity, by A. G. Bostel, 432; by D. Ross Kennedy, 458
  National industrial organisation, by H. Allcock, 8
  News from Ruhleben, by W. F. Swale, 650
  Oil-immersed circuit-breakers for use on continuous current supplies, by "G. G.," 345
  Profit-sharing, by "Electrical Manufacturer," 151

Correspondence—*continued.*
  Rugby [illegible] Smith, by [illegible] Smith, 213
  S[illegible] by "B[illegible] P[illegible] B[illegible], R[illegible]
  Sale of foreign meters, by H[illegible] Bros., 124
  Suppliers for industrial progress, by H. Bengtsson, 123
  Shop engineer after the war, The position of the, by "Ex Shutty," 66, by "Suum Cuique," 95, by "Get Out," 95
  Small municipal electricity undertakings and war-time losses, by "Quiz," 258
  Sources of error in photometry, by C. E. Forster, 95
  Static substations, by "Mains Engineer," 623
  Telephones and war surcharges, by The Stanneries Metal Works, 205
  Trade after the war, by "A.M.I.E.E.," 623
  Variable speed polyphase motors, by F. Creedy, 150
  Wiring with tough rubber compound cable, by "Another member of the E.C.A.," 493, 543; by "Consumers' Engineer," 531, 567; by A. P. Lundberg & Sons, 531; by W. Ellerd Styles, 543; by "Practical," 543, by St. Helens Cable & Rubber Co., Ltd., 544
  Women and "Shorts," by "Exciter," 123, by the Chairman of Marylebone Borough Council Electricity Committee, 151; by "Exciter and Booster," 345
  Women tramway drivers at Keighley, by the Borough Electrical Engineer and Tramways Manager, 66

Cottrell process in practice—Precipitation of smoke and fumes, by L. Bradley, 710
Crop production: Electroculture and results during 1916, 507
Cruisers, Electrically-propelled, 504
Cuba, Electrical trade of, 626
Curtis-Rateau turbine blading, The deterioration of, 501, 528

DALMARNOCK Power Station, Foundations at, 548
Decimal Association, The, 548
Decimal coinage and the metric system, 75, 130, 159, 295, 313, 325, 353, 365, 372, 382, 408, 439, 466, 494, 531, 582, 655, 703
Depreciation, 114
Depreciation of plant, Principles involved in computing the, by F. Gill and W. W. Cook, 81, 91, 136, 194, 320
De-tinning in Australia, 606
De-tinning progress, British, 516
Development, Empire, 393
Diesel engine making in Sweden, 240
Diesel Engine Users' Association, 363, 684
Disabled soldiers, The training of, 17, 104, 269, 414, 460, 606
Dissolutions of partnerships, 11, 126, 209, 236, 321, 349, 404, 462, 546, 675, 698
Dock construction, Electricity in, 358
Docker and the electrical industry, Mr. Dudley, 652
Drilling tools from oil and gas wells, Removing, 104
Drums, The manufacture of controller, by R. K. Shield, 590
Dry batteries, Compound, for use in building, 184
Dry cell industry, New British, 37
Dublin again, 59
Durban's electrical plant, 630
Durban Municipality and preference, 126
Dust vans at Dover, Electric, 470

EARTH to air discharges and fire risks, 465
Earthing the lead sheathing of underground cables, with special reference to 'solid' systems, Some notes on bonding and, by "G. W. S.," 387
Economic recuperation after war, by Prof. W. R. Scott, 229, 277
Economies in lighting in relation to fuel saving, 614
Economy, Fuel, 141
Education of engineers, The, 87, 518
Education of marine engineers, 408
Educational, 46, 519, 582, 606, 650
Eggs, Electrical incubation of, 269
Electric motor vehicles, Practical encouragement to the use of, 409
Electric steel, 630, 670, 695
Electric Supply Committee, The Board of Trade, 325, 353, 680, 700
Electrical Accessories Association, [illegible]
Electrical contractors in [illegible], Registering, 269
Electrical driving of workshops and factories, Some notes on, by A. T. Bulley, 339
Electrical [illegible], The, 421
Electrical [illegible], 47
Electrical Traders' Benevolent Institution, The, 422, 434
Electrical Trades Union, 551, 577, 676
Electrical Vehicle Committee, The, 15
Electricity, [illegible] plough, 641

Electrically operated tools, 295
Electric-welded tool tips, 212
Electricity, Business by, by G. Basil Barham, 3
Electricity in agriculture: Electro-culture at Hereford, 269
Electricity in agriculture—Electro-culture in Minehead, 358
Electricity in agriculture—I.M.E.A. Agricultural Development Committee, 335
Electricity in agriculture, Some considerations affecting the use of, 62, 88, 116
Electricity in dock construction, 358
Electricity in the present war, especially in the treatment of diseases and wounds arising therefrom, The more recent applications of, by Warrant Officer W. Leeming, 661
Electricity, Irish Agricultural College and, 630
Electricity regulations, The superfluity of, 3
Electricity supply: A retrospect, 397
Electricity supply and the I.M.E.A., The Board of Trade Committee on, 549
Electricity Supply, Board of Trade Departmental Committee on, 325, 353
Electricity Supply, Cheaper, 281
Electric Supply Committees, Provincial, 352
Electricity Supply, Salesmanship and, 478
Electricity Supply Undertakings, Promotion in, 499
Electricity v. gas, 702
Electricity Works Employes—Reserved occupations, 559
Electricity Works, Linking up, 17, 45, 268, 302, 325
Electricity works, Substitution in, 198, 212
Electrification of the suburban lines on the French State railways, 629
Electro-chemistry in France, 353
Electro-culture and crop production: Results during 1916, 507
Electro-culture at Hereford, 269
Electro-culture in Cheshire, 558
Electro-culture in Minehead, 358
Electro-culture in the Greenhouse, 403
Electro-Harmonic Society, The, 269
Electrolysis in open suppurating wounds, 616
Electrometallurgy in the U.S.A. in 1916, 185
Electromobile experience, by R. Borlase Matthews, 68
Electroplating, The brittleness produced in steel springs by, 185
Empire development, 393
Empire resources, 130
Empire, The industries of the, 38, 486
Empire, The policy of, 478
Employers and Employed, The National Alliance of, 478, 577
Employers and the future of industry, 184
Employers, Federated, 130
Employment agency, Navy, 493
Engineer Volunteers, First London, 149, 474
Engineering industry, The, by Mr. Longridge, 482
Engineering labour, 186
Engineering labour and the war, 506
Engineering specifications, Some points in connection with, by J. Shepherd, 248, 276, 373, 503
Engineers, The education of, 87
Engineers, The education of marine, 408
Erith-Riley stoker, 64
Errors of direct-current ampere-hour meters, by "G. W. S.," 118
Excavating data, Electrical, 324
Excess profits duty, 159, 186, 262, 519, 520, 626
Excess profits duty: Electrical cables, 520
Excess profits tax appeal, 8
Exhibition, 99
Explosion due to static electricity, 184
Export manufacturers, A Government register of, 690
Export standardisation rates, 549
Export trade, Co-operation in, 170
Export trade, Co-operative, 166
Export trade with Spain, Our, 366
Exports and imports during 1916, British electrical, 87
Exports and imports during 1916 and previous years, Electrical, 108
Exports and imports of electrical goods during December, 107; during January, 247; during February, 359; during March and April, 637
Exports, U.S. electrical, 630

FACTORY conditions, The importance of, 640
Failures, Fuse, 143
Fair, 1917, British Industries, 188, 236
Fair, The electrical installation at the British Industries, 227
Faraday House scholarships, 466
Faraday Society, The, 89, 360, 612
Farm electrification, U.S., 612
Farms, Electric v. oil power on, 439
Fatalities, 47, 131, 213, 241, 269, 297, 409, 438, 521, 552, 576, 630, 656, 702
Fault localisation, Induction methods of, by H. E. Blake, 661
Federated employers, 130
Federation, Industrial, 282
Federation of British industries, 291, 466
Fleet, Electrical communications in the, 595
Filtration of air, The, 135
Fires, 11, 75, 236, 326, 675
Fires, Electric, by "Hot Air," 308
Fires, Some notes on electric, by G. W. Stubbings, 564
Fixation of atmospheric nitrogen, 549
Flash lamps without batteries, 15
Foreign and Colonial tariffs on electrical goods, 28, 84, 196, 252, 308, 363, 391, 447, 492, 559, 615
Foreign trade, 45, 158, 325, 492, 549, 686, 712
Foreign trade, British capital and, by E. Crammond, 288
Formula for magnet coils, An approximate, 528
France, Electric lighting in, 261
France, Hydro-electric power in, 5, 520
France, Lighting restrictions in, 102
Freemasonry, Electric, 631
French electrical Industry, Prospects of the, 256
French hydro-electric works, Development of, 241
French State railways, Electrification of the suburban lines on the, 629
French trade with South Africa, 155
French view on trade policy, A, 16
Frequency changers, by R. Townend, 219, 361
Fuel and food control, Bradford, 680
Fuel economy, 141
Fuel research, 241
Furnace for testing firebricks, An electric, 89
Furnace, Powdered coal boiler, 242
Furnace, The Greaves-Etchells Electric, 395
Furnaces, Carbon electrodes for arc, 134
Furnaces, Electric steel, 16, 240, 325
Furnaces for ferro-alloys, Electric, 630
Fuse failures, 143
Fuses, Refillable, 261
Future of the British X-ray industry, 418, 571, 711

GALALITH on tour, 618
Galvanometers for A.C. measurements, 438
Gas engineer's views on electricity, A, 414
Gas fatality, 326
Gas, The price of, 190
German companies in Russia, 2
German electrical companies in Russia, Liquidation of, 226
German electrical industry, Sale prices in the, 666, 675
German electrical organisation, American report on, 229
German Electricity Supply Federation, The, 565
German plant, Breakdowns in, by A. E. Val Davies, 124
German professors in England, 270
German scarcity of copper, 702
German substitutes for copper in electrical work, 439
German Union of Technical Institutions, 519
Germany, Lighting restrictions in, 186
Germany, Machinery prices in, 379
Germany, Prices advance in, 572
Germany, Scarcity of metals in, 246
Germany's after the war trade schemes, 159
Gearing, Alquist, 159
Glass and optics, Research in, 186
Goods station, Electrical equipment at a Great Western, 593
Government and the Amalgamated Society of Engineers, 656
Government measures to assist trade, 324
Great Indian Peninsula Railway train control, 257
Great Western goods station, Electrical equipment at a, 593
Greaves-Etchells electric furnace, The, 395

HACKNEY action, The, 423, 425
Hail and storm, by "Electric Niagaras," Fighting, 275, 303
Hardening gauges, 701
Heating and cooking, Electrical, by C. Scott, 598
Harley's War Relief Fund, 190
High pressure cable joints, by "S. G.," 255
High-pressure electric railway systems, 527
High-speed telegraphy, 114, 119, 164
High-tension overhead transmission lines, by G. A. Twiss, 508, 556, 585
Holidays, Electricity works', 629
Hull, Equipment of King George Dock, by L. Leighton, 341, 388
Hungary, Bauxite in, 396
Hustling and team work, by "Tramp Royal," 563
Hydro-electric works, Development of French, 241
Hydro-electric power in France, 5, 520

ICE on transmission line, 630
Illuminating power, The lumen as a measure of, by L. Gaster, 401
Imagination, Reasonable, 449
Imperial preference, 213
Imports during 1916, British electrical exports and, 87
Imports and exports during 1916 and previous years, Electrical, 108
Imports and exports of electrical goods during December, 107; during January, 247; during February, 359; March and April, 637
Incorporated Municipal Electrical Association Agricultural Development Committee, 335
Incorporated Municipal Electrical Association's annual meeting, 1917, 381, 667, 689, 691, 692; Annual report, 691
Incubation of eggs, Electrical, 269
India, Electricity supply in, 326
Individual interest in municipal enterprise, by J. H. Bowden, 692
Inductances, An a. c. method of comparing, by T. Parnell, 664
Induction methods of fault localisation, by H. E. Blake, 661
Industrial federation, 282
Industrial policy, 239
Industrial research, by A. P. M. Fleming, 138
Industries and munitions, 485
Industries, Federation of British, 291, 466
Industries in China, Electrical, 539
Industries of the Empire, 38, 486
Industry, Employers and the future of, 184
Industry, Labour and, 57
Industry, Mr. Dudley Docker and the Electrical, 652
Industry, Problems of, 254
Industry, Science and, 197, 551
Industry, The engineering, by M. Longridge, 482
Industry, The international aluminium, 360
Industry, The need for home support for British electrical, 239
Industry, War and, 296
Inquiries, 132, 186, 241, 326, 353, 438, 494, 607, 656
Inspection of munitions, The—Some new methods, and some old ones, by "Commercial," 171

Institution and Lecture Notes—
  Aeronautical Institute of Great Britain, 551
  American Institute of Electrical Engineers, 656
  Association of Draughtsmen, 297
  Association of Mining Electrical Engineers, 103, 326, 521, 656
  Association of Municipal Electrical Engineers, 186
  Australian Association of British Manufacturers, 186
  Belfast Association of Engineers, 17, 103, 656
  Birmingham and District Electrical Club, 75, 297
  Chief Technical Assistants' Association, 409, 607
  Diesel Engine Users' Association, 160, 439, 607
  Electrical Association of Australia, 353
  Engineering Standards Committee, 326
  Engineers' Club, 240, 296, 325
  Faraday Society, 75, 160, 409
  Greenock Electrical Society, 439
  Illuminating Engineering Society, 551, 575
  Illuminating Engineering Society (U.S.A.), 656
  Institute of Metals, 240
  Institution of Civil Engineers, 240, 326, 466, 493
  Institution of Electrical Engineers, 132, 186, 297, 382, 493, 679; (Students' Section), 213; (Dublin Local Section), 17, 312, 270, 607; (Yorkshire Local Section), 17, 493; (Birmingham Local Section), 466; (Scottish Local Section), 47, 213, 326, 409; (Western Local Section), 160, 409; (Newcastle Local Section), 213, 489, 551, 575; (Manchester Local Section), 409, 521
  Institution of Engineers and Shipbuilders in Scotland, 213
  Institution of Gas Engineers, 213
  Institution of Mechanical Engineers, 213, 240
  Institution of Mining and Metallurgy, 551, 607
  Institution of Municipal Engineers, 47
  Iron and Steel Institute, 409, 493
  Junior Institution of Engineers, 270
  Keighley Association of Engineers, 240
  Nottingham Society of Engineers, 297
  Physical Society of London, 160, 575
  Royal Dublin Society, 297
  Royal Institution, 353, 493
  Royal Society, 656
  Royal Society of Arts, 186, 439
  Society of Engineers (Incorp.), 160, 270, 409, 575
  South African Institute of Electrical Engineers, 466, 607
  Victorian Institute of Engineers, 575

Institution of Electrical Engineers, The annual general meeting, 566
Institution of Electrical Engineers, The annual report, 505, 531
Institution of Electrical Engineers' articles, The, 562
Institution of Electrical Engineers' temporary premises, The, 408
Institution of Electrical Engineers, Wiring rules of the, by W. R. Rawlings, 475
Insulation resistance of a live three-wire network, Some notes on the measurement of the, by G. W. Stubbings, 620
Insulators, Cleaning dirty, 687
Insurance (Unemployment) Acts, 1911 to 1916, National—Decisions by the Umpire, 24, 130, 476, 511, 551, 623, 701
Inter-connection of Lancashire and Cheshire electric supply systems, 286
Internal-combustion turbine, by A. W. H. Griepe, 378
Inventions for the Admiralty, 102
Ireland, Water-power in, 311, 397
Irish coalfield development, 132
Irish Question, The, 492
Iron alloys, Improvements in magnetic, 539
Italian markets, Openings in, 546
Italy, Capital expansion in, 379
Italy, Trade with, 292
Italy, Vickers's enterprise in, 265
Italy, Water-power in, 311

JAPANESE exports, 602
Junction-boxes, Cable, by "S. G.," 31, 60
Junior Institution of Engineers and engineering students, The, 325, 703

KEIGHLEY, Recent developments in electricity supply at, by H. W. Webber, 643
King George Dock, Hull, Equipment of, by L. Leighton, 341, 388

LABOUR and Industry, 57
Labour and the war, Engineering, 506
Labour, Capital and, by Sir W. Lever, 68
Labour, Engineering, 186
Labour problem, Some thoughts on the Capital and, by W. T. Wardale, 331
Labour, Shipyard, 159
Labour, The conditions of, 642
Labour troubles and problems, 606
Labour unrest commissioners, 655, 680
Lamp sales in the United States, Incandescent, 672
Lamps for policemen, Electric, 45
Lamps, Long life tungsten, 46
Lancashire and Cheshire electric supply systems, Interconnection of, 241, 286, 656
Lead, 404

Legal—
  Agreements with German cable companies ended, 375
  Air raid warning: Power company fined, 700
  Alperton Rubber Co. v. Manning & Others, 177
  Backner v. Mile End Palladium, 290
  Barrett v. Enfield Electrical Cable Manufacturing Co., 295
  Battersea B.C. v. Juchau, 122
  Blundell v. Comins, 186
  Bosch magneto patents, 568
  Bradbear v. Balfour, Beatty, & Co., 208
  Breach of electricity regulations, 121
  Breaking insulators, 656, 688
  British Power, Traction, &c., Co. v. Hodgson, 290, 514
  B.T.H. Co. v. Corona Lamp Works, 542
  B.T.H. trade mark, 262
  B.T.H. v. Duram, 262, 291, 325, 347
  Broken trolley wire, 121
  Cedes Electric Traction, 104, 121
  Coal Mines Act prosecution, 154
  Compensation case, 688
  Coupling for electric machinery, 597
  De'Ath v. London Electric Railways Co., 154
  Douglas v. Creasey, 488
  Dundalk U.D.C. v. Attorney-General, 382, 624, 648
  Edmundson's Electricity Corporation v. Roscrea (Co. Tipperary) Bacon Factory, Ltd., 208
  Electrical engineer sentenced, 404
  Electrical installation at a theatre, Alleged breach of contract, 262, 648
  Electrically-welded flexible tubing, 177
  Ellis v. Birkett, 488, 568
  Factories Act prosecution, 382
  Fowler v. Midland Electric Corporation for Power Distribution, 153, 234
  General Electric Co. v. Ossawa, 687
  Gruban v. Booth, 542
  Heating device, Electric, 153
  Helical Rollers v. Lockwood, 154
  Hewitson v. Newcastle Corporation, 208
  High-tension electrometers for X-ray apparatus, 234
  Invalid chair appeal case, Electric, 552
  Irish electrical assessment—Clones Electric Light & Power Co., 624, 656

Legal—*continued*
John Walsh *v.* Webster, 568
Laycock *v.* South London Electric Supply Corporation, 513
Leaving certificate, 179, 234, 290
Liability of tramway authorities, 96
London County Council and tramway rating—Settlement of outstanding appeals, 233
London Electric Railways, 568, 657
London United Tramways—Receiver appointed, 630
London United Tramways *v.* L.C.C., 262
Meirowsky insulating tubes, 175, 234
Moraine *v.* The United Electrical Manufacturing Co., 96
Munitions cases, 207, 290, 325, 404, 541
No lighting rate, 438
North of Scotland Electric Light & Power Co. *v.* North of Scotland Fish Guano Co., 513
Pickman *v.* Western Electric Co., 460
Postmaster-General *v.* P. E. Schweder & Co., 155
Price of an outrage, The, 45
Pritchard *v.* Peto and the Electrical Contract & Maintenance Co., 347
Queen Anne's Residential Mansions and Hotel *v.* H.M. Postmaster-General, 649
Revocation of patent, Petition for, 83
Right to disconnect, The, 598
Rugby U.D.C. *v.* Smith, 122
Secret process in rubber manufacture, 83, 96
Telephones and war surcharges, 176
Tramcar accident claim, 291
Tungsten filament lamp litigation, 649, 688
Using power supply for lighting, 46
Vaughan *v.* Golder's Green Amusement & Development Co., 176, 290
Welsbach appeal case to the Privy Council dismissed, 576
Wilde *v.* Walsall Electrical Co., 234
Woolley *v.* Watson, Marsh, & Co., 154
Workmen's compensation, 75, 404

Lighting energy at power rates: The Hackney action, 425
Lighting in relation to fuel saving, Economies in, 614

Lighting and Power Notes—
Aberdeen, 266, 488, 516
Accrington, 181, 237, 292, 698
Aldershot, 99, 292, 379
Argentina, 71, 266
Ashtead, 181
Ashton-under-Lyne, 435
Asiatic Turkey, 209
Australia, 11, 38, 71, 99, 127, 156, 237, 266, 292, 379, 435, 462, 516, 603, 676
Aylesbury, 349, 405, 572
Ayr, 547
Ayrshire, 71
Baildon, 516, 698
Banbridge (Co. Down), 99
Bandon (Co. Cork), 99
Bangor, 652
Barnes, 209, 435
Barnsley, 12, 322
Barrow, 156, 405, 603
Bath, 156
Batley, 237
Battersea, 40, 181, 653
Bedford, 39, 71, 156, 322
Begelly (Pem.), 349
Belfast, 39, 292, 572, 620, 652, 676
Bingley, 603
Birkenhead, 292
Birmingham, 12, 181, 266, 435, 462, 504, 572, 603, 626, 698
Bispham with Norbreck, 12
Blackpool, 405, 462, 488, 546
Board of Trade Committee and Municipal electricity supplies, 652
Bolton, 237, 603
Bootle, 349, 653
Bradford, 39, 72, 181, 292, 516, 546, 653
Bradford-on-Avon, 181
Bray (Co. Wicklow), 628
Bridlington, 603
Brighouse, 322
Brighton, 678
Bristol, 181, 322, 380
Buckfastleigh, 292
Burnley, 39, 516
Burton-on-Trent, 181, 436, 516, 676
Bury, 603
Canada, 12, 127, 209, 266, 603, 626
Cardiff, 72, 603
Carlisle, 72
Cheam, 676
Cheltenham, 653
Chester, 380, 488
Chile, 72, 127, 380
Chippenham, 39, 266, 380
Chorley, 292
Clayton, 322, 349, 405, 462, 653
Clonakilty, 350
Colchester, 237, 405
Colne, 405, 626
Coniston, 572
Continental, 39, 99, 127, 156, 237, 266, 292, 322, 405, 516, 546, 572, 603, 627, 653, 698
Cork, 156
Coventry, 572
Crewe, 405, 516
Cronton, 322
Croydon, 604
Cuddington, 322

Lighting and Power Notes—*cont.*
Darlington, 39
Dartford, 99
Darwen, 516, 604
Deptford, 267
Derby, 12, 181, 653
Dewsbury, 39, 653
Doncaster, 39, 516
Dover, 156
Dublin, 39, 99, 127, 156, 293, 322, 350, 353, 405, 627, 676
Dundalk, 99, 127, 209, 266, 676
Dundee, 360, 698
Dungannon, 237
Ealing, 12, 573
East Ham, 127, 488
Eastcotts, 380
Eccles, 39, 293, 405
Edinburgh, 12, 489
Elland, 293
Enniscorthy, 266
Epsom, 72, 127, 546
Exeter, 489, 627
Ewell, 99
Farnworth, 405, 436
Featherstone, 72
Finchley, 380, 604
Folkestone, 322, 627
France, 322, 516, 546, 653
Fulham, 99, 293, 489
Gillingham (Kent), 99
Glasgow, 12, 380, 604
Gloucester, 293, 653
Gorey, 237
Grantown, 573
Gravesend, 181
Greenock, 627
Grimsby, 72, 350, 676
Hackney, 350, 516, 620, 653
Halifax, 12, 72, 266, 498, 516, 653, 698
Hammersmith, 463, 573
Harrogate, 209, 546, 653
Haslingden, 604
Haworth, 463
Hebden Bridge, 12, 380, 627
Hereford, 12, 676
Heston and Isleworth, 266
High Wycombe, 12, 237
Holme, 12
Hoole, 463
Hornsey, 127, 350
Horsham, 156, 266
Huddersfield, 237
Hull, 127, 237, 463, 516, 698
Ilford, 293, 380, 489, 604
India, 39, 237, 322, 406, 463, 546, 573
Ireland, 406
Islington, 127
Italy, 322, 603, 627
Itchen, 573
Japan, 573
Keighley, 127, 380, 604
Kendal, 266
Kensington, 293
Kettering, 676
Kilmallock, 266
Kilmarnock, 237, 436
King's Lynn, 676
Kingston-on-Thames, 266
Kirkcaldy, 12, 293, 676
Lambeth, 127, 350, 489, 698
Lancaster, 380, 573
Leeds, 267, 573, 676
Leicester, 237, 676
Leigh, 39, 322, 546
Letterkenny, 604
Lewes, 39
Lewisham, 436
Lincoln, 516, 653
Littleborough, 406
Liverpool, 181, 267, 406, 516
Llandudno, 12, 604
Llanelly, 604
London, 39, 99, 127, 156, 181, 209, 267, 293, 322, 350, 380, 436, 463, 489, 516, 546, 573, 627, 653, 676, 698
London County Council, 99, 156, 322, 380, 489, 573, 676
Londonderry, 380, 436
Loughborough, 237, 653
Lowestoft, 489
Luton, 653, 699
Manchester, 40, 100, 156, 406, 489, 604
Market Drayton, 209
Marylebone, 39, 267, 380, 463, 676
Metropolitan Asylums Board, 489
Mexboro', 237, 350, 380
Middleton, 406, 653
Midhurst, 436
Monasterevan, 322
Montrose, 436
Morecambe, 292, 350, 697
Morley, 72, 181, 653
Morocco, 546
Motherwell, 293
Mytholmroyd, 463
Nelson, 481
New Zealand, 12, 156, 293, 322, 516
Newcastle (Co. Down), 547, 653
Newcastle-on-Tyne, 322
Newport (Mon.), 677
Northwich, 350
Norway, 156, 516
Norwich, 237
Nottingham, 627
Nuneaton, 156, 406, 677
Oldham, 406, 653
Ormskirk, 677
Ossett, 677
Paraguay, 72
Pembroke (Dublin), 436
Perth, 350, 699
Peterborough, 517
Pontypridd, 293
Poplar, 99, 322, 436, 546, 676
Portugal, 39, 267
Portuguese East Africa, 40

Lighting and Power Notes—*cont.*
Preston, 181, 489
Queenstown, 181
Rawtenstall, 489
Redditch, 573
Reigate, 406
Richmond-on-Thames, 12, 436, 547
Rochdale, 156, 210, 267, 350, 406, 463, 489, 517, 547, 573, 653
Rosslea (Co. Fermanagh), 210
Rotherham, 323, 489
Russia, 99, 127, 237, 292, 572
St. Anne's-on-Sea, 40, 406
St. Austell, 604
St. Helens, 181, 293, 436, 653
St. Pancras, 99, 322, 489
Salford, 210, 406, 489, 517, 627
Sheffield, 40, 181, 210, 293, 406, 517, 653
Shildon (Durham), 350
Shilton, 12
Shipley, 627
Shipston-on-Stour, 293
Shoreditch, 127, 156, 209
Shrewsbury, 698
Slaithwaite, 627
Sleaford, 293
South Africa, 12, 72, 293, 350, 406, 463, 573, 627
South Wales, 699
Southend, 72, 210, 436, 489, 699
Southport, 40, 436, 517, 627, 677
Southwark, 40, 546
Southwick, 181
Spain, 99, 156, 405, 603, 653, 698
Spenborough, 380, 627
Stafford, 100, 604
Stalybridge, 127
Stepney, 127, 573
Stockport, 181, 293, 517
Stockton-on-Tees, 350
Stoke Newington, 676
Stoke-on-Trent, 13, 517
Stowmarket, 100, 489, 699
Stratford-on-Avon, 210
Stretford, 72, 181, 293
Sunderland, 156, 547, 654
Surbiton, 323, 489
Sutton (Surrey), 654
Swansea, 40, 72, 323, 406, 463, 517, 654
Swindon, 181, 677
Swinton and Pendlebury, 210
Switzerland, 603, 698
Tasmania, 13, 72, 127, 156, 237, [illegible] 406, 436, 463, 573, 677
Taunton, 13, 323
Tipperary, 157
Todmorden, 157, 267, 293, 489, 627
Tonbridge, 100, 654
Torquay, 181, 210, 677
Troon, 210
Tyldesley, 128
Tynemouth, 128
United States of America, 100, 181, 267, 654
Wakefield, 350
Walsall, 40, 293
Walthamstow, 128
Warminster, 181
Warrington, 699
Watford, 406
West Ham, 238, 350, 489, 573
Westminster, 322, 489
Weymouth, 323
Whitehaven, 72, 498, 677
Whitstable, 210
Wigan, 267
Willesden, 13, 100, 350
Wimbledon, 40, 72
Winchester, 40
Wolverhampton, 436, 547, 654
Woolwich, 40, 322
Worcester, 72, 323, 627, 654
Worcester Park, 181, 679
Worksop, 547
Worthing, 13, 72
Yeovil, 627
York, 267, 293, 406, 517

Lighting Restrictions in Germany, 186
Lightning, Strong, 657
Line Testing, The Simplification of, by G. F. Tanner, 539
Linking-up Electricity Works, 17, 45, 268, 302, 325
Linking-up Electricity Works—Lancashire and Cheshire, 241, 286, 656
Linking-up Scheme, Accrington, Haslingden and Rawtenstall, 426

Liquidations—
Adams Manufacturing Co., 209
Adrif Electric Co., 404, 462
Alphons Custodis Chimney Construction Co., 462
Aluminium Stamping Co., 349
Anchor Electric Co., 321, 435
Anglo Engineering Co., 462
Bakelite & Co., 603
Birmingham Belting Co., 462
Blume, C. H., 488
British Electrical Accessories Manufacturing Co., 462, 698
British Electric Car Co., 209, 292
British Groetzin Light, 652
Brown Low Pressure Superheater System, 435
Climax Stoker and Electric Co., 462, 488
Colston Electrical Works, 349, 652, 698
Crompton & Co., Ltd. (registered in 1888), 488
"D.P." Accumulator Co., 292
Electric railway and tramway carriage Works, 209, 292
Excel Water Circulator Co., 292, 572

Liquidations—*cont.*
[illegible] & [illegible], 180
G[illegible], H[illegible] & Co., 209
H[illegible] Electric Co., 404, 436
H[illegible], J. & Co., 698
[illegible] & [illegible] Co., 99
Isaria, 11, 626
Jaeger Bros., 265
Kent Electric Power Syndicate, 572
K[illegible] Fuel Co., 38, 99, 516
L[illegible] Electric Co., 38
L[illegible] Electric Works, 349
Low Pressure Superheating, 435
Maschinenfabrik Augsburg-Nürnberg, A.G., 180
Marrowsky & Co., 349
Miller Anti-Friction Metal Co., 435
Morris, G. F., & Co., 209, 292
Oldham Boiler Works Co., 404
Pump & Power Co., 546
Quarzlampen Gesellschaft, M.B.H., 292
Railless Electric Traction Co., 209
Scheer Bros., 71
Ships' Carriers, 265
Simplex Generators (Burke's patent), 349, 379
South Wales Wireless Training College, 209
Stoll's Electric & Engineering Co., 652, 698
Stentorphone Syndicate, 99
Stolz Electrophone Co. (1913), 71
Telephone Development, 236
Traun, H., & Sons, 488
Universal Light & Sign Co., 462
Vaughan Engineering Works, 675

Locomotives, The control of alternating current, 709
Lo-Thermo Motor, The, 7
London Chamber of Commerce, 526
London County Council Committees, 325
London County Council contract conditions, 155
London County Council electrical workers' wages, 159, 549, 606, 680
London County Council—Interest on loans, 102
London, The supply of electricity to Greater, 427
Long-distance wireless stations, Some, 283
Lumen as a measure of illuminating power, The, by L. Gaster, 401
Lumen *versus* Candle-power, 394

MACHINE-SWITCHING telephone-gear, by F. R. McBerty, 399, 454
Machine Tools and Engineering Association, 155
Magnesite, The use of, 45
Magnetic elements, The, 673
Magnetic iron alloys, Improvements in, 539
Magnetic standards, Bars for, 46
Magneto industry, The, 408
Magneto Manufacturers' Association, 213
Magnetos: A vital British industry, 102
Making do, by "F. B.," 537
Manchester Electric Supply Conference, The, 253
Manchester engineers' wages, 466
Manchester: The British Westinghouse Co.'s works—Visit of Colonial representatives, 479
Manchester, The warehouses of, 208
Manslaughter of a woman tramcar conductor: Sentence, 493
Marine engine-builders wanted, 439
Measurement, Improved methods of power, 191, 222
Medal for a conductor, 493
Meters, Errors of direct-current ampere-hour, by G. W. S., 118
Metric system, decimal coinage and the, 75, 130, 159, 295, 313, 325, 353, 365, 372, 382, 406, 408, 430, 494, 521, 582, 655, 703
Metric system in the U.S.A., The, 296
Metric system, The, 365
Metropolitan Association of Electric Tramway Managers, 466
Mica, Conductivity of air and of, 275
Miners' [illegible], Our, 382
Mines, Rescue work signalling in, by Dr. W. M. Thornton, 289
Moscow's [illegible], new electrical station, 103
Motor garages, The electrical equipment of, 420
Motor trucks on rails and pavements, Recent investigations of tractive resistance of, 512
Motors [illegible] for steel works, [illegible], 685
Motors, New [illegible] commutator, 32
Motors, Small [illegible], by "Booster," 23
Motors, The Lo-Thermo, 7
Municipal Electrical Association Inc.—Agricultural Electrical Development Committee, 335
Municipal Electrical Association: Annual meeting, 1917, 381, 667, 689, 691, 692. Annual [illegible], 691
Municipal [illegible] Association: [illegible] Water [illegible], 680
Municipal [illegible] Lecture [illegible] by J. H. Rider, 692
Municipal electricity [illegible], by F. P. Harris, 415
Munitions, Industries and, 485

Munitions, The inspection of—Some new methods and some old ones, by "Commercial," 171
Mysore, Registering electrical contractors in, 269

NATIONAL Alliance of Employers and Employed, The, 577
National Insurance (Unemployment) Acts, 1911 to 1916—Decisions by the Umpire, 24, 130, 476, 511, 551, 623, 701
National Physical Laboratory: Report for 1916-17, The, 688
National Service, Employers and, 296
National service of the Press, 431
National Service: The important trades, 213
National Service and War Loan, 170
New Buffalo Power Station, The, 317
Newcastle-on-Tyne Chamber of Commerce: Electrical section, 408

NEW COMPANIES—
  Apex Electric Accumulator Syndicate, 608
  Armstrong, R., & Co., 495
  Association of British Chemical Manufacturers, 19
  Associated British Machine Toolmakers, 216
  Baker, G. W., 633
  Borra Magneto Repairing Co., 216
  British & Allied Electrical Agency, 522
  British Barimar-Thermit Welding Co., 681
  British Chamber of Commerce in Brazil, 704
  British Electron Co., 243
  British Lighting and Ignition Co., 608
  British Magnetos, 578
  British Switchgear, 132
  Burdette & Co., 353
  Bury Electrical Plant Co., 48
  Cathodes, 633
  C. S. B. Electric Bleaching Co., 578
  Cook, C. W., 216
  Corona Lampworks (Northern), Ltd., 19
  Depford Steel and Iron Works, 215
  Double Arc Electric Welders, 353
  Driver, Drennan, & Cooper, 216
  E. B. Magnetos, 608
  Eclipse Carborundum & Electric Co., 354
  Electric Holdings, 608
  Electrical Stores (Nottingham), Ltd., 19
  Ercole, Marelli, & Co., 48
  Express Lift Co., 522
  Falconbridge, C. E., 681
  Hackbridge Cable Co., 353
  Holland, Griffiths & Co., 410
  Hudson's Electrical Engineering Co., 353
  India Rubber Manufacturers' Association, 327
  Isenthal & Co., 353
  James & Shakspeare, 704
  Krupka & Jacoby, 126
  Leon Cornelis, 522
  Little Wonder Battery Co., 299
  Lodge Fittings Co., 410
  Mavall & Co., 353
  Modern Electric Welding Co., 495
  Moul & Co., 681
  National Time Recorder Co., 327
  New Shipston Lighting Co., 19
  New Switchgear Construction Co., 187
  Nicholson & Crockett, 354
  Nottingham Electro-Plating Co., 353
  Pollett & Co., T. P., 19
  Power Engineering Co., 354
  Pressparts, 76
  Radium, 126
  Railway Phonopores, 495
  Reader, E., & Sons, 327
  Renew Electric Lamp Co., 633
  R.E.T. Construction Co., 126
  Ridout & Ratcliff, 76
  Rotax Motor Accessories Co., 215
  Russian industries, 495
  Sentinel & Co., 327
  Shell Bands, 19
  Sheppey Motor Transport Co., 608
  Societe Anonyme des Ateliers de Construction Mecaniques Escher, Wyss, & Cie., 578
  Smith, J., & W. B., 354
  Southport Electric Supply Co., 608
  Surrey Engineering Co., 410
  Taylor, William (Electric Lamp) Co., 105
  Thames Electric Co., 522
  Thrutchley, Percival, & Co., 410
  Wilson-Maculen & Co., 410
  Tingley & Co., 271
  Trade Attracta Co., 19
  Verity Founders, 681
  Victoria Chemical Co., 299

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT—
  Aluminium spinning, 483
  Arc-welding plant, 431
  "Banquo" switch and plug, Combined, 484
  Battery plates, Chemically pure, 174
  Bell, New mining electric, 431
  B.T.H. crane motors, 167
  B.T.H. motor control panels, 432
  B.T.H. pressure governors, 167
  Broadbent power and lighting set, 203

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT—continued.
  Burleigh dynamos and motors, 94
  Cable glands for watertight bulkheads, Multiple, 202
  "Calorite" electric heating apparatus, 375
  Cambridge thermo-couple potentiometer, 530
  Cantie patent fusegear, 174
  Compound thermo element, 259
  Condensers, Precision, 121
  Condensite-cellulac, 54
  Contacts for electrical apparatus, Finger, 530
  Copper-plating propeller blades, 530
  Crane motors, B.T.H., 167
  Crit-point detector, The, 168
  Davies-Railing relay for mining signalling, 55
  Demagnetiser, Humphreys, 233
  "Depthometer," The, 647
  Earth detector for transmission lines, 622
  Electrolysers, New, 316
  Fans, Electrical exhaust, 622
  Fittings, White's patent corrosion-proof U-seal, 120
  "Garrett" safety control gear, 432
  "Girder" machine lighting, 485
  Greaves-Etchells furnace, 174
  Heater for motor cars, 55
  Heaters used in engraving, Electric, 459
  Henley's terminal boxes, 696
  "Hightensite" insulating material, 622
  Ignition for petrol motor vehicles, Battery, 121
  Ironclad switch, 541
  "Kingsway" mine signalling system, 55
  "Kingsway" miners' electric hand lamp, 529
  Lamp, B.T.H. hand, 233
  Lamp extension, Pocket, 95
  Lamp, Motor vehicle inspection, 203
  Magnetic chuck switch, 541
  "Magneto" remagnetiser, 648
  Marconi vacuum ampere gauge, 259
  Mercury vapour lamp, High vacuum, 672
  Mining electric bell, New, 431
  Plastic solder, 259
  Plug and adapter, Simplex combination pin, 374
  Potentiometer, Cambridge Thermo-couple, 530
  Primary cell, A novel, 567
  Pressure governors, B.T.H., 167
  Reel for use in pulling wires into conduit, 459
  Remy thermostatic control, 54
  Searchlight arc, Device for obtaining image of, 54
  Selco electric sirens, 673
  Signalling in collieries, 484
  Siluminite: A new insulator, 483
  Simplex combination pin plug and lampholder adapter, 374
  Simplex heating apparatus, 167
  Simplex weatherproof fitting, 647
  Telephone exchange, An improvised, 375
  Testing the acid resistance of enamels, paints, and varnishes, New method of, 459
  "Thab" patent lamp lock, The, 94
  Truck-type switchboard, 672
  Vent tube for pouring acid from carboys, 259
  Wadsworth lifts and transporters, 317
  Wattmeter correcting for transformation losses, 168
  Welding plant arc, 431
  "Youngblood" electrically operated valve gear, 59

New Zealand trade—Mr. R. W. Dalton's report, 80
New Zealand, Our trade with, 10, 59
"Niagaras," Fighting hail and storm, by "Electric," 275, 303
Nickel in Ontario, 629
Nitric acid in Sweden, 297
Nitrogen from the air, 630
North-Western Railway extension—Bakerloo—Watford, 423
Norwegian water power, 130
Nottingham's electricity policy, 30

OBITUARY—
  Baily, W., 384
  Baird, M. B., 19
  Binnie, Sir Alexander, 578
  Bostel, D. T., 19
  Brodie, J., Alderman, 215, 242
  Brooker, A., 354, 383
  Brown, Sir Benjamin, 271
  Burnham, R. H., 467
  Chamberlain, Captain John, 608
  Charlesworth, S., 299
  Churchwood, E. C., 215
  Collins, A. P., 160
  Cotton, M.P., Alderman W. F., 658
  Cruse, H., 608
  Dunsford, V. M., 495
  Farquhar, F., 105
  Forrest, Jas, 271
  Frankenburg, Alderman I., 522
  Gauntlett, W. R., 607
  Halliwell, W. H., 354
  Hamilton, C. K., 327
  Harford, G. J., 659
  Harpur, W., 633
  Huntley, D., 299
  Ireland, A. J., 19
  Kay, E., 299

OBITUARY—continued
  Kennedy, R., 467, 494
  Klein, Herr Gustave, 522
  Le Feuvre, Captain W. T., 76
  Major, C. G., 215
  Martin, R. W., 105
  Munton, W. H., 578
  Murphy, E. M., 271
  Norfolk, Duke of, 187
  Nussbaum, G. A., 410
  Parshall, Mrs. H. F., 608
  Preece, J. R., 242
  Raworth, J. S., 354
  Rennie, J., 214
  Rhodes, Dr. W. G., 467
  Roebling, F. W., 467
  Seaton, G. D., 704
  Spurrier, C. E., 187
  Staveley, A. W., 467
  Stott, H. G., 160
  Tallett, W., 105
  Teague, O. M., 681
  Toder, J., 132
  Tough, Mrs. G., 704
  Tucker, J. H., 215
  Ward, G. G., 467
  Young, R., 440

OFFICIAL RETURNS—
  Alert Electrical Co., 633, 658
  Alderley & Wilmslow Electric Supply Co., 658
  Allen, W. H., Son, & Co., 658
  Allen, West, & Co., 299
  Alliance, Electrical Stores, 327
  Alpha Electrical Co., 327
  Altrincham Electrical Supply Co., 523
  Aron Electricity Meter Co., 133
  Banbury & District Electric Supply Co., 187
  Birmingham Electrical Accessories Manufacturing Co., 410
  Blackpool & Garstang Electric Railway Co., 77
  Blackwell, R. W., & Co., 327
  Bogota Telephone Co., 327
  Brecknell, Munro, & Rogers, 299
  Bridge, David, & Co., 327
  Brilliant Arc Lamp & Engineering Co., 19, 410, 704
  British Battery Co., 327
  British Electric Transformer Co., 658
  British Electrical Export Co., 327
  British Electrolytic Zinc Co. (Isherwood Process), 410
  British Insulated and Helsby Cables, 658
  British L. M. Ericsson Manufacturing Co., 522
  British Mica Co., 467
  British Miniature Electric Vehicles, 132
  British Prometheus Co., 578
  Bromley (Kent) Electric Light & Power Co., 658
  Brompton & Kensington Electricity Supply Co., 658
  Brown, Boveri & Co., 48
  Bude Electric Supply, 704
  Bullers, Ltd., 327
  Burmah Electric Tramways & Lighting Co., 327
  Burnett, S., & Co., 440
  Burnham & District Electric Supply Co., 105
  Cable Accessories Co., 704
  Caerphilly Electric Supply Co., 410
  Camborne Electricity Supply Co., 658
  Cambridge Electric Supply Co., 440
  Central Electric Supply Co., 327
  Chadburn (Ship) Telegraph Co., 19
  Charing Cross, West End, and City Electricity Supply Co., 440
  Chelsea Electricity Supply Co., 467
  Church Stretton Electric Supply Co., 410
  City of Buenos Aires Tramway Co. (1914), 440
  City of Carlisle Electric Tramways, 658
  City of London Electric Lighting Co., 608
  City of Oxford Electric Tramways, Ltd., 48, 608
  Clarke, Chapman & Co., 467
  Clay, James Wellington, 704
  Coatbridge & Airdrie Electricity Supply Co., 48
  County of Dorset Electric Supply Co., 299
  County of Durham Electrical Power Distribution Co., 608
  Crampton & Co., 440
  Cross & Cross, 440
  Crossley Bros., 440
  Delagoa Bay Development Corporation, 76, 133
  Danks, Fred, 440
  D. P. Battery Co., 187
  Direct Spanish Telegraph Co., 608
  Dove, W. F., & Co., 440
  Duroglass, 132
  Dynamic Electrical Co., 440
  East India Tramways Co., 76, 133
  Electric Construction Co., 105
  Electric Zinc Co., 133
  Electrical Contracts & Maintenance Co., 578
  Electrical Distribution of Yorkshire, 578
  Electrical Industries Development Co., 440
  Electrical Installations, 243, 410
  Enfield Electric Cable & Manufacturing Co., 522, 704
  Engineering and Arc Lamps, 19
  English Electrical Co., 578
  Faraday & Son, 704
  Furse, W. J., & Co., 608
  Hampshire Light Railways (Electric) Co., 77

OFFICIAL RETURNS—continued.
  Harold Wood Electrical and Engineering Supplies Co., 76
  Harpin & Co., 467
  Hexham & District Electric Supply Co., 704
  Horrabridge & District Electric Supply Co., 272
  International Electric Co., 243
  Jacobs, W. A. & R. J., 495
  Johnson & Phillips, 523
  Keith, Jas., & Blackman Co., 76, 243, 704
  Keswick Electric Light Co., 681
  Keynsham Electric Light Co., 132
  Lancashire Electrical Engineering Co., 440
  Leon Cornelis, 579
  Llanwrst Electricity Supply Co., 243
  London Electron Works Co., 327
  Longford Wire Co., 658
  Magnesium Metal Co., 19
  Masham & District Electric Supply Co., 132
  Montevideo Telephone Co., 19
  Montreal Tramways & Power Co.,
  Musselburgh & District Electric Light & Traction Co., 76
  National Electric Construction Co., 133
  New St. Helens & District Tramways Co., 19
  Newtons, 19
  Northampton Electric Light & Power Co., 76, 133
  Northern Engineering and Construction Co., 133
  Oliver Arc Lamp, 187
  Pacific & European Telegraph Co., 19
  Perfect Burglar Alarm, 216
  Pernambuco Tramways & Power Co., 133
  Phillips' Magnetos, 272
  "Pirelli," 48
  Phonopore Construction Co., 704
  Porous Accumulator Co., 216
  Rangoon Electric Tramways & Supply Co., 410
  Railway Finance & Construction Co., 77
  Rawlings Bros, 467
  Rhondda Tramways Co., 19
  Rubber, Bronze, & Metal Co., 299
  San Luis (Mexico) Tramways, 681
  Seear, Scott, & Co., 187
  Sheerness & District Electric Power & Traction Co., 187
  Southern Brazil Electric Co., 76
  Stephens, Smith, & Co., 299
  Sterling Telephone & Electric Co., 272
  Stone, J., & Co., 467
  Sun Electrical Co., 522
  Telephone Co. of Egypt, 48
  Thermo-Electric Ore Reduction Corporation, 704
  Torpoint Electric Supply Co., 243
  Tuke & Beel, 633
  Tyne Electric Steel Foundries, 48, 105, 187, 633
  Underground Electric Railways Co. of London, 495
  U.S. Light & Heat Corporation, 704
  Vaughan Engineering Works, 327
  Walter's Electrical Manufacturing Co., 272
  Weekes, L., 658
  White, H., & Co., 48
  Woking Electric Supply Co., 105

"One-Man" business, The problem of, 666
Ontario power, 144
Optophone in operation, The, 438
Optophone, The, by E. E. Fournier D'Albe, 195
Organisation, American report on German electrical, 299
Organisation, Engineering, 532
Organisation, Trade, 79
Osmotic pressure, General discussion on, 612
Overseas trade, The Government and, 45

PARALLEL operation of electric power stations, by J. S. Peck, 35, 278
Paris, The work of the Central Electrical Laboratory at, 631
PARLIAMENTARY—
  Lancashire Power Construction Co., 213, 549
  Nottinghamshire & Derbyshire Tramways Bill, 549
  West Kent Electric Power Co.'s Bill, 549, 575
Passenger car, New American electric, 103
Patent and trade mark cases, by "Legal Contributor," 625
Patent applications, 349, 546
Patent, Extension of letters, 17
Patent restoration, 71, 180, 652
Patents and alien enemies, 78, 180, 321, 545, 603, 652, 700
Patents, New and published specifications, 28, 56, 84, 112, 140, 168, 196, 224, 252, 280, 308, 336, 364, 392, 420, 448, 476, 504, 532, 560, 588, 616, 640, 664, 688, 712
Patents, New: Comptroller-General's report, 702
Patents registered in Berlin, British and Allied, 408
Peat utilisation, Irish, 631, 680
Perth (W.A.), Electrical developments at, 184

Phantom circuit system for controlling street lights, by A. H. Davis, 228
Phase rotation, A simple method of determining, 605
Piece-work rates, 680
Pipes by electricity, Thawing water, 539
Pirelli-General Cable Works, The, 115
Plant, Breakdowns in German, by A. E. Val Davies, 124
Plant, Principles involved in computing the depreciation of, by F. Gill and W. W. Cook, 81, 91, 136, 194
Platinum, A new source of, 438
Platinum production in the Urals, 636
Plough, All hands to the, 346
Plough electrically, Speed the, 641
Ploughing by electric light, Night, [illegible]
Policemen, Electric lamps for, 45
Policy of Empire, The, 478
Policy, Municipal Electrical Association: Wanted a, 689
Polyphase commutator motors, New, 32
Position of the shift engineer after the war, The, by John Marks, 43
Poster restrictions, 521
Power and the output of boots, Electric, 103
Power Committees, The Agricultural Electric Supply and Electric, 310
Power measurement, Improved methods of, 191, 222
Power stations, The parallel operation of electric, by J. S. Peck, 35
Power supply, Electric, 576, 589
Precipitation of smoke and fumes, The electrical, by W. A. Schmidt, 55
Precipitation of smoke and fumes—The Cotterell process in practice, by L. Bradley, 710
Preference, Durban Municipality and, 126
Preference for American cables in Australia, 231
Preference for British manufactures, 29
Preference, Imperial, 213
Press, The National Service of the, 431
Prices in Germany, Machinery, 379
Prisoners of war, Books for British, 518
Prisoners of war, Educational facilities for British, 325
Prisoners of War Fund: Football match, 382
Private arrangement, 404
Problems of industry, 254
Problems of the moment, 310
Profit-sharing, 701
Profit-sharing, American, 16
Profits duty, Excess, 159, 186, 262
Profits tax appeal, Excess, 8
Promotion in electricity supply undertakings, 409
Propulsion, Electric ship, by W. L. R. Emmett, 279
Provincial electric supply companies, A committee of, 140
Pump, The condensation, 41

PROSPECTUSES—
  British Trade Corporation, 700
  Shropshire & Worcestershire & Staffordshire Electric Power Co., 329

Protected occupations: Electrical workers, The schedule of, 466, 575
Provincial electric supply committees, 352
Publicity, Municipal electricity, by E. P. Hollis, 415

RADIATORS, by "Experiment," 227
Rails, Tramway, 185
Railway extension, The Bakerloo, L. & N.W.—Watford, 423, 439

RAILWAY NOTES—
  Australia, 238, 267, 381, 406, 517, 573, 677
  Bolivia, 210
  Brighton Railway electrification, 238
  Canada, 210
  Continental, 100, 128, 182, 294, 407, 490, 677
  Dublin, 267, 294, 323
  France, 677
  Germany, 490
  Italy, 128, 407
  Irish electric railways and the Board of Trade, 654
  London, 100, 182, 490
  London Electric Railway Co., 490
  L. & Y. Elec. Railway, 157, 182, 490, 654
  North-Eastern Railway electrification, 238
  North London Railway electrification, 238
  North-Western Railway electrification, 238, 323, 439
  Railway signal breakdown, 74
  Russia, 182
  Signalling on the G.W.R., Electric, 75
  South Africa, 14, 128
  South-Western electrification, 238
  Spain, 100, 294, 407, 490
  United States, 182, 238, 294, 381, 490

Railway systems, High-pressure electric, 527
Range standardisation, Electric, 665
Ratho railway smash, The, 111
Rating of an electric lighting station, The, 87
Rawson, F. L., 45, 74
Reconstruction policy, 45
Recruiting and Experience, 617
Rectified alternating currents, High-pressure, 690
Rectifier, The Tungar, 584
Recuperation after war, Economic, by Prof. W. R. Scott, 229, 277
Redditch electricity undertaking, Development of the, 619
Refillable fuses, 261, 326
Register of export manufacturers, Government, 690
Register of British manufacturers, A, 155
Registration of business names, 126, 236, 416, 698
Regulations, The superfluity of electricity, 3
Repairs and renewals in war time, Factory, by "Legal Contributor," 565
Research in America, The great need of promoting, 223
Research in glass and optics, 186
Research, Industrial, by A. P. M. Fleming, 138
Research, Scientific and industrial, 326
Reserved occupations: Electricity works' employes, 559
Resistance of a live three-wire network, Some notes on the measurement of the insulation, by G. W. Stubbings, 620
Restrictions on the importation of certain goods, 353
Review of 1916, 1

REVIEWS—
  Actions physiologiques et dangers des courants electriques, by J. Rodet, 546
  Alternating current machinery, by R. R. Lawrence, 514
  Alternating current work, by W. P. Maycock, 264
  Alternating currents, by H. R. Kempe, 571
  Alternating currents, A treatise on the theory of (Vol. II), by A. Russell, 251
  Applied electricity for practical men, 298
  Atoms, by J. Perrin, 600
  Business Names Act, Guide to the Registration of, by K. Brown, 291
  Calculation and measurement of inductance and capacity, The, by W. H. Nottage, 515
  Depreciation and wasting assets, by P. D. Leake, 570
  Discovery: or the spirit and service of science, by R. A. Gregory, 390
  Electrical contractor, The, by L. W. Moxey, 53
  Electrical engineering, by Prof. E. J. Berg, 391
  Electrical engineering, First course, by E. J. Berg and W. L. Upson, 53
  Electrical engineer's diary, 38
  Electrical measurements and testing, Direct and alternating current, by C. L. Dawes, 321
  Electrical switch and controlling gear, by C. C. Garrard, 600
  Elementary strength of materials, by E. S. Andrews, 631
  Emission of electricity from hot bodies, The, by O. W. Richardson, 320
  Engineering applications of higher mathematics, Part V., Problems in electrical engineering, by V. Karapetoff, 264
  Engineering workshop drawing, First steps in engineering drawing, by H. J. Spooner, 632
  Engineer's Year Book of formulæ, rules, tables, data, &c., for 1917, by H. R. Kempe, 390
  Experimental wireless stations, by P. E. Edelman, 264
  Gas, oil, & petrol engines, by A. Garrard, 631
  Groupes électrogènes en régime troublé, by L. Barbillion, 297
  Les surtensions dans les distributions d'energie electrique, by I. Van Dam, 251
  Mechanical drafting, by C. B. Howe, 251
  National system of economics, by J. T. Peddie, 632
  Practical dynamo and motor management, 652
  Practical safety methods and devices, by G. A. Cowee, 297
  Principles of the telephone—Part I. Subscribers' apparatus, by C. M. Jansky, 391
  Principles of electrical design, by A. Still, 297
  Principles of electrical engineering and their application, by G. Kapp, 600
  Telegraphy, by T. E. Herbert, 250
  Two-stroke engine, The, by A. M. Low, 631
  Ventilation, Some modern methods of, by R. Grierson, 514
  Weights and measures, Our, by A. Granger, 349

Rochdale Corporation electricity supply undertaking, 367
Roll of honour, 19, 48, 76, 104, 132, 160, 187, 214, 242, 271, 299, 327, 354, 383, 410, 440, 467, 494, 521, 552, 577, 607, 632, 657, 680, 703
Rontgen Society, The, 56, 195, 306
Rotary converters, The voltage regulation of, by G. A. Juhlin, 304, 333, 343, 472
Rotation, A simple method of determining phase, 605
Rural transmission lines, by A. S. Hall, 135
Russia, German companies in, 2
Russia, General electrification extension foreseen, 420
Russia, Liquidation of German electrical companies in, 226
Russia: The 1886 Company: A long arm, 186; More resolutions, 694
Russia, Trade credit in, 208
Russia, Trade with, 102
Russian electrical control, 111
Russian electrical energy tax, 131
Russian electrification project, 550
Russian exhibition in London, 515
Russian Government electrotechnical section, 680
Russian language, 158

SAFETY controlling device for electric motor vehicles, A, 352
"Safety First" campaign, The, 16, 74
Sales prices in the German electrical industry, 666, 675
Salesmanship and electricity supply, 478
Scarcity of metals in Germany, 246
Scheme of arrangement: Tyler Apparatus Co., 37
Science and industry, 197, 551
Science, Training in, 470
Scientific information, 255
Scientific Societies, The Conjoint Board of, 700
Selenium cell, A sensitive, 688
Self-propelled electric vehicles and their application, by L. Brockman, 163
Shanghai, Electricity supply in, 559
Shanghai power station, A German in, 438
Shift engineer after the war, The position of the, by John Marks, 43
Ship propulsion, Electric, by W. L. R. Emmett, 279
Shipyard labour, 159
Sicilian sulphur, 521
Siemens shares, Sale of, 132, 179, 326
Signalling in mines, Bare wire, by Dr. W. M. Thornton, 289
Signs in Scotland prohibited, Illuminated, 679
Sleet on transmission lines, 588
Small electric motors, by "Booster," 23
Smelting at Heroult, Electric, 165
Smoke and fumes, The electrical precipitation of, by W. A. Schmidt, 55
Smoke and fumes, The Cotterell process in practice, Precipitation of, by L. Bradley, 710
Society for Electrical Development, 630
Soldiers, The training of disabled, as sub-station attendants, 17, 104, 269, 460, 606
Sounding by electricity, 112
South Africa, French trade with, 155
South Africa, The electrical trade position in, 519
South African electrical supplies, 242
Spain, Lamp manufacture in, 546
Spain, Manufacture of telegraphic apparatus in, 435
Spain, Our export trade with, 366
Sparking, Suppression of, 703
Specifications, Some points in connection with engineering, by J. Shepherd, 248, 276, 373, 503
Sperry anti-submarine device, The, 576
Stabiliser, Electric, 326
Standardisation, Electric range, 665
Standardisation rules, Export, 549
Standards, Bars for magnetic, 46
Starting for motor cars, Car lighting and, 56
Starting sets on motor cars, 102
Static sub-stations, 611
Station electricity, Explosion due to, 184
Steel, Electric, 630, 670
Steel furnaces, Electric, 16, 240, 325
Steel in France, 102
Steel in South Africa, Electric, 409
Steel tubing plant, New, 46
Steel works, Auxiliary motors and control gear for, 687
Steel works on the Tees, 655
Sterling Athletic and Social Club, 679
"Sterling" British products, 103
Storm damage, Nevada transmission, 260
Street lights, Phantom circuit system for, Controlling, by A. H. Davis, 228
Strike, Electrical Trades Union (Liverpool branches), 607
Strike, Engineers', The, 576
Strike of electricians at Athens, 353
Students, The Junior Institution of Engineers and Engineering, 325, 703
Submarine device, A Marconi anti-, 605
Submarine device, The Sperry anti-, 576
Sub-stations, Static, 611
Substitutes for copper in electrical work, German, 439
Substitution in electricity works, 198, 212, 447
Summer time, 270, 386
Sunday labour, Restriction of, 465
Supply, Board of Trade Departmental Committee on Electric, 325
Supply [illegible] London, in, 427
Surg[illegible]
Sweden, The [illegible] in, 290
Sweden, [illegible], 267
Swiss company, A new, 95
Swiss trade in 1916, 99
Switching, Electric light, 16, 212, 492
Switzerland, Tram statistics in, 262

TARIFFS on electrical goods, Foreign and Colonial, 28, 84, 196, 252, 308, 363, 391, 447, 559, 615, 712
Tasmanian electrolytic zinc, 680
Tax, Russian electrical energy, 131
Team work in line construction, by "Tramp Royal," 592
Technical education in Australia, 438
Technical study, 532

TELEGRAPH NOTES—
  Argentina, 604
  Australia, 238, 547
  Bagdad wireless station, 351
  Birmingham, 699
  Brazil, 183, 267
  Breaking insulators, 14, 213
  Cable breakdown, 294
  Cable rates to the Dominions, 101
  Cable telegrams by sound, Reception of, 267
  Canada, 678
  France, 267
  German wireless, 518
  Great Western Railway, 101
  Heterodyne receiver, The, 490
  High-speed telegraphy, 101
  Holland, 267, 518
  Iceland, 14
  Illicit wireless telegraphy, 518, 547
  Imperial communications, 351
  Italy, 157
  Midway Island, 74
  Mackay Companies, The, 437
  Mexico, 294
  Morocco, 267
  Morse code and ocean cables, 699
  Persia, 239
  Post Office revenue and expenditure, 628
  Post Office staff bonus, 490
  Post Office telegraphs and telephones, 351
  Post Office tube railway, 323
  Relay sounder, A, 129
  Russia, 678
  South American telegraphs, 47
  Spain, 14, 183, 678, 699
  Storm damage, 294, 323
  Telegraphic and telephonic progress in 1916, 129
  Telegram rates, 699
  Telegrams by telephone, 157
  Tower, A lofty, 381
  United States, 14, 408, 437, 699
  United States censorship, 547
  Wayleaves for telegraph wires, 604
  Western Union, 604
  Wireless installations on British ships, 464
  Wireless law, United States, 73
  Wireless litigation: Marconi v. De Forest Telegraph & Telephone Co., 547
  Wireless, Long-distance, 381
  Wireless record, 74
  Wireless stations, New, 239
  Wireless telegraphy, Coming of age of, 628
  Wireless telegraph school, 491

Telegraphic communications of the Empire, The—Report of the Royal Commission, 457
Telegraphs and telephones, Colonial, by R. W. Weightman, 25, 51, 75
Telegraphy, High-speed, 114, 119, 164
Telephone gear, Machine-switching, by F. R. McBerty, 399, 454

TELEPHONE NOTES—
  Australia, 129, 464
  Automatic telephony, 464
  Bell system, The, 436
  Calcutta, 239
  Church telephones, 628
  Edinburgh—Glasgow telephone service, 628
  Electrophones in hospitals, 351
  Glasgow, 381
  Grant to Bell employés, 73
  Guernsey, 294
  Hull, 628, 699
  India, 464, 699
  Morocco, 464
  New York telephones, 436
  Post Office revenue and expenditure, 628
  Post Office staff bonus, 490
  Post Office telegraphs and telephones, 351
  Spain, 14
  Storm damage, 294, 323
  Telegrams by telephone, 157
  Telephone call recorder, 464
  Telephone deposits, 157
  Telephone operators for the front, 576
  Telephone traffic, 699
  Telephone progress in 1916, Telegraphic and, 129
  United States, 491, 547

Telephone wires in streets, by "Legal Contributor," 602

Telephones, Colonial [illegible] by R. W. Weightman, 25, 52, 75
Testing, The simplification of [illegible], by G. F. Tanner, 539
Thawing water pipes by electricity, 539
Thompson, Memorial to the late Prof. Silvanus P., 241
Three-phase motors, Reversal of rotation of, 103
Timber for packing cases, 572
Tools, Electrically [illegible], 295
Tool tips, Electrically-welded, 212
Tough rubber compound cables, Wiring with, by W. Ellard Styles, 451
Tractive resistances to motor trucks on roads and pavements. Recent investigations, 512
Tractors, Electric trucks and, 5
Trade after the war, 111
Trade Bank, The new, 376, 457, 520, 700
Trade, Co-operation in export, 170
Trade, Co-operative export, 166
Trade credit in Russia, 208
Trade, Foreign, 45, 158, 325, 492, 549, 680
Trade, Government measures to assist, 324
Trade in Australia, 572
Trade in 1916, Swiss, 99
Trade mark cases, Some, by "Legal Contributor," 625
Trade, New Zealand—Mr. R. W. Dalton's report, 80
Trade of Ceylon, Import, 112
Trade of China, Import, 24
Trade organisation, 79
Trade policy, A French view on, 16
Trade position in South Africa, The electrical, 519
Trade statistics of Switzerland, 262
Trade, The Government and overseas, 45
Trade union "discipline," 104
Trade union rules, The A.S.E. and, 131
Trade with Canada, 99
Trade with China, 71, 99, 180
Trade with Italy, 292
Trade with New Zealand, Our, 10, 59
Train control, Automatic, 270
Train control on the Great Indian Peninsula Railway, 257
Training of disabled sailors and soldiers for electrical sub-station work, 17, 104, 269, 414, 460, 606
Trial, American electric vehicle, 270
Tramway Managers'. Metropolitan Association of Electric, 103
Tramway men and war wages, 16
Tramway materials, Ministry of Munitions and, 438

TRAMWAY NOTES—
  Accrington, 73, 128, 157, 238, 267, 463, 517, 604, 627
  Argentina, 238
  Ashton-under-Lyne, 73, 157, 294, 517, 604
  Astley, 40
  Atherton, 323, 463
  Australia, 73, 100, 128, 267, 294, 406, 436, 517, 573, 677
  Bacup, 157, 182
  Belfast, 13, 267, 463, 490
  Bingley, 238, 350, 547, 604
  Birmingham, 128, 350, 573, 627
  Blackburn, 13, 100, 128, 157, 210, 238, 490, 517, 654
  Blackpool, 13, 238, 267, 350, 380, 406, 463, 490, 547, 573, 699
  Bolton, 490, 627
  Bournemouth, 490, 654
  Bradford, 13, 40, 73, 182, 380, 407, 436, 677
  Brighton, 128, 182, 574
  Burnley, 182, 238, 350, 407, 627
  Bury, 100, 463
  Cardiff, 73
  Carlisle, 73
  Castleford, 267
  Colne, 157
  Continental, 13, 73, 100, 128, 157, 184, 490, 574, 654
  Coventry, 380
  Croydon, 267, 699
  Darlington, 40
  Dartford, 436
  Darwen, 157, 182, 547
  Dewsbury, 654
  Doncaster, 40, 182, 294, 490, 517
  Dublin, 604
  Dudley, 40, 182, 463
  Dundee, 128, 157
  East Ham, 267, 490
  Eccles, 627, 654
  Ecuador, 128
  Edinburgh, 13, 73, 490
  Electric vehicle, 128, 182, 380, 464, 699
  Exeter, 294
  Germany, 490
  Glasgow, 13, 73, 128, 157, 182, 323, 517, 604, 627, 654, 677
  Gosforth, 73
  Halifax, 13, 73, 100, 128, 157, 182, 294, 463, 678
  Haslingden, 100, 267, 407
  Huddersfield, 40, 100, 350, 407, 436, 574, 699
  Hull, 323, 627
  Hyde, 73, 238
  Ilford, 294
  Ilkeston, 13, 436
  India, 128, 463
  Italy, 100, 128
  Keighley, 40, 323, 380, 463, 547, 574, 604, 627
  Kilmarnock, 238

TRAMWAY NOTES—*continued*
  Lancaster, 128, 627, 654
  Lancashire tramway wages, 41, 210, 407, 436, 574, 678
  Leeds, 73, 128, 380, 407, 436, 464, 517, 574, 654
  Leicester, 13, 574, 677
  Leyton, 128
  Little Hulton, 294
  Liverpool, 157, 182
  London, 100, 157, 210, 323, 490, 547, 574, 699
  London County Council, 100, 157, 210, 323, 490, 547, 574
  Luton, 14
  Manchester, 73, 182, 380, 464, 654, 678
  Mexborough, 380
  Middlesborough, 128, 294
  Middlesex, 654
  Morecambe, 464, 604
  Nelson, 699
  Newcastle, 14, 323, 351, 547
  Newport (Mon.), 654
  New Zealand, 14, 678
  Northampton, 267
  Norway, 157, 574
  Oldham, 14, 73, 238, 464
  Paraguay, 238
  Plymouth, 294
  Pontypridd, 294
  Preston, 128, 182, 351, 380, 407
  Rawtenstall, 323, 490
  Rochdale, 238, 464
  Rotherham, 73, 182
  St. Anne's, 517
  Salford, 14, 73, 128, 294, 351, 464
  Sheffield, 41, 182, 655, 517
  South Africa, 464, 517
  South Lancashire, 41, 323
  South Staffordshire, 517
  Southend-on-Sea, 73, 211, 323, 678
  Southport, 323, 490, 678
  Spain, 73, 574, 654
  Spen Valley, 294
  Stalybridge, 351
  Stockport, 100, 464
  Stockton-on-Tees, 182
  Stoke-on-Trent, 699
  Stretford, 73, 182
  Sunderland, 157
  Surbiton, 73
  Torquay, 294
  U.S.A., 294, 381
  Vienna, 184
  Walsall, 73, 183, 436, 655
  Warrington, 517
  West Ham, 100, 238, 699
  Wigan, 294
  Wolverhampton, 183, 464, 517, 547
  Women drivers, The employment of, 574
  York, 351, 517

Tramway rails, 185
Tramways and Light Railways Association, The, 548
Transformer, Improper use of auto, 7
Transmission line, Ice on, 630
Transmission lines, High-tension overhead, by G. V. Twiss, 508, 556, 585
Transmission lines, Rural, by A. S. Hall, 135
Transmission lines, Sleet on, 588
Transmission poles, Reinforced concrete, 639
Trap, An electrical, 15
Trench foot and electric leakage, 75
Trucks and tractors, Electric, 5
Tubing plant, New steel, 46
Tudor Accumulator Co—Sale of shares, 75, 160
Tungar rectifier, The, 584
Tungsten, Cornish, 104, 270
Tungsten lamps, Long life, 46
Tungsten ores, British, 131
Turbine, An internal combustion, by A. W. H. Griepe, 378
Turbine blading, The deterioration of Curtis Rateau, 501, 528
Turbines for land purposes, Steam, by H. L. Guy, 14, 171
Turbo sets, Self-contained, 102
Tyler Apparatus Co., Scheme of arrangement, 37
Tyneside electrical men and industry, 700

UNION, The complete, 534
United States, Industrial situation, The, 11
Uruguay, Electrical imports of, 155

VEHICLE, A simple electric, 592
Vehicle business, Co-operation in the electric, 561
Vehicle business, The control of the electric motor-, 198, 241
Vehicle charging stations in Great Britain, Public electric, 368
Vehicle Commitee, The, 16, 657
Vehicle investments in the U.S.A., Commercial electric, 296
Vehicle manufacturing licences, Electric, 606
Vehicle notes, Electric, 562
Vehicle sales, Electric, 379
Vehicle trial, American electric, 270
Vehicles, A safety controlling device for electric motor, 352
Vehicles and their applications, Self-propelled electric, 163
Vehicles in demand, Electric, 631
Vehicles in Germany, 382
Vehicles, Standard battery jars for electrical, 159
Victoria Colliery, Ebbw Vale Electric winding at, 535
Voltage indicator, Puncture, 493
Voltage regulation of rotary converters, The, by G. A. Juhlin, 304, 333, 343, 472
Volunteers, The First London Engineer, 149, 474, 701

WAGES, Engineers', 132, 159, 297, 492
Wages, London County Council electrical workers', 159
Wages, Manchester engineers', 466
Wages, Tramway men and war, 16
War and industry, 296
War, Economic recuperation after the, by Prof. W. R. Scott, 229, 277
War, The more recent applications of electricity in the present, especially in the treatment of diseases and wounds arising therefrom, by Warrant Officer W. Leeming, 661

WAR ITEMS—
  Accidents, Restricted lighting, 235
  A.E.G. workers, 235
  After the war: Extracts from the Premier's Carnarvon speech, 152
  Air raids and tramcar lighting, 697
  Air raid warnings, Electricity works and, 697
  Aluminium, Official price and census of, 78, 207
  America and British Colonial trade, 599
  American searchlight corps, 512
  Armorduct Co. to be wound up, The, 9
  Aron Meter Co., German, 36
  Australia, Exports to, 152
  Badged electricity workers, 97
  Bangalore, From, 376
  Banks and industry in Germany, 673
  "Be a Potatriot," 600
  Belgian General Electric, 487
  Birmingham Electrical Engineers' Volunteers, 319
  Brighton Tramway Group scheme, 487
  British Trade Corporation, 674
  Carel Frères bombed, 697
  Carlisle Electricity Department, 97
  Central station industry and war possibilities, American, 289
  China, Exports to, 9, 37, 132, 235, 289, 346, 419, 434, 460, 512, 599, 651, 673
  China, German preparations for trade in, 289
  Coal and metals: Enemy shortage, 569
  Cockerill's works, Fire at, 235
  Companies to be wound up, 125, 179, 260, 289, 419, 487, 569, 674, 697
  Contracts, Pre-war, 376
  Controlled works, 9, 125, 260, 419, 651
  Copenhagen, Lighting economy at, 569
  Copper, 235
  Denmark, Coal shortage in, 599
  Disabled soldier's pension, A, 673
  Discharged men in kinemas, 125
  Electrical export prohibition, 235
  Electrical training of disabled soldiers, 696
  Employment of discharged soldiers at Marylebone Electricity Works, 487
  Enemy companies winding up, 125
  Enemy firms, The Board of Trade and, 207
  Engineering industry after the war, 569
  Engineering wages, 235
  Engineering wages and the cost of living, 697
  English cyanamide interests in Germany, 569
  Entertaining the wounded, 260
  Excess profits and after-the-war trade, 697
  Exemption applications, 9, 37, 67, 97, 125, 152, 179, 207, 235, 260, 290, 319, 346, 376, 419, 434, 460, 487, 512, 542, 569, 600, 624, 651, 674, 697
  Exports from countries abroad prohibited, 439, 487
  Exports to China, 9, 37, 132, 235, 289, 346, 419, 434, 460, 512, 599, 651, 673
  Female labour at Bristol, 542
  Fruits of barbarism, 673
  German Aron Meter Co., The, 36
  German commercial preparation for peace, 569
  German electrical industry, 419
  German litigation in war time, 152
  Ghent, The Professors of, 697
  Hong Kong and enemy trading, 376
  Imperial preference, 487
  Imports from neutral countries, 260
  Industrial problems after the war, 599
  Institution of Electrical Engineers and the U.S.A., The, 673

WAR ITEMS—*continued.*
  Japan and enemy trade, 152
  King's tour of industrial works, The, 569
  Labour after the war, 125
  Lead, Ministry of Munitions and, 152
  Liberia, Exports to, 319
  Lighting Order, New, 599
  Lighting restrictions, 9, 152, 235
  Loans for new works, 319
  Locomotive engines, Ministry of Munitions and, 152
  Manchester war bonus, 97
  Marylebone electricity staff, 345, 674
  Men in protected trades and tribunal exemptions, 650
  Ministry of Munitions and copper, 9
  Ministry of Munitions and electric lamp glass, 345
  Ministry of Munitions and insulated wires and cables, 636
  Ministry of Munitions and tramway materials, 438
  Ministry of Munitions and the A.S.E., 673
  Municipal employes for military service, 624
  Municipal war wages, 460
  Munition work in Switzerland, 67
  Munitions and copper, The Ministry of, 15
  Munitions and trade, 260
  Natal and preference to British and Allied manufacturers, 36
  National Service Department, 460
  Non-essential industries and National Service, 235
  O.T.C., Vacancies in the, 36
  Optical and glassware munitions, 37
  Paper supplies and catalogues, 260
  Post Office electricians' clearance certificates, 487
  Power Station Volunteers, 319
  Prohibited exports, 67, 74, 104, 235, 241, 270, 353, 376, 607, 626, 630
  Profits on Government contracts, 697
  Protected trades and tribunal exemptions, 674
  Railway rates after the war, Higher, 235
  Rathenau again, Dr. Walter, 97
  Raw materials and men in Germany, 97
  Reconstruction in invaded France, 673
  Restricted lighting: Accidents, 235
  Restriction of electrical imports, 319
  Returning municipal employés, 651
  St. Dunstan's Hostel for Blinded Soldiers and Sailors: Annual report, 542
  Separation allowances, Station staff, 319
  Siemens shares, The, 132, 179, 326
  Sleeping at their posts, 36
  Souchez power station, 651
  Standardisation of copper tubes for aircraft, 651
  State and the coal mines, The, 207
  Sterling Telephone and Electric Co., 78
  Street lighting, Summer, 650
  Substitution, 460
  Sulphuric acid, 599
  Switzerland, Exports to, 289
  Trade after the war, Report on, 179
  Trade in China, German preparations for, 289
  Traders in neutral countries, Information concerning, 512
  Trade policy, After the war, 599
  Trade protection cards not exemption certificates, 697
  Trading with the enemy, 37, 97, 152, 207, 260, 319, 376, 434, 487, 542, 599, 651, 696
  Tramways and substitution, 36, 97, 158
  United States and the war, 487
  Unruly member, The, 345
  Vienna, The tramways of, 235
  Wages of discharged soldiers, 697
  Wages, Municipal war, 460
  War Trade Department, 97, 235
  Westinghouse wages, 674
  Westinghouse War Relief Funds, 345
  Wires and cables, Ministry of Munitions and insulated, 636
  Women in engineering, 289, 599
  Women workers, 36, 260

War Loan, National Service and, 170
War on construction contracts, Effect of the, 310
Water powers, Canadian, 199
Water power in Italy, 311
Water power in Ireland, 311, 397
Water powers report, Canadian, 550
Watford extension, The Bakerloo—L. & N.W., 423, 439
Watt-hour meter construction, Novel features in D.C., 474
Wattmeter and non-inductive standards of low resistance, A concentric standard dynamometer, by A. F. Moore, 637
Wattmeter readings, The determination of the sequence of phases from, by Dr. G. Kapp, 566
Wayleaves, 421, 533
Wayleaves, by C. Vernier, 443, 454, 480, 613; by W. A. Chamen, 555
Welding, Electric arc, 408
Welfare study, 381
Westinghouse works, New American, 104, 349
Wills, 48, 187, 578, 681, 704

Winding at Victoria Colliery, Ebbw Vale, Electric, 535
Winding systems, Comparison of electric, by S. E. T. Ewing, 376
Wire-drawing industries, The, 311
Wire in place of small stranded cable, Use solid, 241, 296
Wires in street, Telephone, by "Legal Contributor," 602
Wiring rules, Institution of Electrical Engineers', 353
Wiring rules of the Institution of Electrical Engineers, by W. R. Rawlings, 475
Wiring with tough rubber compound cables, by W. Ellerd Styles, 451
Wireless stations, Some long-distance, 283
Women electrical workers, Wages of, 15, 701
Women in the engineering industries, 338
Works, Extension at Preston, 10
Wounds arising therefrom. The more recent applications of electricity in the present war, especially in the treatment of diseases and, by Warrant Officer W. Leeming, 661

X-RAY equipment, 630
X-ray industry, The future of the British, 419, 571, 771
X-ray industry, British, 515
X-rays, A [illegible], 761

ZINC as a substitute for copper, 666
Zinc, electric, 532
Zinc smelters, Electrolytic, 439
Zinc, Tasmanian electrolytic, 686

Printed by WM. CATE, LTD., 147-150, Gt. Saffron Hill, E.C. 1, and Published by the Proprietors, H. ALABASTER, GATEHOUSE & KEMPE, 4, Ludgate Hill, E.C. 4.

Index to the Electrical Review.
July 6th, 1917.

THE

ELECTRICAL REVIEW.

VOL. LXXXX. JANUARY 5, 1917. No. 2,041.

ELECTRICAL REVIEW.

Vol. LXXXX.] CONTENTS: January 5, 1917. [No. 2,041.

Page
1916: A Backward Glance ... 1
German Companies in Russia ... 2
The Superfluity of Electricity Regulations ... 3
Baking by Electricity, by G. B. Barham ... 3
Electric Trucks and Tractors (*illus.*) ... 5
The Lo-Thermo Motor (*illus.*) ... 7
Improper Use of Auto-Transformers (*illus.*) ... 7
Excess Profits Tax Appeal ... 8
Correspondence—
  National Industrial Organisation ... 8
  City and Guilds Examinations ... 8
War Items ... 9
Business Notes ... 10
The Ministry of Munitions and Copper ... 15
Notes ... 15
City Notes ... 19
Stocks and Shares ... 21
Market Quotations ... 22
Small Electric Motors, by "Booster" ... 23
Import Trade of China ... 24
National Insurance (Unemployment) Acts, 1911 to 1916 ... 24
Colonial Telegraphs and Telephones, by R. W. Weightman (*illus.*) (*continued*) ... 25
Foreign and Colonial Tariffs on Electrical Goods ... 28
New Patents Applied for, 1916 ... 28
Abstracts of Published Specifications ... 28
Contractors' Column ... Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. *Established 1872.*

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain

Subscription Rates.—Per annum, postage inclusive, in Great Britain £1 1s. 6d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.
AUCKLAND N.Z: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.
BRISBANE: Gordon & Gotch, Queen St.
CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.
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JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c.: Central News Agency, Ltd.
LAUNCESTON: Gordon & Gotch, Cimitiere Street.
MELBOURNE: The Mining & Engineering Review, 90, William Street Gordon & Gotch, Queen Street.
MILAN: Fratelli Treves.
NEW YORK: D. Van Nostrand, 25, Park Place.
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto 1° 307.
SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.
WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank Newgate Street Branch."

THE UNIVERSAL ELECTRICAL DIRECTORY

(J. A. Berly's).

1916 EDITION.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

1916: A BACKWARD GLANCE.

As we enter upon the year 1917 there is abroad amongst Britain and her Allies a spirit of quiet confidence, of assurance in increasing strength, and of expectation of a victorious conclusion of the war before another winter passes. Our inclination just now is not so much to look backward as to look within for our state of preparedness and forward to the heavy tasks that still await us all. Yet 1916 must not be allowed to pass out of mind with its praises all unsung, for it has been a year of grand achievement. No hasty phrases can pay fitting tribute to the magnificence of the Fleet—whether in Jutland Battle or in silent watchfulness; to the unexampled fortitude, self-sacrifice, and valour of the land Forces, shaking the German *moral*; or to the resourcefulness and daring of our heroes in aerial flight. Nor can we in few words make more than the barest suggestion of the immense nature of the organisation and reorganisation of our productive powers in factories at home and abroad. Are we not now approaching the full utilisation of all our forces and resources for the "knock-out blow" which is to bring in a Peace which shall be lasting? If 1917 is to be the decisive year, we believe that from many standpoints history will regard 1916 as almost equally momentous.

The manufacture of munitions of war in thousands of works throughout the British Empire has made such demands upon engineering genius and skill as to have demonstrated for all time the essential nature of the engineering profession and industries of the nation. And the part that electricity and its applications have performed in this connection, though only partly known at present, will remain for ever a monument in honour of the usefulness of the electrical engineer. Assuredly the war has raised the status of all branches of engineering—may the nation not be slow to recognise the fact, and register it with appropriate action!

The year that has gone, however, has not only been one of continued organisation for the purposes of war, for deliberations and investigations begun in the Press, and carried on in many directions ever since August, 1914, have become focused in committee-rooms where, at the bidding of the Government, experts have been inquiring into the details of our great industries and the measures necessary for safeguarding their interests after the war. The sittings have not yet been concluded, for the inquiries have been no light undertaking, but engineering, electrical, and other trades have all been preparing their suggestions with regard to the future. One of the Governmental Committees has urged the setting up of additional financial facilities in the form of a Trade Bank to assist our industries. The Economic Conference at Paris has formulated the Allies' after-the-war policy. The Institution of Electrical Engineers courageously leaving the beaten path of its quondam "professional" virtue has elaborated an excellent trade policy. The large industrial concerns have been "getting together" in federated association. Electrical and other engineering trade associations have been actively pursuing the same worthy object. The Board of Trade has made changes in its Intelligence Services, and the appointment of new Ministers of Shipping and Food has relieved it of some of its overload of work. Capital and Labour have made advances toward each other in the interests of industrial harmony. Yet, notwithstanding all our preoccupation with actual war work, and with all these efforts at industrial and trade reorganisation, individual manufacturers have been able to lay the foundations for special lines of manufacturing, and, besides meeting the exceptional needs of war factory installations at home, have admirably maintained the value of our electrical and allied exports at a figure which, but for restricted tonnage accommodation, labour, and material, would have been multiplied several times, so great has been the demand of the world.

The intense activity of our industries in general has caused the demand for electric power to multiply and increase far beyond even the high record of 1915, and has thus reacted upon the electricity supply industry, which has been hard put to it to keep pace with the growing load; the nation's grateful thanks are due to the station engineers, who, short-handed as to staff and starved as to capital, have manfully contended against unprecedented difficulties and have almost invariably succeeded in maintaining an adequate supply of energy. Those undertakings which are situated in manufacturing districts have recorded outputs of energy breaking all records, and in many cases substantial profits have been made; large stations have been hastily extended, and some small stations, which never anticipated anything in the nature of a power load, have awakened to find themselves equipped with three-phase turbo-alternators and badges, and a 24-hour load. That the war activities of the supply stations will secure for them the confidence of power users and generate a momentum which will ensure to them a permanent and substantial development cannot be doubted.

The spirit of co-operation for patriotic ends, which has pervaded the industrial councils of the nation since the outbreak of war, has made itself felt in the electricity supply industry to good purpose, and has brought into existence a movement which under ordinary circumstances might have perished at its birth—the movement towards the interconnection of electricity supply undertakings, which was initiated in the Institution of Electrical Engineers, developed by the Lancashire and Cheshire Committee, and immensely invigorated by the unexpected support of the Board of Trade. Under the ægis of the I.E.E., the I.M.E.A., and the I.A.E.P.C., the scheme has gathered strength, and several district committees have been formed to carry it into effect; but little open opposition has been manifested, and the technical difficulties, which admittedly exist, are not incapable of solution by the men who have the matter in hand, while the Treasury has promised to assist in providing the necessary funds.

The spirit of co-operation, as indicated by the last remark, has extended to Government circles also, and we gladly recognise again the striking change of attitude adopted by our rulers towards industry in general. The Committee of the Privy Council, guided by its Advisory Council for Scientific and Industrial Research, and backed up by the Treasury, has recently declared its intention to devote comparatively large sums to the promotion of research and similar purposes, in consultation and collaboration with representative trade associations—a significant indication of the new spirit that sways the Government. The admirable work of the National Physical Laboratory has also been generously acknowledged by the Council, and we may count upon its future development with adequate financial support from the State—which it never had until the war broke out.

Committees have been appointed to consider the position of science in schools and universities, and to reform the curricula adopted by the Civil Service Commissioners, and we trust that they will ruthlessly sweep away antiquated notions and remove the fetters which have so long enthralled our schools. During the year good progress has been made in the electrification of several important railways, and in presence of the shortage of petrol the electric vehicle has had an exceptional opportunity to display its qualities—marred only by the difficulty of obtaining it. We have for many years advocated the use of electricity in agriculture, and the favourable reception accorded to Mr. W. T. A. Kerr's account of his experiences in this connection, at the I.M.E.A. meeting, fills us with hope for future progress.

We have only lightly touched on some of the outstanding operations of the year in the foregoing, recognising that no one nowadays has leisure to indulge in detailed retrospection; but we have said sufficient to indicate how important and interesting have been the movements and tendencies of 1916. In the New Year we shall doubtless witness progress on very similar lines, placing us in a better state of preparedness for the period of Peace, which will not now, we hope, be long delayed.

German Companies in Russia.

A REPORT on this subject has been published by the German banking institutions which formerly offered for subscription shares in the Russian A.E.G. and other electrical companies in Russia. The report is based upon a statement made in a Russian newspaper concerning a recent meeting of the "Special Commission for Combating German Domination." It appears that the Commission had under discussion the question of removing German influence from the Siemens and Schuckert Co., Siemens & Halske, the A.E.G., the Electro-Peredatscha, and the Petrograd Electric Lighting Co. of 1886. The representative of the Ministry of Commerce submitted three proposals by which the problem could be solved, namely, liquidation, purchase by the State, or participation of the Government in the companies so as to exercise the requisite supervision.

The Commission decided in favour of the liquidation of the five companies, and the preparation of a definite scheme for this purpose was left to the liquidators to be appointed. The general principles of the scheme, however, were outlined by the Commission. According to these, the bearer shares in all the companies are to be abolished and replaced by registered shares. The holders of the former will be entitled to apply for an exchange for registered shares, but only those who are not suspected of having relations with German capital will be permitted to effect the transfer. All the remaining shares will be purchased by the Government at the nominal prices, and will either be retained by the Government, which in this way will become interested as a shareholder, or they will be sold by the State at their quotation value as registered shares. It would be a good thing for our future electrical trading operations in Russia if British holders could be found for some of the German electrical investments. It is stipulated that the liquidation of the five companies must be ended by July 1st, 1917.

The German banking institutions, in commenting on the above statement, remark that further information as to the extent to which these proposals are being carried out is lacking. The adoption of the scheme, it is held, would deprive German shareholders of their rights as such, and render them dependent upon a claim on the Russian Government for an amount corresponding to the nominal value of their shares. It is intended to lodge a protest against the scheme, and to take all necessary steps for the representation of German shareholdings, and for this purpose German holders are notifying their shares to the banks concerned, which include the Disconto Gesellschaft, of Berlin.

THE SUPERFLUITY OF ELECTRICITY REGULATIONS.

[Communicated.]

Electricity supply suffers from too many regulations; gas supply does not. It is not because gas is such an inoffensive sort of thing; the Board of Trade inquiries into railway disasters where people are roasted to death, owing to the use of gas for lighting purposes, prove the contrary. The electrical industry has been foolish enough to burden itself with all the safeguarding measures and their cost, whilst the gas industry allows compo tubing to be run in any manner, and it is consequently much cheaper to install. If a person is blown through a window owing to bringing a naked light near to a leakage of gas, the verdict is "What a stupid thing to do!" If a house is destroyed through a leakage of gas being ignited by an electric spark, the verdict is "Fire caused by fusion of an electric wire," and the public exclaim "What a dangerous thing electricity is!" After 20 years' experience, the writer has never known an electric spark do £5 worth of damage, provided there was no gas leakage. Verily we deserve what we get in the way of blame that should not be ours by right. Do not the regulations say: "Thou shalt earth all tubing, covers, and the like: thou shalt not go near any gas pipes or fittings; thou shalt completely cover up thy fuses"?—all to save people from the effects of a leakage of gas. The electrical industry should say: "We are out for all the business we can get: all rules will be abolished forthwith; and if a complaint is received about a person getting a shock, he will be informed that he should not have been so silly as to touch the thing; or if the complaint is that a house is burnt down, he will be advised not to have gas in his new house at all." The gas industry would then have to run iron tubing covered with insulating material, and put insulating connectors between the gas meter and the tubing.

Each electricity supply authority used to make its own rules, and the confusion was awful. A contractor doing work in a strange town had to go to extra trouble and expense to conform with the local fads. Nowadays most supply authorities accept the I.E.E. wiring rules, the Board of Trade regulations, and the Factory Acts. The official who has to study all these regulations and pass work accordingly, has got his work cut out if they are all to be adhered to. In passing a job he has to consider whether a certain part of the work is covered by the I.E.E. rules, the Board of Trade, or the Factory Act. He even has to consider special regulations insisted on by insurance companies. Now, this state of things is unfair to the inspector, the contractor, the manufacturer, and the general public. If scores of rules are necessary, let them at least be issued by one authority: let the Board of Trade be that authority, and let the rules be issued in three sections. The first section should deal with the supply authority and private generating stations; the next with workshops of all descriptions; the last should deal with private houses, shops, and offices.

In order to greatly diminish the number of rules, why not deal with electrical wiring apparatus in the same way as meters are dealt with? A new type of meter is submitted to the Board of Trade and, if satisfactory, has their approval stamped on it. Let the lampholder, switch, wall socket, &c., be stamped "B.O.T.," and let new designs be submitted before being placed on the market. If this idea were carried out, the inspector's duties would be reduced to looking out for faulty workmanship. Arguments as to the length of break of fuses or switches would vanish. The public would also probably get more standardised articles, as a manufacturer would prefer to make to a standard design rather than ask for permission to make, for instance, a wall-plug having its pins ½ in. further apart than any one else's.

Rules are too numerous, and, owing to the system of inspection, are not all kept. The bulk of the work is left to the supply-authority's inspector, who receives no help from any of the people who make the rules. The Board of Trade could take over the whole business of inspection, and the certificate of the local B. of T. inspector would satisfy the supply authority and the insurance companies, who could dispense with their inspectors.

BAKING BY ELECTRICITY.

By G. BASIL BARHAM.

When the possibilities of baking on a large scale by electricity were first discussed, it was the general consensus of opinion that the idea was impracticable. The electric ovens then on the market were far from efficient, and with energy at a comparatively high price, there seemed to be no possibility of electricity supplanting steam, coal, or gas in the bakery.

Even at that time, however, small electric ovens were demonstrating the possibilities which existed, and proving that electric cooking was not the expensive luxury that many considered it to be. Experiments were made with a view to improving the efficiency of the electric oven, and certain Continental manufacturers of electrical appliances devoted large sums of money for the purpose of developing electric cooking apparatus. One of the big German firms realised that the chief stumbling-block in the way was the cost of energy, and at once adopted different tactics to its competitors. It increased the size of elements, worried but little about efficiency, set to work to build ovens of large size, and sent an army of agents to push their sale in countries where electricity was the cheapest possible form of power, such as Norway, Sweden, and, more particularly, Switzerland. Few engineers are aware that in that country are some of the largest electric cooking installations in existence.

Electric Bakeries.

As the writer pointed out some little time ago, the convenience, cleanliness, and great range of regulation possible with electricity are so great as to constitute powerful arguments in favour of electrically-heated bakehouses, even in localities where electricity costs money and cannot be obtained for next to nothing.

There is a large electric bakery in Bregenz, Switzerland, which has a baking surface of about 6 ft. 7 in. by 19 ft. 8 in., or about 14 sq. yards. This surface is, however, divided into two storeys, placed one above the other. The controlling switches are mounted on a switchboard placed beneath the doors of the oven, and shielded from the heat by a protective screen. Each of the two storeys of the oven is controlled by 10 switches, which are so arranged that their positions on the board correspond to the positions in the ovens of the heating elements they control. The elements are so arranged that when they are all in operation the heat is very evenly distributed, and a careful temperature test will show no difference in heat between any two parts of the oven. It can therefore be seen that, with 20 circuits for the two storeys, the heating can be adjusted within very wide limits, and it is possible not only to reduce it from full to zero all over the oven, but also to raise any desired parts of the latter to a high local temperature, whilst the remainder of it continues comparatively cool. As may be supposed, ordinary thermometers are useless, and in order to show the temperature inside, pyrometers are fitted in the front of the oven. The oven is lighted electrically by means of incandescent lamps, but as the bulbs of these would not stand the heat were they fixed inside the oven, openings are provided at the right-hand side of the doors. An electrically-heated steaming apparatus is provided on each storey, as steam is required when dealing with certain kinds of bread, and in connection with the ovens a large water tank has been installed, which supplies all the hot water needed for the domestic operations carried on in the adjoining house as well as that required in the bakery itself.

Private Bakeries.

Anyone who has not devoted close attention to the subject would be surprised to know what immense strides have been made in the direction of equipping what I may term private bakeries with electric ovens. The majority of large hotels and restaurants do all their own cooking, including the baking of bread and pastry, and in many of them electric ovens, specially designed for their needs, are installed. At the same time, it need not be supposed that the demand has already been filled. As a matter of fact, the demand has not yet been stimulated, and there is a vast field open to the firms who care to undertake its cultivation.

One of the first questions that the hotel or restaurant proprietor or manager will raise when approached on the subject, is that of the relative costs of electricity, coal, and gas.

The popular impression is that electricity is expensive, and the hotel man fears he will find himself face to face with the prospect of higher fuel bills. Generally speaking, one does nominally pay a higher rate for electricity. This is only one phase of the question, however, and before deciding that he cannot afford electricity in his bakery, the prospective customer should be shown that the cost of fuel is only one item in the expense of the bakery. It has been pointed out that the first consideration in the installation of a bakery in an hotel is the amount of space required for it, and the possible location, and here is just the beginning of the electrical advantages. If electricity is to be used, much less space is required. Electric ovens can be built with three or four decks or compartments, giving several ovens of equal capacity in a space where only one deck of any other class could be placed. In the large city hotels this consideration of space is an important one, and the reduction in the rental cost that has to be charged against the bakery is a real saving.

Where the bakery has already been installed, and the question is one of substituting electricity, the question to be asked is, "Can you advantageously use the space thus saved?" As a matter of fact, the question of space is a very important one in the kitchens and bakeries, and very few hotel kitchens, where business is good, are not overcrowded and in need of more room.

For obvious reasons the hotel bakery should be located so as to secure adequate light and ventilation; but the use of electricity will much improve any situation that may be selected, and can be adopted in places where the use of fuel would not be possible.

The next point, after the saving of space and the possible use of space not otherwise available, is the economy of labour. Here the question of the best oven enters, for there is a wide variation among electric ovens, and the great progress in electric baking in the past few years has effected economies and advantages in their use that make the present-day oven far better than those of even a few years ago.

Economical Advantages.

Some of the economical advantages resulting from the use of electric ovens may then be pointed out. When the extreme heat of a modern electric oven is turned on, the temperature necessary for quick and efficient baking is attained in a comparatively small space of time. The long period of preliminary heating necessary in coal and gas ovens is avoided. This is more than a simple saving in fuel; it is a big saving in labour as well. The wages of the fireman may be small, but they go on in good times and bad, and add to the cost of operating coal ovens. The time spent by the pastry *chef* in watching his oven heat to the proper degree has a calculable effect on the amount of work he can turn out. This is an appreciable factor, too, after the baking has started, for the uniform regular heating of an electric oven requires less of the time of the pastry *chef*.

Economy of Operation.

As an illustration of what can be produced in actual operation under working conditions, the pastry *chef* of the Quaker Cafetria, Sacramento, Cal., with an electric oven consuming 10·5 kw., produces per week 500 pies, 63 large cakes, 105 pans of hot bread, 15 pans of shortcake, 45 loaves of nut bread, 250 cups custard, 600 baked apples, 250 apple dumplings, and 35 puddings. Another and smaller bake oven for meats, consuming 6·5 kw., turns out each week 280 lb. rib roast, 60 lb. lamb, 40 lb. pork, 210 lb. stew, 100 lb. hash, 50 lb. bacon, 30 lb. ham, 50 lb. of "made" steak, 15 lb. meat loaf, 90 lb. turkey, 75 lb. chicken, 50 lb. duck, 450 lb. fish, 800 lb. roast potatoes, 100 lb. beans, 100 lb. macaroni. Great quantities are possible with electricity, where practically no time is lost and the maximum baking heat is steadily maintained.

Comparing the space occupied by an electric oven and an ordinary brick oven, Mr. G. J. Bucker, who has devoted considerable study to the question, gave the following example:—A brick oven having a capacity of 240 1-lb. loaves of bread occupies a floor space of 10 ft. wide × 12 ft. deep, or an area of 120 sq. ft. An electric oven of the same capacity measures 4 ft. wide × 8 ft. deep, or an area of 32 sq. ft., which is about one-fourth the floor space occupied by the brick oven.

A still further consideration affecting the comparative cost of baking by coal and gas or electricity is to be found in the reduction of waste and loss. The heating elements of a modern type of electric oven are not confined to either the top or the bottom of the oven, but are uniformly distributed, so that every part of the oven is at the same temperature. There are no variations in different parts of the oven, or at different periods of the baking. The results are uniformly baked products. The oven bakes the same all day long, and day after day. Requiring less of the attention of the *chef*, it results in practically no spoiled baked goods.

These various advantages have been accentuated because they all bear directly on the cost of fuel, and that is so often the stumbling block in the minds of many hotel managers, who would otherwise install electric ovens. They see no further than the figures of their coal or gas bills, but when the reduced overhead cost is properly figured, the reduced labour bill calculated, the increased volume of pastry, and the lessened loss from poorly baked goods are taken into consideration, the nominal differences between the fuel bills are insignificant.

There are further advantages in electric baking, not so intimately connected with the cost problems, but still very matter-of-fact advantages, which indirectly mean money to the hotel. Take that same uniformity of baking of which we have spoken. Nothing is more helpful in keeping customers than the bread and pastry, and when the quality is always uniform in colour and texture, it binds the customer to the place.

The employés find better working conditions where electricity is used, as the temperature is less and the ventilation better, and their satisfaction will be reflected in the character and amount of work they turn out. Emphasis has been placed on the fact that the up-to-date electric oven has almost perfect insulation, and retains a high temperature for hours after the current has been switched off. As a matter of fact, pyrometer tests have been made which show that a baking heat is still retained for hours after the oven is disconnected. In order to utilise this heat to advantage, bread should be baked first at the highest temperature, and, after switching off the energy, lighter goods, such as cakes, pies, puddings, &c., can be baked, as they do not require so much heat. Here, again, is a saving which should be pointed out to the prospective customer, as with less efficiently insulated gas or coal ovens it would be necessary to use fuel throughout the whole of the baking.

Some Actual Figures.

To give a final example of the economy and advantage of electric cooking, we may take the figures of the New Vienna Bakery in Salt Lake City. This bakery has a thorough modern equipment, including individually motor-driven mixers, dividers, rounders and electrically-heated wrapping and sealing machines, and the company does an exclusive wholesale business, its entire product being sold through retail dealers. The scale of its work may be judged from the fact that it sells 18,000 loaves daily.

The main body of the oven measures 4 ft. high, 10 ft. wide, and 12 ft. deep; it rests on an angle-iron frame 27 in. high. It is divided into four chambers, each 56 in. × 34 in. × 16 in. high, which provide a baking surface of 208 sq. ft. The oven has a capacity of 836 12-oz. loaves or 456 25-oz. loaves of bread. The oven is divided in the centre by a partition, with two baking compartments on each side, one above the other. All compartments have $1\frac{3}{4}$-in. tile floors. The customary steam connection is provided for each. Each half of the oven has three heating elements—one in the top of the upper compartment, one in the top of the lower compartment, and one directly under the floor of the bottom compartment. With this arrangement, heat is provided for the top and bottom of each baking chamber. Each compartment has a mercury thermometer and inside lights.

The oven is wired for 220-volt, two-phase service. It takes a maximum of 75 kw., and averages 48 per cent. of this demand when baking 16 hours per day, and 55 per cent. on eight hours' baking per day. When making $\frac{3}{4}$-lb. loaves, it requires 45 minutes to load the oven, bake the bread, and take out the finished product. On this schedule, 25,000 $\frac{3}{4}$-lb. loaves could be baked in 24 hours' continuous baking.

To sum up, it may be said that the chief selling points to emphasise in connection with the installation of electric ovens for bakeries, either for bakers and confectioners or for big hotels and restaurants, are :—

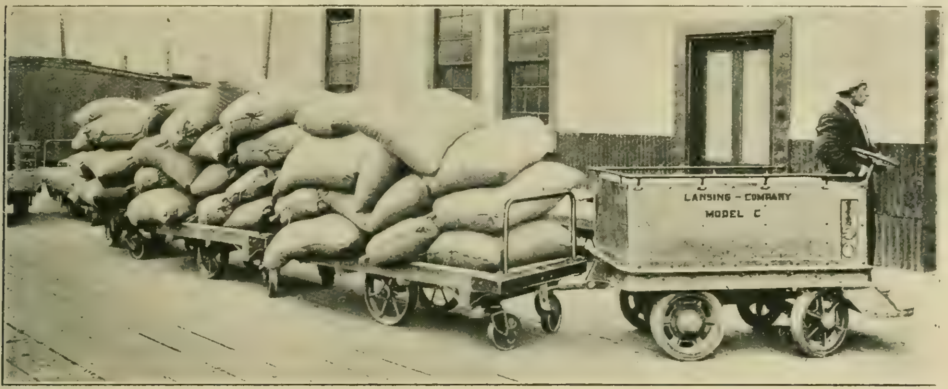
Maintenance of a uniform temperature throughout the period of baking ; the entire absence of the dirt, dust, and smoke, which inevitably go with the old brick oven ; simplicity of operation ; ease of control ; perfect heat distribution ; better results in baking ; cleanliness and sanitation ; utilisation of all heat generated, and the great saving in floor space.

Water-power in France.—By a law enacted in September last, the French Government has given sanction to the State financial support of hydraulic works for the production of energy for sale, with, of course, a measure of control and a share in the profits. The importance of this question is due to the large importation of coal—18 million tons in 1912, of which half came from Great Britain. There is still three million h.p. at low water and eight millions, on the average, in French waterfalls which have have not been utilised.

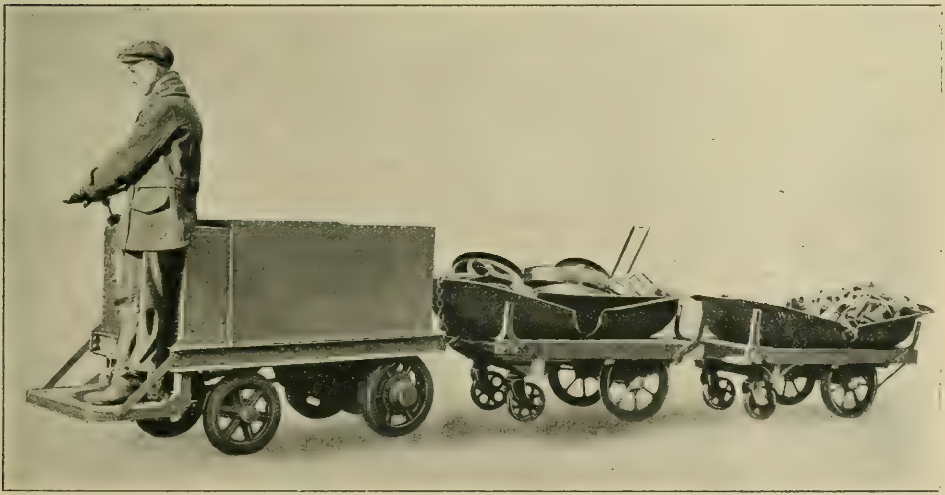
ELECTRIC TRUCKS AND TRACTORS.

Amongst the many problems which have been forced into prominence in this country by the war, those which have reference to labour economy must occupy a leading position. In the past, small fortunes have been wasted on the assumption that manual labour was cheap because wages were low and such labour was plentiful. Now, with the scarcity of labour of all kinds, even the most conservative have perforce turned their attention to labour-saving appliances. One direction in which there is an enormous field for improvement in this country is in the internal handling of material in our warehouses, factories, and railway terminals.

Despite the adoption of transporters and cranes, the hand-truck and barrow still figures very largely as a local means of transport, although obviously out of date, inefficient, and wasteful. To meet the conditions of such work, the industrial electric battery truck has been introduced and very largely applied in America, while it is also significant that it is being tried, and giving satisfaction, in various situations in this country.



Lansing Industrial Electric Tractor with Loaded Trailers.

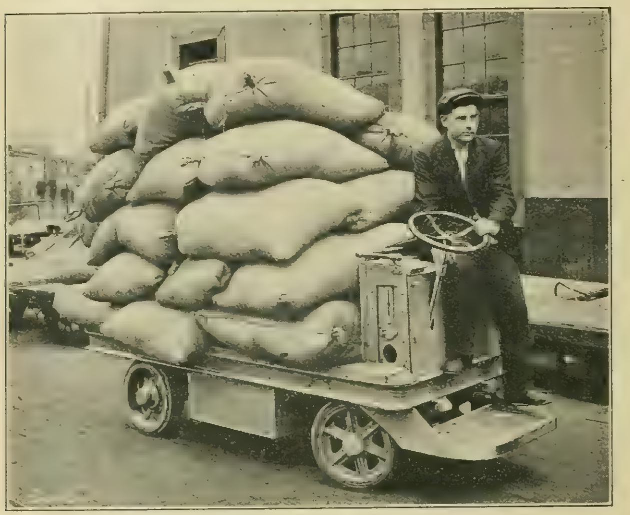


Lansing Industrial Tractor Handling Foundry Products.

It must be obvious that there are numerous situations where satisfactory crane facilities are almost impossible, though a small power-driven industrial truck for short haulage would meet the case quite well. There are other situations in warehouses and railway stations where a small battery tractor is preferable and more economical, because it can be kept in operation all the time, if necessary.

hauling less expensive trailers which are loaded and unloaded in relays continuously.

The latest type of industrial battery truck and tractor to be placed on the British market is the "Lansing," which is being supplied by Messrs. Baxter & Caunter, Ltd., and is illustrated herewith. Like its predecessors, it is of American origin, and has, we believe, met with very considerable appreciation by the railway authorities on the other side.


The Lansing Industrial Truck.

In the Lansing truck the operator's platform and seat are so placed that he can either sit or stand, and in a quarter-turned position has a view both behind and in front of the truck. Although both lever and wheel steering can be supplied, the wheel steering is for the most part adopted, being preferred by the users. The steering is easy, due to suitable load distribution, and the short wheel base and small over-all dimensions enable turning to be done in a small space.

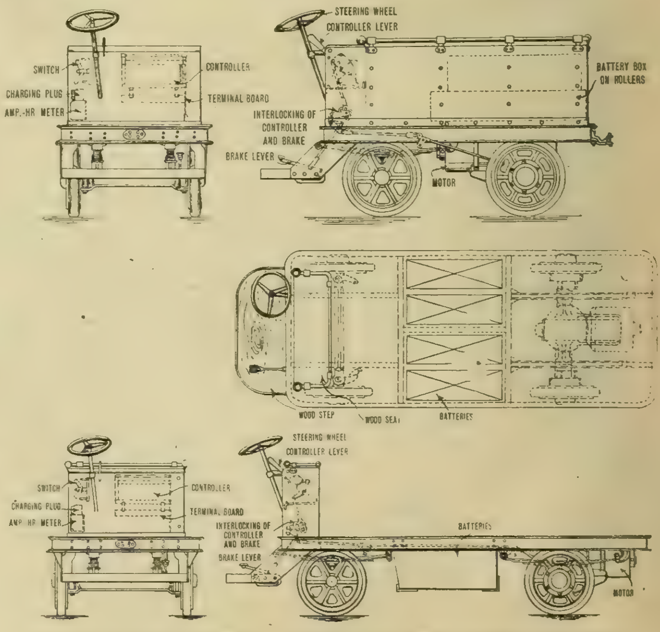
The controller is under the driver's seat, with an operating handle, having an up-and-down movement under the steering wheel, on the driver's right.

The controller is of the Westinghouse series-parallel type, giving four speeds each way; each step is indicated by the quick action of a ratchet wheel and pawl, and it is provided with a special interlock with the brakes, such that the brakes can only be set when the controller is in the neutral position. The controller is locked when the brakes are set, although with the controller in the neutral position the brakes may be released and operated freely in coasting. The controller may be thrown to neutral position either by the controller lever or by the pedal which simultaneously sets the brakes. This arrangement eliminates intermediate switch or circuit-breaker, ensures that the motor will not run with the brakes on, or that the machine will not start with the brakes off until the controller handle is moved, and provides an effective emergency stop. The motor, of standard Westinghouse vehicle pattern, has certain details specially adapted to the Lansing drive-axle, which consists of a steel casting enclosing a 10 to 1 worm drive, differential, and bearings in an oil chamber, attached direct to the motor. The gear is of bronze alloy, with a case-hardened steel worm, the shank of which is attached to the motor shaft, and is carried at the motor end in an annular ball bearing and at the opposite end in a double-thrust bearing. The differential is of the bevel gear type with six high-carbon or nickel-steel gears. Timken roller bearings for wheel hubs, and solid rubber tires on wheels, are fitted. The trucks and tractors are usually fitted with 24-cell Ironclad-Exide batteries, although other types are available if specified; a double-throw charging switch and standard plug, together with a Sangamo ampere-hour meter, form part of the equipment.

The frame is built of standard rolled sections, the driver's platform being a fixture; the driver operates the brakes by means of a foot pedal, and a latch holds them set; the brakes are external acting steel bands, lined with raybestos.

The trucks, being self-contained load carriers, have the battery fitted under the frame or chassis, while in the case of the tractor the battery is carried inside a compartment forming the body of the vehicle.

The Lansing trucks are built in several sizes: models H and G, with a rated capacity of 5,000 lb., are 9 ft. 4 in. over-all in length, and have a turning radius of 5 ft. 6 in. and 6 ft. 6 in. respectively. The tractors, which are very popular in the States, have in models C and D, rated trailer load capacities of 4,000-5,000 lb. and 10,000-12,000 lb.; overall lengths of 6 ft. 8 in. and 7 ft. 9 in.; wheel bases of 2 ft. 9 in. and 3 ft. 6 in.; and wheel treads of 27 in. and 30 in. respectively, while the overall height is 4 ft.



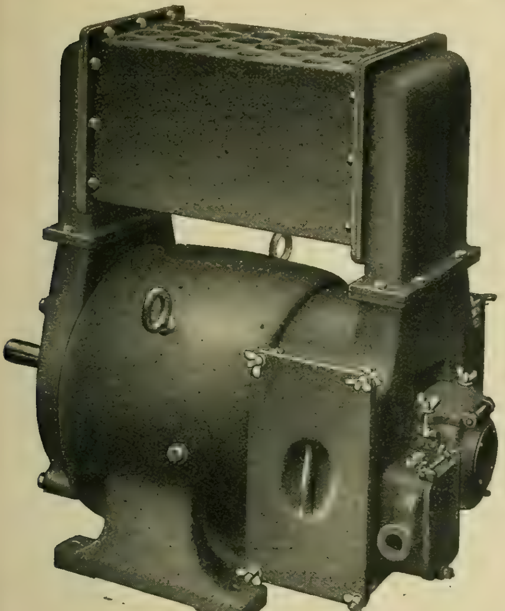
Views showing Constructional Details of Lansing Tractor and Truck.

Accident at Nottingham.—Last week a car, descending the Derby Road tramway route, got out of control and ran into a stationary car, upsetting the latter, two persons being killed and several others injured as a result.

THE LO-THERMO MOTOR.

Messrs. Electromotors, Ltd., of Openshaw, Manchester, send us particulars of a new development in the design of totally-enclosed motors which marks a further step in the advancement of practical electrical science, and for which, we understand, patents are pending.

The demand for totally-enclosed motors has, in the past, been restricted by the difficulty in constructing them, particularly as regards machines of large size, and they have been extremely costly in comparison with ventilated motors.



Lo-thermo Motor, with Tubular Radiator.

The reason for this is that all the heat generated in an enclosed motor must of necessity be radiated through the outside carcass of the machine, and as the rate of dissipation is limited, it follows that the heat generated must also be limited, and, from a practical point of view, this necessitates that the output for a given carcass is restricted, with the result that these machines are relatively costly. Furthermore, high speeds have been impracticable, for the very reason that a large proportion of this heat is generated by the armature-iron losses alone, and as these increase with the speed, a point is soon reached when these losses alone balance the radiating capacity.

Many expedients have been employed to overcome this, such as pipe-ventilated motors, forced ventilation, &c., but the necessary trunking is always an objection, and frequently impossible. Other devices, such as pipes through the machine itself, have been employed, and fins and ribs upon the carcass, but still without much success.

A more successful means has been the employment of a hollow bedplate upon which the motor is mounted, and through which air is circulated from the motor. The hollow bedplate is embedded in concrete to absorb the heat, or can be cooled by a system of water-pipes. This introduces an element which has to be taken into account in any scheme of erection, and any arrangement which eliminates this fixture is an obvious advantage.

The idea of the present invention lies in a practical means of providing large air-cooling surfaces constructed in such a manner that the system can be applied to standard machines of the well-known chimney or pipe-ventilated type, the construction being such that the surface can easily be adjusted by the manufacturer to suit any requirement.

It is constructed in various forms, illustrations of two of which are given herewith. In the first of these the radiator proper consists of a box with end pieces designed to fit on vertical trunk openings in the motor end covers, and through this box pass in a vertical direction a number of thin metal tubes. Inside the back bearing of the motor a fan is fitted on the armature-shaft, which causes a circulation of air through the machine and through the radiating box, and the arrangement of the tubes, &c., is such that the air impinges on the thin vertical tubes, giving maximum cooling. The advantage of the system is that not only is increased radiating surface provided, but as the tubes are thin compared with the motor carcass, the radiation is much greater, and it is possible to approach within quite reasonable limits of the capacity of a ventilated motor of given frame size without the use of anything excessive in the size of the radiator.

Another form of the invention is also shown, in which the tube radiator is replaced by one having thin sinuous metal sides with top and bottom covers, and also having baffle plates mounted inside the radiator, which cause the air to impinge in a thin stream against the outside surfaces, so that this type performs the same functions as the tube radiator.

The design lends itself admirably to an entirely water or dust-tight construction, widening its field of use enormously, yet at the same time, the bulk is of quite moderate dimensions—in fact, less than for an ordinary totally enclosed motor when dealing with the larger powers.

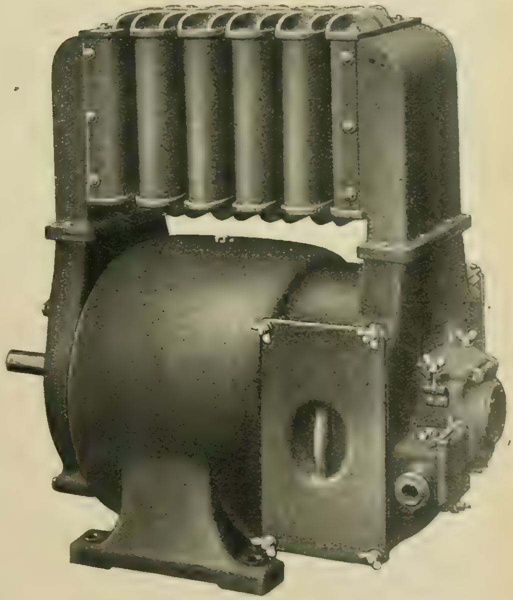
This development will have exceptional opportunities in ammunition factories, chemical works, collieries, foundries, flour mills, bleach works, steel works, wood-working plants, breweries, for outdoor use, and, in fact, anywhere where it is necessary for motors to work in either an explosive, dust-laden, or wet atmosphere.

To centrifugal pump makers it offers exceptional advantage for the reason that high speeds are available, which not only means cheaper motors but enables smaller pumps to be used for a given duty, thus materially reducing the total cost of such combinations.

A considerable number of these motors have already been built and put into practical service in collieries, chemical works, &c., with the most satisfactory results.

IMPROPER USE OF AUTO-TRANSFORMERS.

The principal cause of the favour with which auto-transformers have been regarded during recent years is their moderate first cost. From the technical point of view, however, they must be used with caution, and the following example (from *L'Industrie Electrique*) is an excellent illustration of the grave risks resulting from unsuitable application of this type of apparatus. A supply company contracted to supply a distributing company with 3-phase bulk supply at 22,000 volts, 50 cycles per second, but had available for the purpose only a 16,000-volt, 50-cycle distribution, and a 25-cycle supply. A frequency-converter was installed giving 2,300-volt, 50-cycle supply, and the problem then was to establish a transformer equipment capable of converting the 2,300-volt and 16,000-volt supplies to 22,000 volts. The arrangement adopted is shown in fig. 1 (page 8), and consists of a delta-connected primary winding for 2,300 volts and a star-connected secondary for 22,000 volts, the secondary playing also the part of a 3-phase auto-transformer, raising the 16,000-volt supply to 22,000 volts.



Lo-thermo Motor, with Baffle-type Radiator.

The neutral of the existing systems of distribution being insulated, the same arrangement was retained for the secondary of the new transformer in order to avoid the addition of current transformers and the substitution of 3-pole for the existing bipolar gear on the oil circuit-breakers.

The first trouble experienced on the system was under the following conditions:—Having opened the 2,300-volt primary delta, it was proposed to supply 22,000-volt current from the

16,000-volt supply alone, using the star-secondary as auto-transformer. Immediately severe telephonic disturbances were set up, several lines being unusable, and in order to get over the trouble, the primary delta winding was kept closed. Some time afterwards an accidental earth on the distributor's network revealed another defect of the transformer equipment. The pressure on the supply company's system rose from 16,000 to 19,000 volts, a high-frequency current (caused by the arc to earth) flowed through the auto-transformer, and a violent discharge destroyed the lightning arresters.

After this experience, a supplementary transformer was installed to effect the 16,000-volt/22,000-volt transformation. Had a double wound secondary been used in the first place, instead of the auto-transformer, the cost would not have been much higher, and disturbances would have been eliminated.

From this example it may seem that the neutral point of all auto-transformers should be earthed. It should be remembered, however, that: (1) Earthing an existing insulated distribution system requires the substitution of 3-pole for 2-pole relays on automatic circuit breakers. (2) The presence of several earths on a distributing system favours the development of harmonic currents, which may produce serious telephonic disturbances, and even attain values high enough to cause material damage. (3) It is not advisable, in any case, to connect two important systems of distribution by auto-transformers, since all disturbances, of whatever origin (atmospheric disturbances, earth faults, &c.), are then transferred freely from one system to the other. The magnetic circuit of a double-wound transformer forms an elastic link, eliminating these risks.

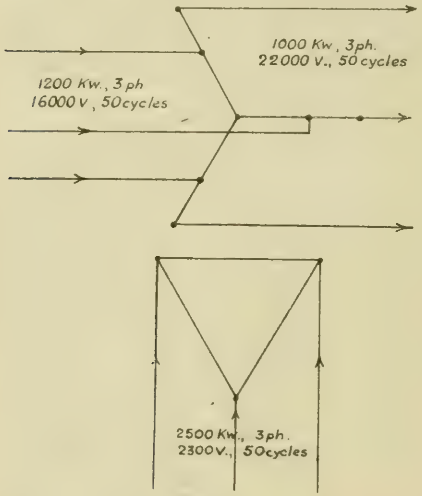


FIG. 1.

EXCESS PROFITS TAX APPEAL.

[DECISION IN FAVOUR OF ELECTRIC SUPPLY COMPANIES.]

ON Friday, December 15th, the appeal case of the Electricity Supply Companies of Great Britain was heard by the Board of Referees. The Provincial Companies and certain of the London Companies (127 undertakings in all) were represented by Mr. H. B. Renwick (managing director of the County of London Electric Supply Co.), and certain other of the London companies (10 in number) by Mr. W. F. Fladgate (director of the Charing Cross Electricity Supply Co.). The appeal thus represented no less than 137 companies' undertakings, involving a capital expenditure of about £25,000,000. The application of the companies was for an increase of the statutory percentage.

The Referees decided that in the case of the London-suburban and provincial companies the statutory percentage should be increased from 6 per cent. to 7½ per cent., and in the case of the London companies (other than the above) the percentage should be raised from 6 to 7 per cent.

The following companies are classed as London-suburban companies:—The County of London Electric Supply Co., the South London Electric Supply Corporation, the South Metropolitan Electric Light & Power Co., and the Metropolitan Electric Supply Co.

The following are the chief considerations which weighed with the Referees in arriving at their decision:—

The electricity companies are working under a concession, viz., a terminable lease. Not only is the lease terminable, however, but the terms of the compulsory purchase provided therein are extremely uncertain, and provide nothing for goodwill. The companies are also working in competition and subject to statutory limitations, obligations, and restrictions, which, due to these and other causes, prevented in the past the forming of adequate reserves for depreciation.

Further, the supply of electricity is an industry newly developed, and the present companies were the pioneers. The industry necessitated a capital expenditure heavier in the first place than in ordinary commercial business, and there is also involved a capital expenditure continuously throughout the whole of its lease in advance of the profitable demand. The pioneer work in developing the industry involved the successive scrapping of plant (which rapidly becomes obsolete owing to new inventions), thus hitherto preventing the providing of adequate reserves. The proper working profits were, therefore, deferred. Moreover, the companies were all originally established as lighting companies in conformity with the Electric Lighting Acts, in which no mention of power for driving machinery is mentioned, and which were framed to deal with lighting only. The supply of electric power was a later development, depending on the invention and perfecting of the electric motor, which has, in fact, become thoroughly efficient only during the last decade or so. The companies, therefore, had to adapt their systems to cope with this now big and growing demand, and in many cases this meant the partial or complete reconstruction of their distributing systems, and the scrapping of a large proportion of their generating plant and, in any case, much larger expenditure of capital in advance of demand.

It was shown very strikingly what a large proportion of the output of many of the electric lighting companies is for power purposes, and, although working under a terminable concession, they are, in effect, practically power companies without enjoying the advantage of perpetual tenure, as in the case of companies working under a Power Act.

Evidence on the above lines was given by Mr. H. B. Renwick, Mr. C. H. Merz, and Sir Harmood Banner.

The thanks of the industry are due to Mr. H. B. Renwick for initiating and organising the appeal, and for establishing, apart from the financial side, the principle that electric supply companies working under statutory obligations, and subject to compulsory purchase, are entitled to special consideration as compared with ordinary traders.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

National Industrial Organisation.

The article published in your issue of the 22nd goes to the root of the matter, and I trust Mr. Looker's outspoken views will be generally endorsed.

Hitherto the public has been apt to view with suspicion any tendency on the part of competing manufacturers to co-operate with each other for any purpose whatever. It has been too readily assumed that a trade association could have but one function, and that a sinister one, viz., to squeeze higher prices out of the consumers of their goods.

Your contributor now shows that the interests of the consumers themselves, and, in fact, those of the entire community, are inseparably bound up with those of the producers.

It is particularly instructive to note that the duty of fostering scientific and industrial research in this country is placed on our *manufacturers*, who are recommended by the Government to work together in these matters through the medium either of their existing trade associations or of new trade associations formed for that specific purpose.

Surely the time is ripe for all our manufacturers to recognise that they cannot hope to survive in the approaching international struggle for the world's trade unless they sink their independence sufficiently to permit of their co-operating with their trade competitors for such purposes as "raising the average standard of production" and increasing the efficiency of their operations by the utilisation of whatever improved materials and processes their co-operative research may reveal.

The need for effective industrial organisation was never more urgent, and I hope the ELECTRICAL REVIEW will continue to exert its influence along the lines it now advocates.

Harry Allcock.

Hale, Cheshire, *December 28th*, 1916.

City and Guilds Examinations.

It should be the duty of every principal, head of department, and teacher at our technical institutions to "read, mark, learn, &c.," the annual report relating to the above, recently published; but we wonder how many will do so.

On more than one occasion you have allowed us to comment on the bad treatment which "Electric Wiremen's Work" (now renamed "Electrical Installation Work") receives at the hands of those in authority at technical institutes. Now this is the fundamental electrical engineering subject; it appeals to all sorts of people besides wiremen, and should, therefore, be taught at more centres than the other electrical subjects, and have a preponderance of students.

From the report we gather the following facts: –

(a) That in session 1915-16, "Electric Wiremen's Work" was taught at only 48 centres, as against 108 centres for "Electrical Engineering," a ratio of 44½ per cent. In 1914-15 the ratio was 48½ per cent.

These figures clearly show that the fundamental subject ("Electrical Installation Work"—to give it its new name) is grossly neglected. In a word, our technical institutes give twice as much attention to the training of officers as to the training of men for the electrical army; even though the cost of equipment in the latter case is far less. We might also infer that when there is any cutting-down to be done, it is the fundamental subject which suffers.

(b) The percentages of those "in attendance" at the classes who got as far as sitting for examination were as follows:—

	1916.	1915.
Electric wiremen's work ...	15 per cent.	23 per cent.
Electrical engineering	28 per cent.	31½ per cent.

Thus, on the average, we have 70 per cent. of the electrical engineering students failing to come up to the examination scratch, and no less than 80 per cent. of the "wiring" students failing likewise. The construction we put on the 70 per cent. is that, in spite of the attraction of well-equipped laboratories, the subject is too far over the heads of the majority. In the case of the 80 per cent., we should say the result was due to inadequate equipment and tuition simply.

(c) The percentages of those who passed to those who sat at the two sets of examinations are as follows:—

	1916.	1915.
Electric wiremen's work ...	51 per cent.	50 per cent.
Electrical engineering	37 per cent.	46½ per cent.

These figures show that in spite of the miserable equipment and poorly-paid teaching vouchsafed to the so-called "Wiring Classes," the examinational results therein are decidedly better than those of the other classes. It is, then, surely worth while giving more attention to these classes. May we not infer, also, from the above figures that many students who are at present pitchforked direct into the electrical engineering course would do better if they had a preliminary grounding in "Electrical Installation Work"?

Very few people, we suppose, are aware that students in a Grade II or Final Class, who find the examination paper beyond them, can take the Grade I paper and obtain the same certificate that they got when in the lower class!

This sort of thing reflects strongly on the quality of the tuition, and depreciates the value of the tabulated results in the official report.

The excellent work being done by Mr. G. Bowron in the electrical workshops at Queen Mary's Convalescent Auxiliary Hospital at Roehampton, London, has attracted much favourable attention, and has been regarded as a novelty; yet it is exactly the sort of work that should have been the regular thing in "Wiring Classes" for years past.

A. P. Lundberg & Sons.

London, N., *December 27th*, 1916.

[We admire our correspondents' enthusiasm on behalf of electrical installation work, though we do not share the view that this is "the fundamental electrical engineering subject." Surely this is an extreme view to take; the manufacture of electrical goods and apparatus is of vastly greater importance in respect of both internal and export trade than the installation of such apparatus, which absorbs only a very small percentage of the cost of construction. Adapting our correspondents' military metaphor, we think they have mistaken the Army Service Corps for the Army itself. We fail to see, too, why the failures of candidates in one case are attributed to quite different causes from the failures in the other; is there not here a suspicion of prejudice? We quite agree as to the excellent work done by Mr. G. Bowron, which we described and illustrated in our issue of October 13th last.—Eds. Elec. Rev.]

WAR ITEMS.

Exports to China.—The "London Gazette" for January 2nd contains a further list of persons to whom exports to China and Siam may be consigned.

Ministry of Munitions and Copper.—The Ministry of Munitions announces that from January 1st no copper will be supplied for the purpose of casting brass or other copper alloy, and no brass or other copper alloy may be cast except for the purposes of Class "A" or Class "B" orders, under the Ministry of Munitions Circular L. 33. A further and lengthy notice respecting the Ministry and copper appears on a later page of this issue.

Controlled Works.—The number of establishments controlled by the Ministry of Munitions is now 4,623.

The Armorduct Co. to be Wound Up.—In the latest list of businesses ordered to be wound up is the following:—

Armorduct Manufacturing Co., Ltd., 6, Farringdon Avenue, London, E.C., electric cable and conduit manufacturers. Controller: John Paterson, 1, Wallbrook, E.C. January 1st, 1917.

Lighting Restrictions: The Lighting of Tramcars.—At Rochdale, on Friday, William Clough, the manager of the Bury Corporation Tramways, was summoned for permitting a lighted external electric lamp to be used on a tramcar belonging to the Bury Corporation on December 17th, at 7.35 p.m. Evidence showed that under the canopy at the front of the car there was an unshaded light. Defendant said it was a 16-c.p. light, and without it passengers using the stairs would be in danger of falling. The lighting of the car was satisfactory to the Bury, Bolton, and County Police, and in Leicester, Sheffield, and Birmingham there had been some relaxation of the lighting order after the attention of the Home Office and Board of Trade had been called to the number of accidents taking place owing to lack of light on the tramcars. The Magistrates' Clerk said it seemed rather absurd that a car should be lighted like that in Bolton, while at Rochdale it must be in darkness. There should be some uniformity about the lighting. The Chief Constable said the Order stated that no light must be visible from outside. Mr. Clough: Consistently with public safety. The Magistrates imposed a fine of 20s.

Exemption Applications.—At the Sheffield Tribunal, in respect of the application of a firm for an electric crane driver, aged 29, married (three children), and passed for general service, the Military Representative pointed out that C 2 and C 3 men could do the work, and that in some instances in Nottingham women were driving cranes. Adjourned to enable the firm to see about badging.

At the Stockton Borough Military Tribunal, Mr. A. E. Forbes, on behalf of the Imperial Tramways Co., Ltd., stated that they had released 421 men for the Army. His application on behalf of two motormen, single, aged 40 and 32 respectively, classed B 3, for conditional exemption was granted.

At Burnley, Mr. H. Mozley, tramway manager, appealed for his cashier and general clerk, aged 30. Out of 17 clerks, 11 had joined the Army, and four had left for other occupations. Training for the position took years. He had 17 clerks, but all were temporary. The case was put back to the end of February.

At Bolton, an electrical engineer appealed for an engineer and wireman, 27, and single. He said the man was the very last he had left. He had let all the others go, and now they wanted the last one. If he had kept the others until they had to go he would probably have been told he could keep so many. Exemption was granted to February 28th, with right of appeal, though it was intimated that the decision would probably be appealed against.

Before the Sevenoaks Rural Tribunal, the Sevenoaks Electricity Co. appealed for Messrs. J. T. Vounsden (32), manager; J. H. Wickenden (27), cable jointer; P. H. Topping (27), engineer; and J. Shaw (29), mechanic. The managing director (Mr. F. R. Reeves) said that the staff had been reduced to a minimum, and to take more men away would cause a stoppage. The applications were made with great reluctance, as the company were quite aware of the country's needs, but they had their obligations. He had been in communication with the Board of Trade, and was informed that workmen would not be taken away unless the company could spare them, electricity, like gas and water, being necessary for the use of the public. Amongst those who had joined up from the staff were the chief engineer and his chief assistant. There were nearly 200 consumers of current in Sevenoaks, and the Government also had a supply. The manager was given conditional exemption, and the others until March 31st.

At Berwick-on-Tweed, the Electric Light Co. appealed for their accountant, Mr. R. Hamilton (34). The manager said they were doing with the minimum number of employés, and women were of no use. They were supplying motive power to several important local factories. Conditional exemption was conceded.

At Sevenoaks, conditional exemption has been granted to Mr. F. G. Humphrey, electrical engineer, from whose works over 30 men have joined up.

At Oxford, Mr. S. A. Stock (24), manager of the electrical engineering business of Mr. E. Storey, defended an appeal by the Military against six months' exemption. The Military Representative said that respondent was passed for general service, and nine months had been allowed to fill his place. Mrs. Storey stated that Mr. Stock was the only man she had to carry on her late husband's business. She had done her best to get another man, and was quite willing to allow Mr. Stock to go if she could get a substitute who was a qualified man. The business could not be carried on without someone who could do the buying, installing, estimating, &c., and she had no income except that from the business. Captain Bailey intimated that it was possible that the Substitution Officer could get a substitute, and the appeal was respited for a month for this to be done.

At Faringdon, Mrs. Butler, of Carswell Manor, asked for conditional exemption for H. R. Jacobs (36), who has charge of the electric light plant, but exemption was refused.

At a sitting of the Surrey Appeal Court, the Military Representative appealed against conditional exemption granted at Godalming to E. Lown (29), electrician to Messrs. Read & Co., of Farncombe, on the ground that he was doing work of national importance. The exemption was revised to three months.

At Barnsley, the Electric Traction Co. appealed for a car-shed foreman (3), a brakesman (39), the parcels superintendent (36), two traffic inspectors (24 and 35), and a tram driver (26). The car-shed foreman, the parcels superintendent, and the eldest traffic inspector were conditionally exempted, and the other appeals were rejected.

At Oxford, the Electric Co., Ltd., appealed for temporary exemption to January 31st for L. J. Hodge (31), electrician, who has been with the company for seven years, and is regarded as indispensable. Hodge, it was stated, did important work, connecting all the cable from the streets to the houses and the power stations. It was dangerous work, to the man, to the buildings, and to the valuable plant at the generating station. A substitute had been obtained and was being trained, but it was impossible to think that he would become efficient in a month. It was intimated that Hodge had been anxious to volunteer for service, and had only been kept back by pressure. The Tribunal allowed until January 31st.

At Chesterfield, a final month has been allowed to a fireman engaged at the refuse destructor works for the T.C. A similar term was previously granted for a substitute to be obtained.

At Barnsley, an appeal was made by Mrs. Burns for the retention of B. Gregory (22), electrician, passed in Class A. Two months were allowed for a substitute to be found.

At Whitby, the Military Representative asked for a review of a certificate of exemption held by H. Frith, electrician with Mr. A. H. Walker, but no alteration was made. The Military Representative said that he should appeal against this decision.

A Brighton firm of electrical engineers, engaged on much hospital work, appealed for a wireman and electrician. The firm stated that it was impossible to replace the man, as those available found they could now start on their own account. Two months were granted.

At Bexhill-on-Sea, Messrs. J. L. French & Co. asked for further time for H. Mullinger (40), manager of the electrical and heating department of the business, and who is continuing on special Government work. Another three months, with the Volunteer condition, were granted.

The West Kent Appeal Court, on December 19th, had before them again the case of Mr. A. Leach, electrical engineer, of Maidstone, referred to in a recent issue of the Electrical Review. Mr. Leach claims having applied for naturalisation in America, and for a passport for that country, and, as the matter is being considered by the Home Office, the case was further adjourned to await the decision.

At Coventry, the Corporation tramway department asked for exemption for five single and 72 married men, owing to the difficulty of obtaining suitable substitutes. The pre-war staff numbered 314, and that number is reduced to 147. It was stated that out of 27 substitutes, 12 had been retained. It was suggested that tramway workers, passed in low categories, who are already in the Army, should be released to replace men now working on the trams, and the Tribunal decided to place all the men claimed on the substitution list.

At Sheffield, Messrs. T. B. & W. Cockayne appealed for the retention of W. Fuller (35), electrical engineer, and exemption to June 30th was conceded.

Messrs. Page & Bloomer appealed, at Stourbridge, for T. White (31), electrician, and three months were allowed.

Worcester Tribunal has granted conditional exemption to F. J. B. Cook (36), the only man left in the electrical department of Messrs. J. Ward, Ltd.

At Weston-super-Mare, the Electric Supply Co., Ltd., appealed for H. Brewer (38), wireman, engaged in installation work. The manager, Mr. G. Charlton, said that if Brewer were taken the installation department could not carry on work. One wireman of higher classification was under orders to serve, and that would leave only two, including Brewer. The Military Representative recommended that the case be adjourned *sine die*, based on the medical category, C 3, and this course was adopted.

At Stockton-on-Tees, on December 28th, the Imperial Tramways Co. appealed for two motormen, aged respectively 40 and 32, and both passed in Class B 3. Mr. A. E. Forbes, for the company, said they had released 421 men for the Army. The Mayor said that the Tribunal were satisfied that the men appealed for would not be of a great deal of service to the Army, and they would be given conditional exemption.

At the Kingston-on-Thames Tribunal, the borough electrical engineer applied for exemption for a stoker, 26 and passed B 1. He said that owing to the scarcity of men he and his chief assistant had several times had to stoke the boilers. The Mayor, evidently willing to serve as a substitute, remarked that it was a "very healthy exercise for you; better even than golf. I would rather shovel coal than knock a golf ball about." Final exemption until Jan. 31st was granted.

Holidays.—The works of Messrs. Bruce Peebles and Co., Ltd., at Edinburgh, reopen to-day, after having been closed from Saturday last for the New Year holidays.

BUSINESS NOTES.

Calendars and Diaries.—The Victa Electrical Co., Ltd., 60, Queen's Road, Battersea, S.W., have issued a plain wall calendar with monthly slips.

From the British Aluminium Co., Ltd., of 109, Queen Victoria Street, London, E.C., we have received a wall calendar with neat monthly date slips at top right-hand corner above an interesting view of the company's Dam at Kinlochleven. On the back of the card is a complete roll of honour of the staff and employés of the company who are, or have been, with the Forces.

Messrs. Pope's Electric Lamp Co., of Hythe Road, Willesden, have issued a calendar with daily slips for 1917. The block is practically surrounded by cartoons of the Elasta funny man and the performances of the Pope Elasta British-made wire lamps.

From Messrs. Haslam & Stretton, Ltd., of Cardiff and Bristol, we have received a wall calendar, with monthly date slips, which will, by means of the picture in colour, "Annabel," brighten our New Year.

We are once more indebted to the Electric Construction Co., Ltd., for one of their very useful pocket diaries. It is a simple and handy vest-pocket engagement book that cannot easily be done without, especially after one has become as used to it as we have.

Messrs. W. H. Wilcox & Co., Ltd., of Southwark Street, S.E., have sent us one of their 1917 Date Remembrancers—a wall calendar with monthly sheets.

Messrs. Toy & Winslow, of Larkhall Rise, Clapham, S.W., have issued a wall calendar for 1917, small monthly date-slips appearing below a study in colour of "Aida." A series of desk-blotter slips has also been received.

The Electric and Engineering Specialities Co., of 79, Great George Street, Liverpool, have issued a wall calendar with monthly slips for 1917. The feature is a woman-worker, executed in colour, who has set down her pails the while she enters into a neighbourly gossip, in which, presumably, she makes a forecast of coming events—"You mark my words!"

The *Chemical Trade Journal* has published a wall calendar, as usual, with large monthly sheets.

To the Langdon-Davies Motor Co. we are again indebted for a pocket memoranda book, the opening pages of which contain a number of useful tables and particulars of the firm's standard sizes and types of motors. An insurance coupon is included.

Our Trade with New Zealand.—The *Board of Trade Journal* contains extracts from a supplementary report by Mr. R. W. Dalton, H.M. Trade Commissioner in New Zealand, in which, while recognising the difficulties under which home manufacturers are at present working, he lays emphasis upon the desirability of such manufacturers appointing agents in New Zealand at once, and warns them against deferring until more normal times the first steps towards the preparation of a selling organisation. Mr. Dalton says that the most important class in which the trade of the United Kingdom is deficient is machinery. In normal times our share of this trade should be larger than it has been. He finds that there is lacking a sufficiently close touch with the special needs of the market in specialised lines different from those in use at home, and an active selling campaign.

Mr. Dalton reports that an agent, whose head office is in Australia, but who travels through the whole of New Zealand once a year, desires to take up the representation in the Dominion of British manufacturers of electric lighting glassware, dry batteries, electric bells and indicators, ceiling roses and fuses, insulators, conduit tubes and fittings, porcelain counterweights, electric fans, lampholders, pocket flash-lamps and lighting switches. Particulars can be obtained at the Board of Trade Department of Commercial Intelligence in London.

An Ediswan Supper.—The staff of the West of England and South Wales Branches of the "Ediswan" Co., at the invitation of the district manager (Mr. F. W. Fifield), partook of supper at "Maxwell's" Restaurant, Bristol, on Tuesday evening, December 19th. Mr. Fifield proposed "The Ediswan Co." and "Bristol and Cardiff Staff," and referred to the continued progress of the company. He expressed the hope that on the occasion of their next happy party the war would be over. The enjoyment of the gathering was added to by the presence of Sergeant Ronald David, who at the time was in Bristol recuperating from wounds sustained in the Somme fight. Sergeant David, who joined the 6th Gloucesters at the outbreak of war, was the manager's chief assistant at Bristol, being transferred from the Cardiff office when the local depôt opened. The members of the staff contributed to the musical programme.

Works Extensions at Preston.—At the last meeting of the Preston Town Council, reference was made to a lease having been obtained by Messrs. Dick, Kerr & Co., Ltd., of a plot of land at the Dock suitable for the erection of new buildings.

Palestine.—We have received from Mr. S. Feingold, of 3, Boulevard de Ramleh, Alexandria, Egypt, some literature respecting Teutonic efforts for trade domination in Palestine before the war, together with particulars of the Anglo-Palestine Commercial Intelligence Agency which he has formed for the purpose of awakening an interest in Great Britain and her dependencies in the prospects of doing business with Palestine after the war. He is anxious to get into touch with British manufacturers issuing export trade catalogues.

For Sale.—The Swansea Harbour Trust is offering for sale some electric motors, &c. Particulars will be found in our advertisements.

Catalogues and Lists.—From Messrs. Noyes Bros. (Melbourne) Pty., Ltd., we have received a fully illustrated brochure, showing electrical installations carried out by them in Australasia.

Messrs. A. J. Greenly & Co., of 37 and 38, Strand, W.C., have published a list of advertisement designs, with a view to giving a more or less definite idea of the cost of various forms of advertising work.

Dearborn Chemical Co., Chicago.—32-page illustrated pamphlet respecting corrosion, incrustation, and foaming in boilers, their causes, and the prevention of same by the use of proper reagents in the water.

Messrs. Cravens' Patent, Ltd., 97 and 99, Corporation Street, Manchester.—24-page price list (illustrated) of many kinds of factory and warehouse trucks, ladders, trolleys, baskets, &c.

International Time-Recording Co., Ltd., 57, City Road, London, E.C.—16-page illustrated pamphlet describing their various time recorders.

Mr. O. N. Beck, 11, Queen Victoria Street, London, E.C.—16-page pamphlet describing the bar and pipe-bending tools of the Wallace Supplies Manufacturing Co., of Chicago, for whom he is sole agent here.

The Arora Co., Loughborough, Leicestershire. New list in a condensed form, arranged for over-printing on the front page, and covering all the goods put on the market to date—electric fires, boiling plate, rapid grill, and hearth stand—all of which can be supplied from stock with no advance in prices.

Bankruptcy Proceedings.—C. B. Ogilvie, electrical engineer, 43, Dudley Road, Whalley Range.—Receiving order made December 22nd on a creditor's petition.

The U.S. Industrial Situation.—In the course of an editorial on "Present Business Conditions," the American *Electrical Review and Western Electrician* (December 9th) contains the following comments on the present and prospective situation :—"In the electrical industry there is no dearth of orders, and business is as active as could be desired. The great difficulty seems to be that manufacturers are unable to secure the necessary raw materials, and consequently cannot show an output sufficient to meet the demand. There is nothing in the present conditions to indicate an early change in the industrial situation. Employment is easy to secure, wages are advancing, the agricultural as well as the manufacturing districts are very prosperous, and the railroads have more business than they can handle. The situation is abnormal and in some respects unsatisfactory, but the volume of production and consumption is unprecedented, and will no doubt continue so until the termination of the European war. Gold is rapidly accumulating in the country and credits are expanding, with the resultant danger of a reversal in these conditions at the close of the war. A rapid contraction of credit invariably involves severe losses and a period of depression."

Hardening Steel.—The Westminster Electrical Testing Laboratory, of York Mansions, York Street, S.W., has sent us a circular, describing the results obtained with the Wild-Barfield process for hardening steel, which is particularly suitable for hardening screw gauges, as it causes no change of dimensions, and scale, while the steel offers remarkable resistance to wear.

Dissolutions and Liquidations.—Home-Morton, Ker, and Gibson, consulting engineers and industrial works designers' Glasgow and London.—Messrs. D. H. Morton, A. Home-Morton, W. A. Ker & G. H. L. Gibson have dissolved partnership. The business will be continued, by all excepting Mr. Ker, as Home-Morton & Gibson. Mr. Ker will carry on business as W. Arthur Ker & Co., at 115, St. Vincent Street, Glasgow. Messrs. Home-Morton & Gibson will attend to debts.

H. Traun & Sons, 25, Goswell Road, London, E.C.—Creditors must send particulars of debts, &c., to the Controller, Mr. J. D. Pattullo, 65, London Wall, E.C., by February 10th.

Isaria, Ltd.—Creditors must send particulars of their claims, &c., to the Controller, Mr. G. S. Pitt, 140, Leadenhall Street, E.C., by January 28th.

Book Notices.—We have received copies of several journals published by Messrs. L. Vaudecrane et Cie., of the Rue Taibout, Paris. One is a recently started weekly paper, *L'Exportateur Francais*, and another is *Le Bureau Moderne*, which has reached its fifth year. Both of them are business-like publications, which should be of interest to those who are concerned, or wish to be, with French home and colonial industrial and commercial affairs.

"Some Modern Methods of Ventilation." By R. Grierson. London : Constable & Co., Ltd. Price 8s. 6d. net.

"Engineering Directory." No. 63. October, 1916. London : Engineering, Ltd.

"Practical Safety Methods and Devices—Manufacturing and Engineering." By G. A. Cowee. London : Geo. Routledge & Sons, Ltd. Price 12s. 6d. net.

Our old friend *Hazell's Annual*, in the thirty-second year of its existence, assumes a somewhat altered appearance, and has changed its parents, for it has now adopted the title "The New Hazell Annual and Almanack" (3s. 6d. net), and has passed under the joint control of the Oxford University Press and Messrs. Hodder and Stoughton. The main characteristic features of the old volume have been preserved in the new, and others have been added, and the volume, which is almost doubled in size, has been given an entirely new setting. The opening 52 pages, following upon a full index, are occupied with calendar and almanac matter, and naturally a great deal of space is devoted to the war (with maps) and matters arising out of it. The recommendations of the Paris Economic Conference are printed, and a whole mine of information appears relating to such matters as the Army and Navy, trade after the war, aviation, Parliament, industries, banking, education, and so forth. The sections on the British Dominions and Colonies and on foreign countries have been entirely rewritten, and embody full statistical information.

"Water Powers of Canada." Ottawa, Canada : Department of the Interior Dominion Water-Power Branch.

"*Proceedings* of the Physical Society of London." Vol. XXIX. Part 1. December 19th, 1916. London : The *Electrician* Printing and Publishing Co., Ltd. Price 4s. net.

Trade Announcements.—The E.S. Co., Ltd., of "The Light House," 233, Tottenham Court Road, London, announces that by an extraordinary resolution of the shareholders the capital of the company has been increased to £10,000. Mr. Vernon H. Wells, electrical engineer, late of Faraday House, Clarke, Chapman & Co., and the Westminster Engineering Co., Ltd., &c., has joined the board of directors, and he took up his duties as from January 1st. Mr. E. Cecil Beman, the founder of the company, remains managing director as heretofore. On the company's premises the latest applications and developments of electric lighting, heating, and power may be seen. The first annual dinner of the company was held at the Horse Shoe Hotel, Tottenham Court Road, on Friday evening, December 22nd, when the whole of the staff and a few friends interested in the company sat down. Mr. E. C. Beman, the managing director, presided, and Mr. V. H. Wells, the new director, was the guest of the evening. Both gentlemen delivered speeches appropriate to the occasion.

The name of the Anglo-Mexican Petroleum Products Co., Ltd., has been altered to the Anglo-Mexican Petroleum Co., Ltd. It will continue to market the products of the Mexican Eagle Oil Co., Ltd., including fuel oils, Diesel oils, lubricating oils, &c.

Messrs. Irwin & Jones, Ltd., of London House, E.C., have been appointed sole agents in the United Kingdom and France for the sale of the "Hunt" storage battery industrial trucks manufactured by the C. W. Hunt Co. (Inc.), of America. The firm will also look after Messrs. Hunt's interests for elevating and conveying coal and general merchandise. Mr. Herbert A. Jones has just returned from an extensive tour in the United States and Canada, where he has been inspecting and studying modern methods of handling and transporting raw materials and finished products.

Fire.—The *Birmingham Daily Post* states that early on the morning of December 28th a serious fire was discovered at the Cable Works, Lydbrook. The generating station was found to be in full blaze, and practically the whole station was gutted before the arrival of the Ross Brigade. Fortunately, the main portions of the buildings were kept intact. The cause of the fire is a mystery. The whole works had been closed from the previous Friday. The damage is estimated at considerably over £1,000.

LIGHTING AND POWER NOTES.

Australia.—In order to augment the electric lighting plant at Barcaldine (Queensland), the Council proposes to install a battery.

The report of the Goulburn (N.S.W.) Municipal Electrical Department for the year 1915-16 shows a total revenue of £4,531, the average price per unit sold being 4·82d. ; private lighting accounted for 102,107 units, realising £2,514 ; street and municipal lighting for 54,218 units and £1,098, and power for 69,992 units and £877. The accounts show a gross profit of £2,200, and after allowing for depreciation, &c., a credit balance of £1,518 is carried forward.

A scheme for the supply of electricity for lighting and power to Lilydale (Vic.) was considered at a meeting of ratepayers recently ; the proposal is to utilise the river near Yarra Junction, from which sufficient power can be generated to supply the whole of the route (about 16 miles) with light and power, while probably many orchardists and agriculturists will become users of this cheap means of irrigation. The Lilydale Shire Council is to be asked to investigate the possibilities, and to approach the Upper Yarra Shire Council to co-operate. If the scheme outlined be carried on, Lilydale, Healesville, and Warburton, besides the smaller settlements on the line, could be adequately supplied.

The sanction of the ratepayers of the Moonta (S.A.) Council has been obtained to the borrowing of £4,000 for an electric light scheme. For more than 30 years the Y.P. Gas Co. has supplied coal gas to the business and private residences, but the price of the illuminant (15s. per 1,000 ft.) has not given satisfaction, and the ratepayers in business centres in many instances installed acetylene plants of their own.

A loan has been arranged by the Strathalbyn (S.A.) Council for the installation of electric light ; it is proposed to obtain a second-hand plant from Melbourne.

The Yarram (Vic.) butter factory has given an option to Mr. V. J. Crowley on the whole of its electrical plant, which at present supplies power to the factory and for lighting the town, with the object of installing a hydro-electric scheme. A company has been formed with a capital of £10,000 for the purpose of carrying out the scheme.—*Commonwealth Engineer*.

The annual report of the Fremantle (W.A.) Municipal Tramways and Electric Lighting Board for the year ended August 31st last shows a gross profit of £17,000 being an increase of £574 on the previous year's working. The total income amounted to £63,113; the working expenses were £46,118. After providing for interest on loans there was a net balance of £10,640. The amount to the credit of depreciation reserve account at August 31st, 1915, was £22,613, to which a sum of £6,469 has been added.

By entering into an agreement with the Government for the supply of electricity for a period of 25 years, the Board has secured the right of supply within a 5-mile radius of Fremantle Town Hall; when the arrangements for the taking the new supply are completed the Board's power house will be closed down, and the capital cost of the plant, less residual value, will require to be written off against depreciation account. Land has been acquired for a sub-station building, and the necessary machinery and appliances will be installed, and this expenditure will be financed out of depreciation funds. A general rearrangement of the distributing mains will also be necessary, and all motors will require either rewinding or replacing.—*Commonwealth Engineer.*

Barnsley.—BULK SUPPLY.—The Corporation has given formal notice that it is making application to the B. of T., as the undertakers under the Barnsley Electric Lighting Order, 1890, for an Order permitting it to supply electricity in bulk to the Electrical Distribution of Yorkshire, Ltd.

Birmingham.—Councillors Beale and Appleby, two new members of the Electricity Committee, have been asked to inquire fully into recent failures in electricity supply and to present an independent report to the Council.

Bispham-with-Norbreck.—The Electricity Committee of the Urban District Council has decided that in future the charge for electricity for power purposes shall be 2d. per unit for the first 200 units per H.P. installed.

Canada.—NIAGARA POWER.—A meeting of the Ontario Hydro-Electric Radial Railway Association, at Toronto, recently passed a resolution calling on the Ontario Government to permit the Hydro-Electric Commission to expropriate the plant or product of the Canadian Niagara Power Co. and others developing power at the Falls. Sir Adam Beck stated that when the Chippawa development was completed energy will cost $7·5 per H.P.-year; he disagreed that Buffalo was being deprived of power, stating that the agitation was for the purpose of compelling the U.S. War Department to hand over an additional 4,000 cb. ft. per second of water from Niagara River.

Derby.—PROPOSED LOAN.—The Electricity Committee has recommended application for sanction to a loan of £34,000 for a 2,000-KW. turbine, rotary converter, boiler, economiser, &c., and works extensions.

Ealing.—YEAR'S WORKING.—The Council's electricity undertaking made a loss of £3,038 last year, after meeting financial payments of over £10,000. Coal cost increased by £2,459, rates by £667, insurance by £177 wages, bonuses, &c. by £775, making a total of £4,000; on the other hand, it was estimated that but for the war £3,000 extra revenue would have accrued, and the profit would have been £4,000. After meeting the loss out of reserve, the latter stands at £13,000.

Edinburgh.—YEAR'S WORKING.—During the year ended May 15th 1916, the Corporation electricity undertaking had a total revenue of £139,136, working expenses amounted to £79,477, and the gross balance was £59,659 resulting, after meeting interest and loan payments, in a deficit of £8,075 on the year. We note that the bulk of the revenue is credited to private lighting at the low war-time figure of 2½d per unit, less discounts, and, after meeting the above deficit, the reserve fund stands at £102,183. During the year 17,373,558 units were sold, or rather less than in the previous year; private lighting accounted for 9,573,928, and power for 7,216,379 units.

Glasgow.—The Secretary for Scotland has now sanctioned the borrowing by the T.C. of a further £500,000 for electricity extensions, raising the authorised borrowing powers to £3,000,000. A licence has also been granted to proceed with the erection of buildings at the new Dalmarnock power-house site.

The Electricity Committee has recommended a contribution of £50 towards the expenses of the action pending between the Hackney B.C. and Gas Light and Coke Co. in regard to alleged preferential charges. The chief engineer has been authorised to furnish any available information to the Committees dealing with the question of interlinking electric supplies.

Halifax.—PUBLIC LIGHTING.—The Tramways and Electricity Committee has completed arrangements with the Luddenden Foot U.D.C. for supplying electricity in connection with public lighting within the district.

Hebden Bridge.—SUGGESTED BULK SUPPLY.—Inquiries are to be made of the Yorkshire Electric Power Co. and the Halifax Corporation as to terms for a bulk supply, also of Messrs. Willans & Robinson as to the price and time of delivery of an oil engine of equal power to that at present on the works.

Owing to increased costs of production, the Electricity Committee has decided that prices for electricity must be increased as from January 1st, 1917. Lighting charges are advanced 20 per cent., and power prices 25 per cent.; this is the first advance at Hebden Bridge since the war broke out.

HYDRO-ELECTRIC PLANT.—A small hydro-electric plant, utilising a fall of about 500 ft., has been installed in connection with the Old Town Mills. The plant is about half a mile from the mill, from which it is controlled electrically: it consists of a Pelton wheel running at 600 R.P.M., supplied by Messrs. Gilbert Gilkes, and fitted with a shaft governor, which, we gather, shuts off the water by a deflector, in case of accident, in a fraction of a second. In addition, needle control in the nozzle adjusts the water to the power requirements independently of the deflector, thus saving water. The electrical equipment was supplied by the General Electric Co., and consists of a 500-550-volt generator, supplying energy by an overhead line to a 630-R.P.M. motor, which drives the mill shafting through a Renold chain drive. The distant control consists of a hydraulic sluice operated by the piston of a hydraulic cylinder, the water supply to which is controlled by a magnet-operated four-way valve. The magnets are energised from accumulators, and electrically connected to the mill by wires on the overhead line, which also carries telephone and lighting wires. The installation was carried out by Messrs. Gilbert Gilkes and Co.

Hereford.—LOAN APPLICATION.—The T.C. has applied to the L.G.B. for sanction to a loan of £63,309, instead of £45,000, as orginally asked for, to meet the cost of installing additional generating and transmission plant.

High Wycombe.—PUBLIC LIGHTING.—The Electricity Co. having declined to modify the terms in settlement of its outstanding claim for public lighting—a payment of £100 per quarter, with an undertaking to renew the contract for seven years upon the expiration of the existing contract—the T.C. has decided not to extend the contract at the present time.

Holme.—The electricity company's balance-sheet for the past year shows that, after allowing £76 for depreciation of plant, there was a profit of £32. A dividend of 3 per cent. has been declared, and a balance of £25 carried forward.

Kirkcaldy.—EXTENSIONS REPORT.—Sir John Snell, in a report on the question of plant extensions, recommends that the existing station should be remodelled, the extensions to be spread over 10 years, at a cost of £61,300. An alternative proposal is that the Fife Electric Power Co. should acquire the existing station at, roughly, £38,000, to be paid within two years after the war, and supply in bulk for the Corporation's requirements.

Llandudno.—PROPOSED BATTERY.—A statement has been presented to the U.D.C. showing the profit or loss on the electricity undertaking from the time current was first supplied to the Light Railway Co. for traction purposes. The Council attributes the loss on working to the fact that no battery for small loads has been available. The electrical engineer has been requested to report fully on the question of providing a battery. The L.G.B. is also to be asked to authorise the necessary capital expenditure and the borrowing of the money.

New Zealand.—The report of the Christchurch Municipal Electric Lighting Department for the year ended March 31st, 1916, shows that there were 2,935 consumers, as against 1,623 in 1914-15, whilst the units sold were 2,260,672, as against 1,375,738.

The electricity department of the Gisborne B.C. in its annual report shows expenses totalling £9,623, against a total revenue of £10,515, leaving a balance to carry forward of £892. The generating plant comprises three 150-H.P. Diesel engines, but it is being extended by the installation of a steam plant—Babcock & Wilcox boilers and Belliss & Morcom triple-expansion condensing engines of 500 H.P. A hydro-electric scheme is also under consideration. The number of consumers is now 1,150. The tramway revenue amounted to £2,064 and the expenditure to £2,190; the tramway debit balance at date of accounts was £444. The cars are of the storage battery type.

The year's working of the Wellington Corporation Electricity Department shows a net credit balance of £10,558. The revenue from power supply and public lighting amounted to £12,763 (power £9,472, public lighting £3,291). The H.P. of motors connected at the power station was 4,058, and the average revenue per unit sold for power 1·99d. The revenue from private lighting was £67,623, and the H.P. of motors connected to electric lighting station 1,504.—*Commonwealth Engineer.*

The ratepayers of Tauranga have voted in favour of the Council borrowing £4,600 in connection with the completion of the electric lighting scheme.

Richmond-on-Thames.—The Guardians have approved of an increase of 20 per cent. in the charges of the Electric Light and Power Co. for power and heating as from the termination of the present quarter.

Shilton.—The Council has refused an offer to light 20 street lamps electrically at £2 per lamp for six months, and has adopted a scheme for using oil lamps.

South Africa.—For the quarter ended September 30th the working of the Cape Town Municipal Electricity Department resulted in a falling off in revenue, although a considerable increase in sales of energy occurred. Of 277,475 extra units sold, 275,809 were sold for power, the additional revenue from which was only £778, while during the same period the temporary closing of certain premises and the introduction of half-watt lamps resulted in a decreased lighting revenue. For the whole year it is estimated that the profit will be decreased by £3,500.—*S.A. Mining Journal.*

A hydro-electric plant of 110-KW. capacity has recently been constructed and put into operation at the mine of the Pigg's Peak Development Co. in Swaziland. Most of the equipment has been lying in disuse at this old Swaziland mine for some years, and the addition of this plant is likely to prove of service in increasing the gold output of the mine.

Stoke-on-Trent.—Cooking Rates.—With reference to electricity for cooking, the T.C. has decided that where domestic consumers are prepared to guarantee a miniumum consumption of £4 per annum. energy in excess of this amount shall be charged at ¼d. per unit.

Tasmania.—Hydro-Electric Report.—In his second annual report on the State Hydro-Electric Department, the chief engineer and general manager (Mr. J. H. Butters) states that the contract entered into with the Electrolytic Zinc Co. of Australasia, Ltd., is the first step towards a revolution in the industrial life of the State, and is, he firmly believes, the forerunner of many large industrial enterprises in Tasmania which will require a large amount of hydro-electric power. In view of the contracts which have been entered into, and the contracts which are in negotiation, viz., with the Mount Lyell Co., the Launceston Municipal Council, and others, it has become essential to form some idea of the State's water power. A commencement has been made in this direction during the financial year; rain and snow gauges have been established throughout the Great Lake and Ouse detachment areas, and means of measurement of all the water passing the dam at the Great Lake has been established. Preliminary investigations are being made at Arthur's Lakes, Lake St. Clair, the river Derwent, and the Franklin River. The report states that the impression seems to exist that the Great Lake scheme is entirely a Southern one; that the Arthur's Lakes scheme, if proved, and when developed, will be for the North, whilst the Lake St. Clair scheme will be for the West. This is quite erroneous, as all the schemes on the central plateau would be interconnected. From conservative information available, says the report, it has been established that 70,000 H.P. can be developed from the Great Lake scheme after the Ouse diversion has been effected; but the policy of the Department would be not to load this scheme up to its full capacity until a number of years' readings have been obtained of actual discharge through the Great Lake sluiceways, and rather to recommend the development of one of the other schemes, which, in its turn, would be loaded up to, approximately, three-fourths of its calculated capacity, and so on; this Mr. Butters considers will conduce to the most satisfactory working.

The contracts which have already been secured will load up the southern line, and further large contracts will necessitate the building of additional transmission lines. The Department will induce manufacturers to establish in divergent centres such as Launceston and the West Coast, in order that the benefits of hydro-electricity may be distributed throughout the State, but the deciding factor in settling the site will be the manufacturers themselves.

Mr. Butters points out that the industries which will be likely to establish themselves in Tasmania are ones whose electric power costs represent a large proportion of their total annual costs, and which require a very large amount of electrical energy, which makes the power costs the most important factor of their operations—such as the electrochemical and electrometallurgical industries. This may be emphasised when it is noted that the whole of the requirements of the City of Hobart and its suburbs at the present moment amounts to less than 2,000 H.P., while one contract alone for an electrometallurgical industry will require 30,000 H.P. These electrochemical and metallurgical industries (*i.e.*, the primary industries) will be the first fruits of the hydro-electric investment, and they, in their turn, will induce a large growth in existing secondary industries, and also the establishment of additional secondary industries, &c.; these secondary industries, however, will neither require nor expect electric energy at prices much below what can obtained on the mainland; in fact, it may be stated that there are few secondary industries whose principal market is outside Tasmania, which would come here even if power were supplied free, as the extra shipping and marketing charges would more than outweigh this concession. The prosperity of the State, therefore, clearly depends upon being able to induce large primary industries to establish themselves.

Taunton.—Staff Supply.—The Electricity Committee recommends that the electrical engineer should in future have 2,000 units without charge, and be charged ½d. per unit for additional supply to his residence, which, by arrangement, was equipped with domestic electric appliances for light, heat, cooking and hot water supply, to provide facilities for inspection to prospective consumers, and to obtain data; the last year's consumption for all purposes was 5,757 units. The Committee has also decided to extend to any of its workmen an existing arrangement for supplying them at 1d. per unit, flat rate, on the understanding that on failures of the light such men should immediately report for breakdown duty.

Willesden.—Loan Sanction:—The Council has recently received sanction from the L.G.B. to raise £5,000 to cover the cost of laying a new direct-current feeder in order to meet the growing demand of local factories; this, together with recent sanctions for other extensions, will represent over £10,000 spent on developments of this kind.

Worthing.—Price Increase.—There will probably be a deficit at the end of next March (including the debit balance of £416 brought forward) of £1,984. An increase of 20 per cent. on the present charges during the next quarter would, if put into operation at once, reduce this deficiency by approximately £350, and it would also largely meet any deficiency in the coming year, assuming the war continues so long; and the Committee has accordingly recommended a further increase from 10 to 30 per cent. on the pre-war charges, with the exception of supplies registered by slot meters. It was stated that had the year been normal, the undertaking would have shown a profit of from £1,500 to £1,600.

TRAMWAY and RAILWAY NOTES.

Belfast.—Since Mr. Moffet, the new manager, assumed charge of the tramways he has instituted some beneficial changes. Amongst these is the much-needed electrically lighted numbering of the cars for showing the direction in which they are going. Although every car has been fitted with coloured lights for the past eight years, no attempt was made to utilise them as way-direction lights.

Blackburn.—The traffic returns for the Corporation Tramways for the week ended December 27th show that 240,897 passengers were carried, the number a year ago being 237,306. The receipts amounted to £1,252, an increase of £20 compared with last year.

Blackpool.—Traffic Returns.—Mr. Charles Furness, general manager of the Corporation Tramways, reports that the month's receipts were £2,599, an increase of £133 compared with the same period last year. Passengers showed an increase of 76,947. From April 1st to December 14th the receipts were £81,105, an increase of £13,856 compared with the same period last year. The receipts during the whole of 1913, which were a record, amounted to £84,000: passengers this year show an increase of 2,780,094.

Bradford.—Tramway *v.* Railway Fares.—In connection with the new railway fares and reduction of facilities, a few interesting comparisons have been made at Bradford between the suburban railway service, under the new conditions, and the tramway service. The figures indicate the prospect of a heavy increase in tramway patronage, at the expense of the railways. Practically every place served by the railways around Bradford, and many which are not so served, are served by the tramways. Amongst some of the most startling comparative figures are the return fares for Thornton, railway 1s. 3d., tramway 4d.; Bingley, 1s. 4½d. and 6d.; Queensbury or Stanningley, 1s. and 6d. In regard to the linking-up of the city with other towns, the return fare by railway between Bradford and Leeds will be 2s. 3d., as against 1s. by car; Halifax, 2s., as against 1s.; Huddersfield (which has hitherto shown practically no advantage by tramway, owing to the circuitous route), 3s. 1½d., as against 2s. through, or 10d. by going *via* Brighouse, and walking to the Fartown terminus of the Huddersfield system.

Traffic Returns.—The receipts of the Corporation Tramways for the 267 days of the current tramway year show an increase of over £10,000 on the corresponding period of the previous 12 months—£261,326 compared with £251,258.

Continental.—Italy.—Messrs. Aroedi, Grippa & Co., of Milan, have submitted a scheme to the Italian Ministry of Public Works for the electrification of the secondary and complementary railways of Sicily. The electrification embraces 11 secondary lines, with two branches, serving 25 towns and cities, and seven complementary lines, with two branches, serving 28 towns and cities. The consumption, at present, of coal on all these lines is 70,000 tons, worth 3,500,000 pesetas, and a saving will be effected of 1,000,000 pesetas when the network is electrified. It is intended to use single-phase current at 11,000 volts pressure. The distribution will be made from a transforming and converting station at Nicosta, which will be fed from the central station of the Società Elettrica della Sicilia Orientale. The distribution will be made at 50,000 volts from 14 sub-stations, where the pressure will be stepped down to 11,000 volts.—*Industria e Invenciones.*

Edinburgh.—Tramway Purchase.—The City Tramways Committee has recommended the acceptance of the Tramway Co.'s offer to sell the rolling stock, cables, and other plant to the Corporation for £50,000.

A Sub-Committee has been appointed to inquire into the present or prospective need for additional transport facilities between Edinburgh and South Queensferry, and as to what assistance would be given to the Corporation in the event of the facilities being provided.

Glasgow.—The valuation of the tramway undertaking by the Assessor of Railways and Canals for the year 1917-18 was reported to be £275,896, as against £269,087 for the previous year.

Mr. Dalrymple, the general manager of the Corporation Tramways, has addressed a memorandum to the traffic staff, in which he makes suggestions for the avoidance of accidents, which have been somewhat frequent recently.

Halifax.—The queue system of loading tramcars, and methods of maintaining order in loading and unloading usually associated with that system, are to be adopted early in the year. At first the adoption will be partial, and it will be extended to all routes as the passengers become accustomed to it.

Ilkeston.—Tramway Sale.—The Notts. and Derbyshire Tramways Co. is asking for Parliamentary powers to take over the Corporation Tramways undertaking at an agreed price of £28,150, to be paid in instalments. The transfer would take effect as from September 30th last.

Leicester.—Fare Increase.—Owing to the additional expenditure required during the ensuing year, the Tramways Committee has found it necessary to increase the revenue, and has decided to fix a 1½d. fare for the full journey on all the tramway routes, with a 1d. stage on each route, and also to increase the fare for children to 1d.

London.—On Boxing Day, owing to an exceptionally high tide in the Thames, the railway in the vicinity of Kew Bridge was submerged, and the electric trains were for a time held up.

Cooking Installation.—According to the *Engineer*, the companies associated with the London Electric Railways have converted a building at Earl's Court Station into a club for their women employés, who number over 4,000, and have provided an electric cooking plant consisting of four baking ovens, a large boiler and steamer, boiling plates, grills, &c., for cooking 200 meals.

Luton.—Accident.—On December 28th last, a Luton car, descending a hill, left the track, and was wrecked against a bank, two persons being badly injured.

Newcastle.—In reply to complaints as to irregular tramway services, Mr. Hatton, the manager of the Corporation tramways, has submitted a statement showing that, despite the difficulties of the present situation, the passengers per week now number 1,509,000, as compared with 1,180,000 before the war; that during the war 696 new motormen and auxiliary motormen, 201 youths, and 528 women had been trained to fill vacancies, and that the engineering and maintenance staffs had been considerably depleted. The overhead construction had been well looked after, but the track could not be properly repaired. Many interruptions were due to slight defects in equipment, collisions due to inexperienced driving, overloading, and lack of lighting. It was surprising that they had done so well under the circumstances.

New Zealand.—The annual report of the Wellington Corporation tramway department for the year ended March 31st last records a total revenue of £187,864, as compared with £167,331 for 1914-15, and a net credit balance of £21,474. The car-mileage was 2,784,402 as compared with 2,521,692, and the passengers carried were 28,687,773 as compared with 25,517,515. During the year, 10 double saloon passenger and 1 freight car have been constructed, the rolling stock now numbering 112 vehicles; provision has been made to build and equip another 10 large cars during the present year. In view of the small margin of generating plant available for meeting emergencies, provision has been made in this year's estimates for the purchase of a 1,000-kw. mixed-pressure, geared turbine set. The average revenue per car-mile was 15·76d., the average working expenses 10·24d., and the average total expenses 13·86d.—*Commonwealth Engineer.*

Oldham.—Lost Mileage.—At a meeting of the Tramways Committee held on Thursday, December 28th, it was reported that 900 car-miles had been lost on the system during the past week through the fog and 520 car-miles were lost through snow.

Salford.—The Corporation Tramways Committee has agreed that the claim for time and a-half pay for Sunday labour shall be dealt with by the Committee on Production.

South Africa.—Electrification of Railways.—The South African Railway Administration has under consideration the question of electrifying certain sections of the railway system. Sir William Hoy, the general manager, in a letter addressed to the Durban Town Council, states that in all probability consulting engineers will shortly be invited to South Africa to report upon a scheme which has already been drawn up. Some years ago a scheme was proposed to construct an electric railway between Johannesburg and Pretoria, and it would seem that from the point of view of possible traffic, both passenger and freight, the time is ripe for the revival of this scheme. Apart from uniting the two towns, and developing the intervening district, it would furnish an admirable and practical solution to the problem of finding work, not only for South African soldiers who are even now returning from G.E.A., but also for the great mass of industrial workers who are likely to be thrown out of work at the close of the war.

The original promoter of this electric scheme was Dr. William Macdonald, who, with the then Mayors of Johannesburg and Pretoria (Mr. H. J. Hofmeyer and Sir Johannes van Boeschoten), proposed a route some 10 miles shorter than the existing steam line to Pretoria. The cost was estimated at £400,000, and it was then affirmed by the S.A.R. Administration that the profits were likely to be so large that the new railway would more than pay for the possible loss on the old route. The capital required to construct this line was offered by more than one private firm, who saw the enormous potentialities of such a line. Power was offered, it is understood, by the Victoria Falls E.P. Co., and the then general manager of the S.A.R. was heartily in favour of the scheme.

The scheme was shelved in consequence of opposition from the outset by certain Cape members of the Cabinet at that period, who did not look with favour upon the linking-up and closer union of Pretoria with Johannesburg.

TELEGRAPH and TELEPHONE NOTES.

Breaking Insulators.—On December 27th, seven youths were fined 15s. each for throwing stones at telegraph insulators at Habergham Eaves. Mr. J. H. Callis, of the Sectional Engineers' Office, Blackburn, stated that no fewer than 300 insulators had been broken at this particular section in 1916.

At a Children's Court at Preston, on Monday, five young boys were fined for stone-throwing at insulators. It was stated that in Cadley Lane, Fulwood, alone, 150 insulators had been broken, and on one section £400 damage had been done to insulators during the past nine months.

Iceland.—The Great Northern Telegraph Co. of Denmark announces that its rates have been reduced to Iceland and the Faroe Islands to 4d. and 3d. per word respectively.

Spain.—The new postal headquarters at Madrid is to be equipped with wireless telegraph and telephone apparatus of the latest models. The transmitter will be of the same type as that which made possible the transmission of the human voice from New York to Honolulu and Paris. The antenna will be carried by four iron posts mounted on towers on the top of the building. From the central tower, 90 metres high, wires will be led to the other three posts, two at the front of the building and the other in the rear. The receiving apparatus will include some type of telephonic relay, enabling the intensity of the feeble current received to be amplified 500 times.—*Industria e Invenciones.*

United States.—A Bill forbidding foreign ownership of wireless stations within the United States is being prepared.—*The Times.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—Feb. 19th. Municipal Council. Meters, maximum-demand indicators, feeder regulators. Specification from E.L. Department, Town Hall.

January 22nd. Deputy P.M.G. Nine electrically-controlled clocks for Newtown Post Office.*

Perth.—January 10th. P.M.G.'s Department. Telephone instruments and parts. See "Official Notices" December 15th.

Melbourne.—January 31st. Department of the Navy. Dynamos, switchboard, motors, balancers, and control gear, for Flinders Naval Base. Specifications from the Director of Naval Contracts, Melbourne.*

March 5th. Council. One 7,500-k.v.a. turbo-alternator. See "Official Notices" to-day.

Bootle.—Corporation. Tramway rails. See "Official Notices" December 29th.

Glasgow.—The chief engineer of the Corporation Electricity Department has been authorised to obtain tenders for the supply of one 6,000-kw. turbo-generator set to meet the demands of the winter of 1917-18.

New Zealand.—Tauranga.—February 12th. Borough Council. Supply of six three-phase transformers, 11,000-400 volts. Messrs. H. W. Clime & Sons, Consulting Engineers, Raetihi.—*N.Z. Shipping and Commerce.*

South Africa.—Durban.—February 12th. Six four-ton electric travelling portable jib-cranes for the harbour.*

Spain.—Tenders have lately been invited by the municipal authorities of Caceres (Province of Caceres) for the concession for the electric lighting of the town during a period of 15 years. The municipal authorities of Torroella de Montgri (Province of Gerona) have also lately invited tenders for the electric lighting of the town.

West Ham.—January 11th. Corporation. One water-tube boiler, one 3,000-kw. turbo-alternator. See "Official Notices" December 29th.

Wigan.—January 8th. Tramways Committee. 30-h.p. motor tower-wagon. Mr. Frank Buckley, General Manager, Market Place.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Aberdeen.—Corporation Tramways Committee. Four electric motors for cars: British Thomson-Houston Co., Ltd.

Aldershot.—On the recommendation of the B. of T., the U.D.C. has renewed a contract for 1,200 tons of small coal for the electricity works, at £1 3s. 6d. per ton.

Glasgow.—The Statute Labour Committee has accepted the offer (£132) by Messrs. Wm. Anderson, Ltd., for additional wiring at the harbour tunnel.

Messrs. Wm. McGeogh & Co., Ltd., have secured the contract to supply the electrical materials to the T.C. Cleansing Department for the next six months.

Salford.—Gas Committee. Accepted tender:—12-H.P. electric motor: Messrs. Mather & Platt, £123.

The Electricity Committee has accepted the offer of Mr. J. Heaton for 2,500 tons of Tyldesley No. 1 slack coal under the conditions of the existing contract (approximately £2,333).

The General Purposes Committee has considered the contract entered into with Messrs. E. M. Evans & Son for the maintenance of the intercommunication telephone system for the Finance Committee, and has recommended the Council to agree to the payment of an increase of 20 per cent. in respect of the same, the Council reserving the right to reconsider the matter on the termination of the war, should such event take place prior to the termination of the contract.

Surbiton.—U.D.C. Two electrically-propelled dust vans: Edison Accumulators, Ltd., £1,025 each.

FORTHCOMING EVENTS.

Institution of Post Office Electrical Engineers (London Centre).—Monday, January 8th. At 6 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Paper on "The Story of the Keyboard Perforator," by Mr. H. H. Harrison.

Liverpool Engineering Society.—Tuesday, January 9th. At the Royal Institution, Colquitt Street. Paper on "Screw-Measuring Apparatus," by Mr. A. Brooker.

Institution of Civil Engineers.—Tuesday, January 9th. At 5.30 p.m. At Great George Street, S.W. Paper on "Recent Progress in Dredging Machinery," by Mr. W. Brown.

Association of Engineers-in-Charge.—Wednesday, January 10th. At 8 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "The Design and Construction of Industrial Premises," by Mr. A. Alban H. Scott.

Greenock Electrical Society.—Thursday, January 11th. At 7.45 p.m. At 22, West Stewart Street. Paper on "Factory Installations," by Mr. R. T. Paterson.

Institution of Electrical Engineers.—Thursday, January 11th. At 8 p.m. At Victoria Embankment, W.C. Paper on "Principles Involved in Computing the Depreciation of Plant," by Mr. F. Gill and Mr. W. W. Cook.

(**Scottish Local Section**).—Tuesday, January 9th. At 7 p.m. At Princes Street Station Hotel, Edinburgh. Paper by Messrs. Gill and Cook.

(**Yorkshire Local Section**).—Wednesday, January 10th. At 7 p.m. At the Philosophical Hall, Leeds. Ordinary general meeting.

THE MINISTRY OF MUNITIONS AND COPPER.

THE Minister of Munitions has issued the following Notices and Orders, dated January 1st, respecting copper supplies:—

1. He hereby takes possession as from the date hereof until further notice upon the terms specified in the Schedule hereto of all unwrought copper, including copper scrap and swarf, in any form whatsoever subject to the following exceptions:

(*a*) Rough copper, copper ore and copper scrap, and swarf, in the possession of, or due under an existing contract in writing for future delivery to, a smelter or refiner for the purpose of conversion into refined metal.

(*b*) All copper, including copper scrap and swarf, in the possession of or due under an existing contract in writing for future delivery to a manufacturer for use in such manufacturer's own works.

(*c*) Copper scrap and swarf specially excepted under the written authority of the Minister of Munitions.

2. If any person having control of any metal to which this notice applies without the consent of the Minister of Munitions sells, removes or secretes it, or deals with it in any way contrary to any conditions imposed in any licence or permit that may have been granted in respect thereof, he will be guilty of an offence against the Defence of the Realm (Consolidation) Regulations, 1914.

3. All existing licences issued by or on behalf of the Minister of Munitions for dealing in any scrap or swarf to which this notice applies are hereby cancelled.

4. The Minister of Munitions hereby requires every smelter or refiner to make a return to the Director of Materials at the end of each calendar month, including the month of December, 1916, of the total quantities of refined copper of each description in stock, distinguishing between (1) that sold for use on Class "A" or Class "B" work; (2) that allocated for such use in his own works; and (3) the residue not so sold or allocated. And he further requires every maker and holder of copper scrap or swarf to make a return to the Director of Materials at the end of each calendar month, including the month of December, 1916, of the total quantities of each class of such scrap or swarf in stock, distinguishing between (1) that sold for use on Class "A" or Class "B" work, (2) that allocated for such use in his own works, and (3) the residue not so sold or allocated.

5. All applications with regard to this Order should be addressed to—

The Director of Materials, A.M.2.B.,
Armament Buildings,
Whitehall Place,
London, S.W.,

and marked "Copper Permit."

The before-mentioned Schedule referred to:

(*a*) Copper included in the Returns made in accordance with Clause (2), Sections (*a*), (*b*) and (*c*) of the Order made on December 8th, 1916, and taken over under the above Order (except copper due for future delivery on sliding-scale terms) will be paid for on delivery by the Minister of Munitions on the basis of the value as indicated by the average of the official quotations of the London Metal Exchange for the last 15 days of December, 1916.

Copper due for future delivery on sliding-scale terms will be paid for at not more than 10s. per ton of metal over the original full contract terms, including all discounts, commissions, or rebates of any sort.

Special circumstances in connection with any copper taken over may be taken into consideration by the Minister.

(*b*) A Price Schedule for copper scrap and swarf based downwards on the quotation for electrolytic copper as a standard will be drawn up by the Director of Materials for the purpose of the taking over of stocks under the above Order, and as a basis for future transactions.

(*c*) The quantities of refined copper specified in the returns of smelters or refiners under Clause (4) of the above Order and not sold or allocated as therein mentioned, will be paid for on delivery by the Minister at the average of the relative official quotations of the London Metal Exchange for the month in question.

(*d*) The scrap and swarf specified in the returns by makers and holders under Clause (4) of the above Order and not sold or allocated as therein mentioned will be paid for on delivery as may be directed by the Minister on the basis of the average of the quotations for electrolytic copper for the month in question, subject to any adjustments for quality that may be necessary.

(*e*) In all cases where two prices are quoted for the same description of copper by the London Metal Exchange, the price paid by the Minister, if based thereon, will be the mean of the two prices, and all prices paid by the Minister will be net per ton delivered c.i.f. U.K. port if imported from abroad, or free on rail at the producers' works if made in England, or equal thereto.

NOTES.

An Electrical Trap.—A Cape Town firm missed a number of brass fittings from fire extinguishers, but could not trace the thief. A powerful electric charge was therefore applied to certain apparatus. Subsequently one of the firm's employés—a coloured man named Michael Brown—was found to have received a severe shock, and without saying anything to him about the matter the firm informed the police, with the result that Brown, who had nothing to say, was found guilty, and was ordered to pay £5 fine, or to do one month's hard labour.

Flash-lamps without Batteries.—The great convenience of portable and pocket "flash-lamps" is discounted to quite a considerable degree by the short life of the dry cells generally employed. A practicable flash-lamp without a battery—either primary or secondary—sounds almost too good to be true, yet, according to *L'Industrie Electrique*, the feat has been accomplished in Germany by utilising a tiny magneto-generator driven by a spring and clockwork. The mechanism is provided with an escapement which ensures constant speed of revolution for the generator armature, and hence constant voltage. Apart from the advantage of these lamps in service, they can, of course, be kept in stock indefinitely without deterioration, whereas so-called dry cells only work when they are moist, and are rarely worth much three months after they are made. There is no doubt that a clockwork mechanism can develop sufficient power to light a small lamp. The ordinary flashlamp bulb generally requires 0·15 ampere at 3 volts—*i.e.*, less than ½ watt. A man working a crank can develop 100 watts easily, and he can store sufficient energy to light a half-watt lamp for some time in a spring which can be wound up by his fingers. Our contemporary is certain that French manufacturers will take up promptly this interesting innovation, which has so many useful applications. Nothing is said about the initial cost of the apparatus, which must be much greater than that of the battery lamp; but by manufacturing in great quantities it should be possible to bring it down to reasonable limits.

Low Wages of Women Electrical Workers.—The *Times* recently reported Miss Mary Macarthur, hon. general secretary of the National Federation of Women Workers, as saying that "in electrical engineering . . . there are women earning very small wages. . . . Last week a girl of 19, with five brothers at the Front, who was only earning 9s. 9d. for a 52½-hours' week at stator winding, was refused a leaving certificate." 2·23d. per hour!

Battery Patent for Sale.—The Svenska Ackumulator Aktiebolaget Jungner, of Stockholm, is offering for sale or licence several patents for "Improvements in electrical accumulators." A notice on the matter appears among our advertisements to-day.

"Electric Light Switching."—The results of the Second Batch Examination in this subject are given below. Those desiring further particulars should communicate with Messrs. A. P. Lundberg & Sons, 477-489, Liverpool Road, London, N.

Candidates whose papers were in time for this batch, and who do not find their names below, have failed to qualify.

Advanced Grade (in Order of Merit). W. A. McCall (Blackburn), H. Grimshaw (Golborne, Lancs.), J. J. Rogers (Dundalk, Ireland).

Intermediate Grade (in Order of Merit).—John Moran (Bury, Lancs.), R. H. Lawrenson (Romsey, Hants.), T. A. Holt (Birmingham), N. A. Jassawalla (Karachi, India), S. Booth (Warrington), J. Prime (Stafford), E. Emery (Old Hill, Staffs.), Sapper N. A. Robinson (Beaumaris), J. Wright (Grimsby), W. M. Fowler (Grimsby), W. R. Clements (St. Margaret's-on Thames).

Worked another Paper. J. Bibb (London, S.W.), D. H. Keeling (H.M.S. *Ajax*).

Preliminary Grade (in Order of Merit).—H. M. Osborne (Birmingham), R. F. Galea (Malta), P. F. Hood (Leith), J. Pendleton (Sheffield), "Parwin" (Hinckley, Leicestershire), H. Pritchard (Rhymney, Mon.), W. F. D. Morgan (Tredegar, Mon.), M. C. Stoker (Manchester), S. Addyman (Leeds), R. P. Gilbert (London, N.), D. L. Little (Rugby), G. Doudney (London, S.E.).

Worked another Paper.- A. J. Tourle (Dunstable), R. C. Stripp (London, N.W.), J. Hamer (Dewsbury), Sapper R. Rees (B.E.F.).

Electrical Table Cloths.—The Board of Trade Department of Commercial Intelligence has received an application for the names of makers of electrical table cloths.

Trade with Portugal.—A local agent at Lisbon desires to get into touch with British suppliers of electrical materials and installations for electrical lighting. *Board of Trade Journal.*

The "Safety First" Campaign.—The Council for the "Safety First" campaign of the London General Omnibus Co., which was appointed at the recent conference, is now complete, and Mr. H. E. Blain, operating manager of the company, expects that in the course of a week or two the campaign will be in working order. It is understood that the Council will at once appoint a number of Special Committees to deal with every form of street danger.—*The Times.*

Volunteer Notes.—FIRST LONDON ENGINEER VOLUNTEERS.—Headquarters, Chester House, Eccleston Place.—Orders for the week by Lieut.-Col. C. B. Clay, V.D., Commanding.

Friday, January 5th. Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.25—8.25. Lecture on "Telephones," 7.30.

Saturday, January 6th. Commanding Officer's Parade, 2.45 (uniform), for drill in Battersea Park.

Sunday, January 7th. Entrenching at Otford. Parade, Victoria (S.E. & C.R. Booking Office), 8.45 a.m.

Special Order.—General Sir Desmond O'Callaghan, K.C.V.O., desired that his complete satisfaction with all that he had seen on his inspection should be recorded in the orders.

(By order) MACLEOD YEARSLEY, *Adjutant.*

American Profit-Sharing.—The *Electrical Review and Western Electrician* states that the Consolidated Gas Co. and the New York Edison Co., and their affiliated companies, have adopted a profit-sharing plan. An official statement on the matter says: "It is increasingly recognised that profit-sharing in some form promises more than anything else to stimulate the interest of employés in the success of the undertakings with which they are identified. This relationship tends especially to promote individual and collective effort and a better spirit of co-operation in the various departments of the complex organisations now required by the larger public-utility corporations that they may render satisfactory service. The directors of these companies have decided to pay all employés, other than those of the executive and administrative staff, receiving not over $3,000 per annum, a percentage upon their salaries or wages equal to the dividend rate paid to the stockholders of the Consolidated Gas Co. Quarterly dividends are now paid at the rate of 7 per cent. annually, and, consequently, these employés—some 17,000 in number—will receive a like rate, which will approximate $1,000,000 annually, in addition to their salaries and wages." The first payment was to be made on December 15th, 1916, to all employés who, on November 30th, 1916, had been six months or longer in the service of the companies.

Tramway Men and War Wages.—At a sitting of the Bradford Munitions Tribunal, last week, 55 employés of the Bradford Corporation Tramways Department complained that the department had refused leaving certificates. The case of William Wood, a fitter, was taken as a basis. Ald. A. Taylor, of the Amalgamated Society of Engineers, representing the men said their reason for wishing to leave was their allegation that they were not receiving the standard rate of wages. In October an award fixed the standard rate in the engineering trade in Bradford, and the Tramways Committee, so far, had not carried out the terms of the award, or given the men the full benefit of it, and they had refused leaving certificates. Wood said his wages were 41s. per week, whereas the standard was 44s., but he received a bonus of 3s. In the granting of the bonus nothing was said about any award which might be made. He said the men had refused to accept a suggestion that the matter should be placed before the Committee on Production, for arbitration. Mr. C. J. Spencer, manager of the Tramways Department, said the Committee were as anxious as the men for payment of the standard rate. The majority of the Committee considered that they were already paying the standard rate, and it would be bad policy and dangerous to pay more than that rate. They held that the difference between war wage and war bonus was as the difference between "Tweedledum and Tweedledee." The bonus was paid as ordinary wages by a special resolution of the City Council. As to the leaving certificates, the Committee had offered to submit this to arbitration by the Committee on Production as a third party, and in refusing this offer, he submitted, the unreasonableness was on the side of the men. Ald. Taylor said the bonus could not be regarded as wages, and could be removed by resolution, and the men could not sue for it. The Chairman of the Tribunal said he was sorry to have to say the Bench were not unanimous. The majority decision of himself and the representative of the employers' panel—was that the bonus of 3s. ought to be considered as part of the wages, and that the refusal to grant leaving certificates was not unreasonable, and this was the decision of the Court. Mr. Moody, of the employés' panel, dissented from this view. Ald. Taylor intimated that the other cases would be withdrawn.

A French View on Trade Policy.—With a view to reviving the manufacture of machine tools in France, the Ministre du Commerce has invited the opinions of the various Chambers of Commerce throughout France on ways and means, as a preliminary to immediate official action. The invitation has brought forth a remarkable contribution from Mons. O. Arnodin, forwarded through the Orleans Chamber. The writer referred to the placing by the French Government of an order for 100,000 fr. worth of machine tools abroad, because the French manufacturers' price was 110,000 fr., or 10,000 fr. above the foreign quotation. By this order leaving France, he contended the nation was impoverished to the extent of the value of the order. The sum disbursed by the French suppliers would have gone in purchase of raw materials, wages of workmen, profit, &c., and as raw materials were only the workman materialised, the amount would be distributed among the population in the purchase of food and clothing, rent, and all the requirements of life, a portion going to the State in the shape of taxes. It was a crime on the part of the State to purchase abroad, and notably in Germany, in normal times, machine tools which could be produced in France. The author also related an electrical transaction in which this country was concerned, and which illustrates Germany's unscrupulous methods. The instance came under the writer's own eyes in the course of a visit to the Felten und Guilleaume Kabelwerke, at Mülheim-am-Rhein, in 1900. The German Government had decided to lay a submarine cable connection with America. As hitherto German manufacturers had not experimented in the making of this kind of cable, the German firm named was asked to make a preliminary study of the question, and accordingly sent a delegate to English manufacturers, surreptitiously to investigate the methods of manufacture. Thereafter the German Government instituted what might be called a "preliminary" international competition, in which offers were solicited, with descriptive schemes; but the right was retained to accept or refuse any offer, even though it might be the most advantageous. Naturally, the English manufacturers, skilled in this class of work, and with well-equipped factories, submitted offers much below that of the Felten und Guilleaume Kabelwerke; the German Government then communicated the details of the English schemes to the German firm, and called upon it to make a lower offer on the occasion of the final adjudication. After a further severe revision of its prices, this firm found itself still unable to touch the English quotations, save at a ruinous loss. At this juncture, the thought occurred to it to call together its workmen, mostly members of the Socialist Syndicate, and these, after examining the situation, decided to accept such a reduction in their wages as would enable their principals to compete, it being understood that the wages would return to the normal so soon as the contract, estimated at 25,000,000 fr., was completed. The outcome of this manœuvre was that the cable was made in Germany, which was the object aimed at.

The Electrical Vehicle Committee.—Mr. Frank Ayton, the hon. secretary, informs us that, as a result of correspondence between the Electric Vehicle Committee and the Ministry of Munitions, a tentative arrangement has been agreed to by the latter under which the firms at present manufacturing electric vehicles in this country will be allowed, for the time being, to manufacture such vehicles for purposes of urgent national importance. The firms, however, are required to apply for a permit in the case of each order that they desire to put through their shops. The firms referred to are Messrs. Ransomes, Sims & Jefferies, Ltd., Messrs. Edison Accumulators, Ltd., Messrs. Electromobile (Leeds), Ltd., and Messrs. Richard Garrett & Sons.

The Committee has received a notification, dated December 29th, from the Board of Trade, Department of Import Restrictions, stating that on and after the 29th ult. it will not be possible to consider the granting of licences for the importation of motor-cars or chassis:—(1) If imported fully assembled; or (2) if imported in parts, unless permission to assemble has first been obtained from the Ministry of Munitions, and the application is accompanied by licence so granted.

The Board requests that immediate steps be taken to prevent the shipment of any further consignments of motor-cars, chassis, and parts and accessories thereof.

Electric Steel Furnace.—At the annual general meeting of the National Steam Car Co., Ltd., on the 29th ult., the chairman stated that, anticipating difficulty in obtaining steel, the company had erected an electric steel furnace and foundry at Chelmsford. By this means they were not only able to produce wheels and castings for their 'buses and transport vehicles, from their scrap material, but were also supplying steel to Sheffield. The business ought to be continued after the war, and would render the company independent of outside sources for all steel castings in the future.

Linking-up Electricity Works—West of England Area. —As briefly mentioned in our last issue, a meeting convened by Mr. W. J. Bache, borough electrical engineer, Cheltenham, was held at the Merchant Venturers' Technical College, Bristol, on the 18th ult. The following gentlemen were present :—Messrs. W. J. Bache (Cheltenham Corp.), G. Charlton (Weston-super-Mare E.S. Co.), F. Christy (Portishead and Mid-Somerset E.S. Cos.), H. Faraday Proctor (Bristol Corp.), J. A. Purves (Blandford, Burnham, Dorchester, and Swanage E.S. Cos.), W. G. V. Smith (Bristol Tramways Co.), and F. Swarbrick (Minehead E.S. Co.).

Messrs. J. H. Bolam (Weymouth Elec. Dept.), A. B. Randall (Salisbury E.L.S. Co.), and F. H. Corson (Gloucester Corp.) were unable to be present.

After an introductory statement by the convener, Mr. H. Faraday Proctor (joint hon. secretary to the National Electric Power Supply Joint Committee) outlined the history and progress of the movement. He stated that the question had been raised as to the outlook for the smaller undertakings; this was given very early consideration, and it was laid down by the Joint Committee at its meeting on June 23rd : "That in formulating any linking-up proposals existing areas and rights should be preserved." It was felt that the output of the smaller undertakings was likely to be much improved. He did not anticipate that very much could be done immediately in the West of England area, but strongly advocated the immediate appointment of a General Committee and a working Sub-Committee, that statistics and data should be prepared of the whole of the undertakings in the area, and that preliminary consideration should be given to the practicability of linking-up existing undertakings. These preliminaries could best be considered by engineers only and from the engineering standpoint, hence this meeting was confined to the chief engineers of the undertakings in question. A little later on they must include the representatives of the company boards and municipal committees. He expressed the hope that everyone would co operate and facilitate to the best of his ability the preparation of data ; although the linking-up of his particular undertaking might not yet be possible, ultimately it would most certainly come. Electrification of railways and the development of electricity in agriculture might both be conducive to hastening the matter. The West of England area as defined was unfavourable for a linking-up scheme of any magnitude, but Mr. Proctor mentioned the probable linking-up of Bristol with Bath and Portishead.

Mr. Christy inquired whether it was the intention to "swallow up" the smaller undertakings, and Mr. Verdon Smith asked as to the compensation for displaced officials. Mr. Swarbrick stated that farmers would welcome a supply if it could be obtained, and referred to what had been done in this connection at Hereford. Mr. Charlton remarked that his undertaking would welcome the prospect of obtaining cheap electricity, which seemed probable under a linking-up scheme.

Mr. Proctor having replied to some of the points raised, it was decided to form a General Committee which should comprise all those who had been invited to the meeting that day, with Mr. Corson as chairman and Mr. W. J. Bache as vice-chairman and secretary.

A Working Sub-Committe was also appointed, consisting of Messrs. H. Faraday Proctor, F. Teague, A. Dimmack, and J. H. Bolam, representing local authorities ; and F. Swarbrick, F. Christy, and G. Charlton, representing companies. The following matters were referred to the Sub-Committee :—Consideration of extent of area ; report on plant capacity and requirements ; standardisation ; consideration of provision of capital required for linking-up ; suggestions as to possibility of immediate linking-up of specific districts.

The Training of Disabled Soldiers.—A school for training disabled soldiers has been started by the Newcastle Electric Supply Co., Ltd., with the active support of the Institution of Electrical Engineers. The school is at the Wallsend generating station of the company. Theoretical and practical training is being given in the control of switchboards, after which it is hoped to find permanent employment for large numbers. The period of tuition is four hours a day for six weeks. The men are to be under 35, and have fairly good use of their limbs, although the loss of an arm or a leg is not an obstacle to their employment. During the tuition period the men are being paid 25s. a week, and they will subsequently earn 30s., with 8s. 6s. war bonus. When the men now in training have received six weeks' tuition there will be vacancies for a fresh contingent, and it is not improbable that the scheme may be considerably extended.—*Yorkshire Post.*

Institution and Lecture Notes.—The Institution of Electrical Engineers.—At a meeting of the Dublin Local Section on December 22nd, a paper was read by Mr. J. P. Tierney on "The Use of Electricity for the Industrial Development of Ireland." Mr. Tierney said that whilst the mineral and industrial resources of England had been developed to their fullest, the corresponding resources in Ireland had hardly been considered. Nearly all the electrical power supply of the country was obtained from sea-borne fuel, the cost of which had been very high. Although about 93,000 tons of coal were mined in Ireland in 1914, in no single instance was there a main-line railway siding into any Irish coal mine, so that the coal had to be transported by road carts. The result was that the people of Dublin were paying 45s. per ton for coal, whereas Irish coal was being sold at the pit's mouth in Athy for 15s. per ton, the actual distance from Athy to Dublin being 45 miles. The Advisory Committee for Scientific and Industrial Research should devote some money for the purpose of ascertaining the exact value of Irish coal. As to the development of the peat industry, the only proper course was the erection of a power station practically in the centre of the peat area. The question of the utilisation of Irish peat for power production was one to which the Local Section should direct the attention of the Advisory Committee.

Mr. David Sherlock, in the discussion, said that a sum of £1,000,000 had been allocated to these purposes.—*Irish Times.*

Meetings of the Yorkshire Local Section will take place at Leeds on the following dates :—January 10th, February 21st, March 21st, April 25th, and May 9th.

Belfast Association of Engineers. A lecture was delivered on December 21st by Mr. A. W. Brown, on "Water Power in Ireland. Mr. Brown said it would be quite possible to bring power to Belfast from Strangford Lough, which offered very promising possibilities. There would be some 20 sq. miles of it available ; it was fed by the sea through a narrow channel 4 miles long and from ¼ to ½ mile wide. The spring tides had a rise of 14½ ft. and the neap tides a rise of 11½ ft., with a range of 7½ ft. To utilise this power to the full, storage batteries of very large capacity would be needed. The power available at the turbines would be some 60,000 to 10,000 w.h.p. The amount of capital expenditure required would be about £1,120,000, and the saving over a steam-driven plant would be about £20,000 a year.

Appointments Vacant.—Shift engineer, for Atherton power station (50s.) ; telephone construction foreman, for Ceylon (£300) ; assistant constructional engineer, for the Birmingham Corporation electricity supply department (£250). See our "Official Notices" to-day.

Extension of Letters Patent.—It is announced that application for extension of term of the following Letters Patent is to be made by Dr. S. Z. de Ferranti and Mr. E. S. Coats :—

"Improvements in and relating to spinning, twisting, and doubling machinery," August 20th, 1903. No. 18,047. S. Z. de Ferranti.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—For the position of chief engineering assistant to the Leeds electricity department, rendered vacant by the appointment of Mr. Robert Owen as borough electrical engineer of Wigan, 78 applications were received by the Electricity Committee, and the following were selected as a short list :—Mr. J. R. Davison, B.Sc., A.M.I.E.E., of Manchester; Mr. R. W. Grubb, M.A., A.M.I.E.E., of Dewsbury; Mr. Ernest A. Mills, A.M.I.C.E., of Birmingham; Mr. Ernest Porter, Leeds; and Mr. W. Yorke, A.M.I.E.E., of Sunderland. The Committee, after visiting Sunderland and Birmingham, recommended Mr. Ernest A. Mills to the Council for appointment, and the matter was to come before the City Council on Wednesday. The salary attaching to the position is £350 per annum.

The Salford Electricity Committee has recommended the Council to increase the salary of the second mains engineer from £130 to £150 per annum, and to fix £150 per annum as the maximum for the position. The scale previously fixed the minimum salary at £100, rising to a maximum of £135.

On the occasion of Mr. J. B. Morgan resigning his post as electrical engineer to the Horsham Urban Council, the works' staff presented him with a case of pipes and a fountain pen. Mr. Morgan has now taken up his duties as works manager at the Horsham Engineering Works.

General.—On Friday last, at the Grand Hotel, Bristol, a few friends from the West of England and South Wales gave a presentation dinner to Mr. Percival F. Crinks, in order to give him a hearty send-off on his removal from the West of England to take up an important position on the London staff of the British Westinghouse Co. Mr. H. Faraday Proctor presented Mr. Crinks with a handsome gold English lever watch, and a gold wristlet watch for Mrs. Crinks. Mr. Proctor spoke of the connection of Mr. Crinks with the Bristol Corporation prior to his joining the Westinghouse Co., and said a man's worth was only appreciated by a department after he had left it. Mr. Crinks resopnded to the toast. Mr. G H. Hedley (managing director, St. Anne's Board Mill) proposed the health of the Chairman (Mr. W. H. J. Porter, district manager of the British Westinghouse Co.), who suitably replied. Mr. Porter spoke in eulogistic terms of Mr. Crinks's connection with the South Wales office, and other speeches were delivered by Mr. H. I. Rogers (Messrs. Brecknell, Munro & Rogers), Mr. A. J. Newman (deputy engineer, Bristol), and Mr. A. H. Dowson (Veritys, Ltd.). The singing of the National Anthem and "Auld Lang Syne" terminated a very enjoyable evening. During the evening musical items were contributed by Mr. A. Fisher (Ashton Vale Coal & Iron Co.) and Mr. F. Clifford (Imperial Tobacco Co.). Those present included, in addition to the gentlemen mentioned above : —Messrs. J. B. Lewis, D. H. Duff, G. W. Matthews, J. Plevin, and R. Wenning, of the Cardiff office of the British Westinghouse Co. ; Mr. F. W. Prosser, sales manager and secretary, Bristol Corporation ; Mr. A J Brooks, station superintendent, ditto; and Mr. I. A. D. Pedler, mains engineer, ditto.

Mr. J. L. CHALMERS, chief electrical engineer to Messrs. Bean & Son, of Dudley, on the occasion of the first anniversary of the establishment of the electrical department of the firm, has been presented by the staff with an illuminated address and a gold albert.

The *Commonwealth Engineer* states that Mr. J. D. WAERN, of Messrs. Gardner, Waern & Co., has returned to Australia *via* America, from a business trip to Great Britain and Sweden. "It is the intention of the firm to embark, in conjunction with some of their principals, on the local manufacture of electrical and other plant."

Ald. J. W. HENDERSON has been appointed chairman of the Corporation Electricity Committee at South Shields, in succession to the late Ald. J. M. Rennoldson, who had held the position since the electrical undertaking was inaugurated over 20 years ago. The vice-chairman of the Electrical Committee is now Coun. T. R. DOWSON, a practical engineer.

Roll of Honour.—For rescuing wounded under fire, Lance-Corporal J. E. T. WRIGHT has been awarded the Military Medal. He was an electrical engineering apprentice with Messrs. Gent & Co., Ltd., Leicester.

Sapper CLARENCE LEVER, R.E., has been killed in action. He was formerly employed as an electrical engineer by the Glasgow Corporation, and was 27 years of age.

Private GEORGE JACKSON, Lancashire Fusiliers, killed in action, was employed at the Westinghouse Works, Trafford Park.

Private E. P. FRYCE, of the K.S.L.I., formerly employed on the Liverpool Corporation tramways, has been awarded the Military Medal for delivering dispatches under great danger.

Sergt.-Major E. C. WOODRUFF, D.C.M., Canadian Mounted Infantry, who was formerly on the staff of Messrs. Crompton and Co., Ltd., Chelmsford, was killed in action on December 20th. He was some time ago awarded the D.C.M., and had been recommended for a commission.

Private W. WAITE, Royal Scots, who has died of wounds, was on the staff of Messrs. W. Caverhill & Co., electrical engineers, Berwick-on-Tweed.

The Military Medal for gallantry in the field has been awarded to Sergeant W. E. RICKARD, R.A.M.C., who was on the staff of the India-rubber, Gutta-percha & Telegraph Works Co., Ltd., of Silvertown.

Our South African correspondent says that early in December news reached Johannesburg of the death in action of Lieutenant T. F. WHIMSTER, of the Royal Engineers. Lieutenant Whimster was formerly chief of the Victoria Falls & Transvaal Power Co.'s testing department, which position he had held since 1910. He came to Europe about 18 months ago, and after some 12 months' training went over to France on August 7th. His death is genuinely lamented by all who knew him, and particularly by the V.F.P. staff, who speak of him most highly. Lieutenant Whimster's duties have been carried out by Mr. Monk. The death is also reported from wounds received in action, somewhere in France, of Mr. W. O. SMYTH, late of Brakpan Power Station, V.F.P. Co.

Our correspondent adds:—"Prof. J. H. DOBSON, the general manager of the Johannesburg Municipal Electricity and Tramways Department, who was appointed Major Commanding the S.A. Pioneer Corps in German East Africa, has not had long to wait for Imperial recognition. Congratulations are due to him on the honour just bestowed on him—D.S.O. for services rendered in German East Africa. Major Dobson has been employed on railway work chiefly, and has shown undoubted resource and energy under circumstances at once trying and unusual. His work must of necessity have been out of the ordinary, as it is barely six months since he left Johannesburg, and the fact that he was without previous military experience makes this honour all the more remarkable."

The *Times* reports that Lieutenant C. T. BOWRING, Canadian Machine Gun Company, who has been killed, aged 35, took his electrical engineering degree at Lausanne University, afterwards going through an apprenticeship course at the Westinghouse Works, at Pittsburg. In 1913 he joined the State Elevator Co., of Winnipeg.

Obituary.—MR. ARTHUR JAMES IRELAND. Last week we briefly recorded, with regret, the death of Mr. A. J. Ireland, manager of the supply department and branch offices of the British Thomson-Houston Co., Ltd., of Rugby. Mr. Ireland was born in Northampton 57 years ago. In 1879 he went to America, and subsequently joined the American Brush Co., of Akron, Ohio. He installed a number of "Brush" arc lamps in various parts of the West and in Texas, and as this was in the early days of electric lighting, his experiences in the Western States were not only varied, but often highly exciting. Leaving the Brush Co., he became associated with the Thomson-Houston Co., of Lynn, Massachusetts, and later on was appointed European expert to the Thomson-Houston International Co., who were engaged in carrying out various important contracts for arc lighting plant on the Continent. While acting as their representative at Turin, he was summoned to England, in 1885, to carry out work for Messrs. Laing, Wharton & Down, who had acquired the patent rights of the Thomson-Houston system in the United Kingdom. He was retained permanently on the staff of this company, acting as their chief engineer in connection with the installation of arc lighting systems at various places, including the installations at the American Exhibition at Earl's Court in 1887, and at the Italian Exhibition in 1888.

Mr. Ireland, as chief engineer, took an active interest in the pioneer installations of Thomson-Houston arc lighting at Taunton, Bath, Bristol, and other centres in the West of England, and had charge of the installation to provide the grounds and buildings of the Military Exhibition at Chelsea with electric light. He also carried out some of the early work at the stations and goods yards of the Midland Railway Co. at St. Pancras, Leeds, Bradford, and Derby. In addition to the above he was responsible for some of the early central-station plant put down, such as at Weybridge, Fareham, &c.

ARTHUR JAMES IRELAND.

In 1890 the contract for lighting the eastern portion of the City of London was awarded to the Laing, Wharton & Down Construction Syndicate, and Mr. Ireland had charge of all this work, including the erection of a temporary generating station at Wool Quay; later on he supervised the erection of the first portion of the equipment of the main power house at Bankside, which was designed to furnish power to the whole of the City of London. He was also responsible for the complete installation of street arc lighting throughout the eastern part of the city, and the extensive system of underground mains laid down in that area, as well as numerous sub-stations which were erected to give a supply to private consumers.

In 1894 the Laing, Wharton & Down Construction Syndicate was turned into the British Thomson-Houston, Ltd., and, while acting as chief engineer for the latter, Mr. Ireland carried out important central-station work in different parts of the kingdom, as well as the electrification of tramways in Dublin and elsewhere.

In 1896 the supply business of the British Thomson-Houston Co., Ltd. (the successor of the previous two companies) became so extensive that Mr. Ireland was given entire charge of this work, becoming later also the manager of the various branch offices of the company. Since then he has continued to control this department of the company's business with uniform success.

Mr. Ireland was widely known and highly respected in electrical and manufacturing circles in the United Kingdom. He was a man of strong character and lovable disposition, and all of those who were associated with him, or had any extensive relations with him, were always struck by his honesty of purpose and great sincerity. He was a type of the best of Englishmen, and had the ability to get the most out of all those who worked under him, while still maintaining the most friendly relations with them. Not only his staff, but everyone who came in contact with him, knew that his word could be absolutely depended upon.

He was buried on December 28th at Barnes New Cemetery, Upper Richmond Road, Sheen. He leaves a widow, son, and daughter.

MR. M. B. BAIRD.—We regret to record the death, which occurred at his residence at Glasgow on December 16th, of Mr. Matthew Barr Baird, chairman of Archibald Baird & Son, Ltd., Clyde Steel & Engineering Works, Hamilton.

MR. D. T. BOSTEL.—The death took place at Balcombe (Sussex), on December 24th, of Mr. D. T. Bostel, of Messrs. D. T. Bostel & Sons, electrical engineers, of Ebury Street, London, to which business he had devoted 30 years of his life. Deceased, who was in his 80th year, established the business of Messrs. D. T. Bostel & Sons, of Duke Street, Brighton, where he had served on the Town Council. He later started the London concern, leaving his sons to carry on that at Brighton; they also founded the business of Messrs. Bostel, Bros. (Worthing), Ltd., electrical engineers.

NEW COMPANIES REGISTERED.

Association of British Chemical Manufacturers (the word "Limited" is omitted from the title by licence of the Board of Trade) (145,644).—This company was registered on December 28th, as a company limited by guarantee, and not having a capital divided into shares, with an unlimited number of members, each liable for not more than £25 in the event of winding up, to promote co-operation between British subjects engaged as manufacturers in the chemical or closely allied industries; to place before the Government, and Government officials and others, either in the British Dominions or elsewhere, the views of members of the association and others upon matters affecting the chemical industries; to develop technical organisation; to promote industrial research, industrial efficiency, and the advancement of applied industry, &c. The management is vested in a Council consisting of not less than 16 or more than 20, the first members of which are:—Dr. E. F. Armstrong, D.Sc. (London), F.C.G.I., Joseph Crosfield and Sons, Bank Quay, Warrington; F. H. Carr, F.I.C. (director, Boots' Pure Drug Co., Ltd.), Nottingham, chemical manufacturer; Dr. C. Carpenter, D.Sc., M.I.C.E. (president, Society of Chemical Industry, chairman of South Metropolitan Gas Co.), Old Kent Road, S.E.; Dr. M. O. Foster, F.I.C., D.Sc., F.R.S., British Dyes, Ltd., Huddersfield; J. Gray, F.I.C., managing director, Lever Bros., Ltd., Port Sunlight; C. A. Hill, B.Sc., F.I.C., chairman, British Drug Houses, Ltd., Graham Street, City Road, N.; N. N. Holden, managing director, Hardman & Holden, Ltd., Miles Platting, Manchester; D. L. Howard, Howard & Sons, Ltd., Uphall Works, Ilford, chemical manufacturer; C. P. Merriam, managing director, The British Xylonite Co., Ltd., Hale End, London; The Rt. Hon. Sir Alfred M. Mond, Bart., P.C., M.P., chairman, Mond Nickel Co., Ltd., 39, Victoria Street, Westminster; Max Muspratt, chairman, United Alkali Co., Ltd., 30, James Street, Liverpool; R. G. Perry, chairman, Chance & Hunt, Ltd., Oldbury; Sir William Pearce, M.P., director, Spencer, Chapman & Messel, Ltd., 36, Mark Lane, E.C.; R. D. Pullar, chairman, J. Pullar & Sons, Ltd., Pullar's Dye Works, Perth; A. T. Smith, managing director, Castner-Kellner Alkali Co., Ltd., 257, Royal Liver Building, Liverpool; The Rt. Hon. J. W. Wilson, Albright and Wilson, Ltd., Oldbury, chemical manufacturer; Dr. A. Ree (president, Society of Dyers and Colourists), 15, Mauldeth Road, Withington, Manchester. There are to be "Group" Committees, each consisting of not less than three members, representing:— Group 1: Acids (including acetic and oxalic), carbonic acid, hydrogen, oxygen and gases, alum, chrome, zinc, copper and iron compounds, fertilisers (including superphosphates). Group 2: Alkalis, cyanides, chlorine and compounds, silicate, chlorates, borax, hydrogen, peroxide, magnesia compounds (not medicinal). Group 3: Fats, greases, waxes, resins, glycerine, soap. Group 4: Gelatine, sizes, glue, varnishes, paints, polishes, tanning. Group 5: Distillation of coal, shale, oils, and wood, alcohol, acetone, coal tar, primary products (including ammonia and ammonia products), charcoal, fuel. Group 6: Fine chemicals, analytical, pharmaceutical, photographic, rare earths, synthetic essences and perfumes, alcohol derivatives, ethers. Group 7: Phosphates, manganese, potassium, sodium, barium, calcium, cardimium, &c., lead, arsenic, antimony, tungsten, molybdenum, &c. Group 8: Cellulose products (including paper), celluloid, rubber and substitutes. Group 9: Explosives, and dyes and their intermediaries. Group 10: Glass, porcelain, pottery, refractory materials, lime, cement, chemical-resisting materials. Group 11 (allied industries): Bleachers, dyers, and textile printers. Solicitors: Markby, Stewart & Co., 57, Coleman Street, E.C.

Electrical Stores (Nottingham), Ltd. (145,555).—This company was registered on December 16th, with a capital of £5,000 in £1 shares, to adopt an agreement with J. T. Kemp and H. E. Crammond, and to carry on the business of electrical engineers and contractors, suppliers of electricity, carriers of passengers and goods, manufacturers of and dealers in electric railway and tramway and electric, galvanic, magnetic, and other apparatus, &c. The subscribers (with one share each) are: J. T. Kemp, 19, Highfield Road, West Bridgford, Notts., electrical engineer; H. E. Crammond, 126, Ratcliffe Road, West Bridgford, Notts., electrical engineer. Private company. The number of directors is not to be less than two or more than five; the first are not named. Solicitor: A. Barlow, 1, High Pavement, Nottingham.

New Shipston Lighting Co., Ltd. (145,577).—This company was registered on December 19th, with a capital of £5,000 in £1 shares to take over the business of electricity supply works, &c., carried on at Campden Road, Shipston-on-Stour, Worcs., by the Shipston Electrical Co., Ltd. The subscribers (with one share each) are: W. D. Akers, London House, Shipston-on-Stour, Worcs., draper; J. W. Hence, Shipston-on-Stour, Worcs., butcher; H. Holtom, Shipston-on-Stour, Worcs., bank manager; J. R. King, J.P., Honington Hall, Shipston-on-Stour, Worcs.; C. Stein, Park House, Shipston-on-Stour, Worcs., surgeon; G. Turner, High Street, Shipston-on-Stour, Worcs., jeweller; A. H. Jarrett, Cedar Lodge, Shipston-on-Stour, Worcs., draper. Private company. The number of directors is not to be less than five or more than seven. The first are W. D. Akers, J. W. Hence, H. Holtom, J. R. King, C. Stein, G. Turner, and A. H. Jarrett. Qualification, £50. Solicitor: G. E. B. Rogers, 9, Cross Street, Reading.

T. P. Pollitt & Co., Ltd. (145,566).—This company was registered on December 18th, with a capital of £1,000 in £1 shares, to take over the business of electrical, mechanical, and general engineers, contractors, &c., carried on at Fish Dock Road, Grimsby, as Pollitt & Co. The subscribers (with one share each) are T. P. Pollitt, Fish Dock Road, Grimsby, electrical contractor; Mrs. M. Pollitt, 205, Hainton Avenue, Grimsby. Private company. The first directors (to number not less than two or more than five) are T. P. Pollitt and Mrs. M. Pollitt. Registered by Alfred H. Atkins, 27-8, Fetter Lane, E.C. Registered Office: Fish Dock Road, Grimsby.

Trade Attractor Co., Ltd. (145,581).—This company was registered on December 19th, with a capital of £500 in £1 shares, to adopt an agreement with Max Alexander and Herman Tas; to acquire and turn to account any invention relating to the production, treatment, storage, application, distribution, manufacture, and use of metallic substances, filaments, electricity, and of any apparatus therefor; to carry on the business of advertising agents and contractors, billposters, electrical engineers, &c. The subscribers (with one share each) are: Max Alexander, 61, New Oxford Street, W.C., merchant; Miss Violet Elliott-Lawson, 56, Cleveland Square, Hyde Park, W. Private company. The first directors (to number not less that two or more than three) are Max Alexander, Theodore C. Elliott-Lawson, and Miss Violet Elliott-Lawson. Qualification, one share. Remuneration (except managing director), £50 each per annum. Registered by Simmons & Simmons, 74, Cheapside, E.C.

Corona Lampworks (Northern), Ltd. (145,612).—This company was registered on December 22nd, with a capital of £10,000 in £1 shares, to take over the business of electric lamp supply stores or depôt carried on by The Corona Lampworks, Ltd., and by J. Brown, their agent, at 156b, Briggate, Leeds, together with the agency rights, title, and interest in connection with the "Corona" brand of annealed tungsten wire filament lamps. The subscribers (with one share each) are: Miss F. Wilby, 93, Brudenell Road, Leeds; T. G. Wintle, Hazelmere, Ilkley, solicitor. Private company. The first directors are to be appointed by the subscribers. Qualification, £100. Registered office: 156b, Briggate, Leeds.

Shell Bands, Ltd. (145,660).—This company was registered on December 29th, with a capital of £6,000 in £1 shares, to carry on the business of manufacturers of copper tubes, shell driving bands, and similar articles by electrolytic deposition, to deal in the development of metallurgy relating to the electrolytic deposition of metals, and to enter into an agreement with N. Bosanquet, R. S. Dormer, and H. Philipson. The subscribers (each with one share) are: J. G. England, 97, Strathyre Avenue, Norbury, S.W., cashier; N. E. Bowley, 73, Pearson Street, Kingsland, N., solicitor's clerk. Private company. The number of directors is not to be less than two or more than eight; the first are N. Bosanquet and G. Houston Boswell-Preston, R. S. Dormer, and H. Philipson. Qualification, £1. Remuneration, £500 each per annum (managing director, £15 each per week). Registered office: Electrical Power House, Southwick, Sussex.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Newtons, Ltd. (48,936).—Capital, £40,000 in £10 shares. Return dated October 3rd, 1916. 3,265 shares taken up; £18,650 paid, £14,000 considered as paid. Mortgages and charges: £14,000.

Engineering and Arc Lamps, Ltd.—A memorandum of satisfaction to the extent of £500 on December 9th, 1916, of debentures, dated May 26th, 1911, securing £6,000 has been filed.

Brilliant Arc Lamp & Engineering Co., Ltd.—Assignment of book debts by way of memorandum of deposit dated December 7th, 1916, charged on moneys due or to become due in respect of munitions contract, to secure all moneys due or to become due from company to London and South-Western Bank.

New St. Helens & District Tramways Co., Ltd. (59,426).—Capital, £150,000 in 20,000 pref. and 10,000 ord. shares of £5 each. Return dated November 10th, 1916. 15,980 pref. and 9,000 ord. shares taken up; £125,410 paid, including £510 on 1,020 forfeited shares. Mortgages and charges: Nil.

Chadburn's (Ship) Telegraph Co., Ltd.—Capital, £120,000 in £1 shares (60,000 pref. and 60,000 ord.). Return dated October 10th, 1916 (filed November 1st). All shares taken up; £1 per share called up on 50,000 pref. and 50,000 ord.; £100,000 paid; £20,000 considered as paid on 10,000 pref. and 10,000 ord. Mortgages and charges: Nil.

Pacific & European Telegraph Co., Ltd. (36,683).—Capital, £100,000 in £10 shares. Return dated November 21st, 1916. All shares taken up, £4 per share called up, £40,000 paid. Mortgages and charges: £67,500.

Monte Video Telephone Co., Ltd.—Capital, £160,000 in £1 shares (87,000 pref. and 73,000 ord.). Return dated December 4th, 1916 (filed December 12th). 86,492 pref. and 72,680 ord. shares taken up; £159,172 considered as paid. Mortgages and charges: Nil.

Magnesium Metal Co., Ltd.—Second mortgage debenture, dated December 15th, to secure £10,000, charged on the company's undertaking and property, present and future, including uncalled capital, subject to charge dated February 18th, 1916. Holders: Vickers, Ltd., Vickers House, Broadway, Westminster.

Rhondda Tramways Co., Ltd.—A memorandum of satisfaction to the extent of £4,100 on November 30th, 1916, of charges dated March 24th, 1911, November 13th, 1912, and March 11th, 1915, securing £250,000, has been filed.

CITY NOTES.

Tata Hydro-Electric Power Supply Co., Ltd.

A Bombay newspaper just to hand contains a copy of the report of the directors of this company. It states that the concessions in respect of the development of the Andhra Valley have been transferred to the Andhra Valley Power Supply Co., Ltd., for a sum of rupees five lacs. The company have applied to Government for the grant of a licence which will be transferred to the Andhra Valley Co. The company are also to receive annually a sum of rupees fifty thousands from the Andhra Valley Co., or a sum equivalent to 15 per cent. upon the net profits (after making certain deductions), whichever be the larger sum. The 7 per cent. dividend on preferences shares commenced to run from January 1st, 1916, and the directors recommend out of the balance of Rs. 5,18,866 a dividend in respect of the half-year ended June 30th last on the 7,722 "preference" shares allotted up to June 30th, 1916, at the rate of 7 per cent. per annum after deducting income-tax, and also a dividend in respect of the same period on the 9,349 "ordinary" shares allotted up to June 30th, 1916, at the rate of 5 per cent. per annum. The total amount so payable for dividends will come to Rs. 5,00,653, leaving a balance in hand amounting to Rs. 18,213 to be carried forward to next account.

"During the last season the Shirawta Dam reached a height sufficient for storage at 2097 level, or 13 ft. above the draw-off level. Towards the close of the rains an additional foot of storage was obtained by raising the escape. The work was recommenced on this dam on September 16th, and satisfactory progress has been made.

"The tunnel between Walwhan and Shirawta is completed except for trimming up work; a quantity of excavation remains in widening the approach cut, which will be put in hand when Shirawta Lake is emptied. The excavation for the tunnel head-works is nearly finished, but no masonry is yet commenced. The Walwhan Dam, Lonawla Dam, Duct, and Forebay are all practically completed, and the pipe-line is completed for one upper pipe-line and five small lower pipe lines. The whole of the works on contract No. 1, comprising all the above items except Shirawta Dam and tunnel headworks, are practically complete, only finishing-up work remaining to be done. The construction of the four units of the first installation of the power house with all accessories was completed during the year, and all of such plant put into regular revenue-earning service. The difficulty at first experienced with the generators has been overcome, and operation generally may now be considered as satisfactory. The fifth unit, with its equipment, will soon be ready for beneficial operation. The work of improving the insulation of the transmission lines has been continued throughout the year, and will shortly be completed. All apparatus has been in regular service at the receiving station and given uniform satisfaction. Two more synchronous condensers for improving the power factor in the system are on order. The underground cables have been in full and regular service, and no trouble has been experienced with them.

"Thirty-four mills are now receiving a supply of electrical energy, and we believe we are justified in saying that the service is a generally satisfactory one. All mills, with whom we had contracted for the supply of power from the first installation, are receiving their energy from our system, with the exception of about 3,000 H.P., which the consumers have so far been unable to avail themselves of on account of the difficulty in obtaining their own machinery. This power is now gradually being taken up. There is now a total of 49,910 B.H.P. of motors in service, returning a monthly revenue of approximately Rs. 2,22,000."

British Columbia Electric Railway Co., Ltd.

Mr. Horne Payne, the chairman, was unable to be present at the recent annual meeting, but his speech was read by Mr. H. G. Brown. He said that it was impossible to issue the accounts earlier as the secretary was the sole male employé of the company left in London. The total gross income for the year was only £258,000, as compared with £370,000 in the preceding year and £560,000 in the year before that—a decrease in two years of considerably more than 50 per cent. This was due to a reduction of 30 per cent. in the population of their districts due to the war, and to the continuance of the unfair competition of the jitney cars. It was reasonable to look for an increase in profits on the return of the troops—almost as rapid as the decrease had been. He did not mean to say that they would get back all at once to the dividend formerly received on the deferred ordinary stock, but he thought they would again receive a moderate return on the money invested in that stock within a year or two of the end of the war. The company had deserved well of the people of British Columbia, but in the matter of the jitney car competition they had not received it. They had not yet been able to convince the authorities and the public of the folly of maintaining by preferential treatment, to the detriment of a great enterprise, a service which was merely a convenience to a certain section of the public, and could do nothing to advance permanently the general welfare, by the expenditure of capital, the employment of labour, or the encouragement of industries. They were now called upon to face a large increase in the cost of labour. There had been for some time past a great deal of trouble in connection with labour throughout the American continent, and British Columbia had not escaped. The shortage of men and the increase in prices of commodities created a difficult situation. These conditions seriously affected the company's employés, and although the agreement with them still had a few months to run, it was recently decided to grant an immediate increase of wages. This involved an increase of considerably more than $100,000 per annum in working expenses, and it was to remain in force until June, 1918. An improvement in net earnings commenced in February, and had continued down to the date of the last return received (October). There were grounds to hope that that increase in earnings might continue on a sufficiently large scale to enable them this year to meet the dividend on the 5 per cent. cumulative preference stock without having recourse to the reserve fund, and with perhaps a small surplus. In estimating the prospects of the company, one had largely to be guided by the general outlook in British Columbia. From its geographical position, British Columbia had experienced a more severe set-back from the war and less benefit from war trade than any other province of Canada, the mining industry alone having derived substantial benefit, while such important industries as the shipping trade and the lumber trade had been practically paralysed. There could be no doubt, however, that during the last six months these trades and commercial and industrial conditions generally had been steadily improving. Much attention was being given to the development of the mining industry, and the mines had experienced a great demand for their products for munition purposes. The Provincial Government were assisting the development of the shipbuilding industry, and there seemed no reason why Vancouver and Victoria should not successfully rival Seattle and San Francisco in shipbuilding. There was an increasing export trade with Russia and the East, particularly in munitions, railway materials, &c., and it was believed that after the war the exchange of commodities with Russia across the Pacific would be permanently established. He thought that undoubtedly the worst times were experienced towards the end of last year, and that from now on they would see continued improvement.

Cordoba Light, Power and Traction Co., Ltd.

Mr. G. A. Touche, M.P., presiding at the recent annual meeting, said it was the irony of fate that in a year when, owing to shipping difficulties the price of fuel was disastrous, they should experience such a drought as had never been known in the history of the company. In the 21 years for which they had the official records the rainfall for the six months corresponding to the second half of the financial year had never been anything like as low as it was this year. In ordinary circumstances they used their reserve steam station only as a standby in case of emergencies. This year they had had to generate a large proportion of the electrical energy supplied to the tramways and to their customers, both public and private, by means of steam. The effect upon the accounts would be appreciated when he told them that, in the six months to September 30th last, the operation of their steam station cost practically £23,000, against £540 in the corresponding six months of the previous year. Of this £23,000, no less than £20,400 was the cost of fuel alone. Notwithstanding the bad times in South America, the gross receipts of the combined businesses were not only maintained but increased. They amounted to £162,460, and constituted a record, comparing with £157,590 in 1915, and £160,420 in 1914, up till that date their highest figure. The tragedy came in the expenses, which were £100,539, against £74,270 in 1915, an increase of £26,269. The net receipts were £61,921, compared with £85,320, a decline of £21,399. Taking the Light & Power Co. by itself, the gross receipts were £90,577, against £88,550 in 1915, an increase of £2,027. The expenses were £55,633, in comparison with £30,906 in 1915, an increase of £24,727. The net receipts were £34,944, against £57,644, or a decline of £22,700. The number of customers for light and power on the books at the end of September last showed an increase of 7.38 per cent. over the number at September 30th, 1915. The number of lamps connected was greater by nearly 6 per cent. The number of units of current sold was almost identical with the number sold in the previous year, but the income per unit was nearly 2½ per cent. greater. On the other hand, on account of the steam operation, the cost per unit sold was nearly 81 per cent. more. Practically no change had taken place in regard to their relations with the competing company, but they expected to see the chairman of that company here in London at an early date. The records of the Tramways Co. during the year did not show any great progress; nevertheless, it had not gone back. The gross receipts were £71,883, against £69,040 in 1915 (an increase of £2,843). The expenses increased, being £44,906, compared with £43,360, but the ratio of expenses to gross receipts was slightly less at 62.47 per cent., against 62.8 per cent. in the year to September 30th, 1915. The net receipts were £26,977, against £25,680 (an increase of £1,297). The revenue brought into the accounts of the holding company was £62,383, compared with £78,451 last year. But for the additional abnormal operating expense of the lighting and power business there should have been a profit of about £23,000, or £5,000 more than sufficed to pay the dividend on the preference shares for the year in full. As it was, there was a small loss of £230, after meeting all fixed charges, including debenture stock interest and sinking fund and interest on the promissory notes. In the circumstances they had no alternative but to defer the payment of the preference dividend. The outlook with regard to the fuel situation was still too serious to enable them with any prudence to distribute the accumulations at the credit of profit and loss. It was a matter of some congratulation that they were able to pay, out of the year's earnings, the interest charges on practically a million pounds of loan capital.

The Siemens-Schuckert Group.

The Nuremberg Co.—The accounts of the Elektrizitats A.G. vorm. Schuckert and Co., of Nuremberg, for the year ended on July 31st, 1916, indicate gross profits of £516,000 and balance forward of £76,000, as compared with £436,000 and £66,000 respectively in 1914-15. The general expenses, interest charges, taxes, and customary depreciation absorb £184,000, as against £182,000, and the coupon tax reserve fund £5,000, as in the previous year, leaving net profits amounting to £403,000, as contrasted with £315,000. It is proposed to transfer £26,000 to the provident fund, to apportion £17,000, as against £11,000, as the profit share of the directors, managers, and officials, and to pay a dividend of 8 per cent. on the share capital of £3,500,000, this contrasting with 6½ per cent. in 1914-15, 6½ per cent. in 1913-14, and 8 per cent. in 1912-13.

The Rhenish Schuckert Co.—The report of the Rheinische Schuckert Ges. fur Elektrische Industrie, of Mannheim, which deals with the year ended on July 31st, 1916, states that the unfavourable conditions brought about by the war continued during the year. Constructional activity remained restricted, but a greater amount of installation work was carried out in connection with the company's electricity supply undertakings. The sale of energy increased owing to the growth in the number of connections, although the private consumption, especially in the country, left something to be desired. No changes took place in the number of the company's own supply works, which experienced further satisfactory development, notwithstanding the difficult conditions; the extensions of these works were kept within moderate limits, and comprised chiefly the connection of new consumers. The accounts show net profits amounting to £45,500, as compared with £45,100 in 1914-15, and the dividend is at the rate of 5 per cent. on the ordinary share capital of £550,000, this comparing with the same rate in 1914-15 and 1913-14, and 8 per cent. in 1912-13.

Siemens & Halske.—The directors of Siemens & Halske, A.G., of Berlin, state that the total production in 1915-16 was not less than that which prevailed in the previous year, although displacements took place in various departments in consequence of activity for the requirements of the Army and Navy, whilst the financial results also were approximately the same as in 1914-15. The net profits are stated to amount to £625,000, as compared with £626,000, and after the allocation of £75,000 to the "Siemensstadt" war welfare foundation, as against £150,000 in 1914-15, it is proposed to pay a dividend of 12 per cent., being the same rate as in 1914-15, and comparing with 10 per cent. in 1913-14, and 12 per cent. in 1912-13, on an ordinary share capital of £3,150,000. Including the provision made by the Siemens-Schuckert Works, the capital of this foundation has now reached a total of £500,000. The payment of the dividend absorbs £378,000; the sum of £100,000 has been placed to the special reserve fund, as in 1914-15, and £45,000 has been appropriated for bonuses to the staff. The Siemens family has created, with a capital of £50,000, a foundation for the promotion of dwellings for officials and workmen in connection with the centenary of the birth of Werner von Siemens. The directors of Siemens & Halske have decided, in conjunction with those of the Siemens-Schuckert Works, that each company shall make a contribution of £50,000 towards this foundation, which consequently begins with a capital of £150,000.

Siemens-Schuckert.—The financial statement of the Siemens-Schuckert Werke G.m.b.H., of Berlin, remarks that it was not possible fully to satisfy the demand for electrical manufactures, as the production and improvement of substitutes for electrical conductors and their insulation, in which the company participated largely, occupied a considerable time. It was necessary to accommodate the methods of manufacture to the new material, and to test the latter in working. The exports to transmarine countries ceased entirely owing to the English blockade. The company's workshops were naturally occupied to a large extent on the manufacture of articles of war for the Army and Navy. The increased demand of all industries, particularly the chemical industry and the heavy industry (iron and steel and engineering) caused the most strenuous activity to prevail in the department for electric motive power. Concerning the company's finances, the statement observes that the liquid funds have considerably increased, and that these will, of course, be largely required in the change over of the departments to the production of peace manufactures. As gross profits, the accounts show the sum of £1,275,000 for 1915-16, as contrasted with £1,399,000 in the previous year. After defraying general expenses, interest on loans, and depreciation of buildings, the net profits are returned at £765,000, as against £888,000 in 1914-15. It is intended to divide 10 per cent. between the two proprietary companies, as compared with 10 per cent. in 1914-15, 7½ per cent. in 1913-14, and 10 per cent. in 1912-13. The sum of £125,000 has been transferred to the reserve fund, as in the preceding year; £75,000 has been allocated as bonuses to staff and workmen, as in 1914-15; £25,000 has been placed to the contingency fund, and £75,000 has been allotted to the Siemensstadt war welfare foundation, as compared with £200,000 in 1914-15.

Marconi's Wireless Telegraph Co., Ltd.—The directors report with regret that they have not yet been able to obtain from Government Departments a basis of settlement in respect of either remuneration or compensation for services rendered, for the use of their stations since the commencement of the war, nor in respect of other matters in which the Government is indebted to the company. In these circumstances the declaration of a bonus, to which reference was made at the general meeting, must still remain in abeyance. However, without taking into account the considerable sums which are estimated to be due to the company in respect of the matters referred to above, the business which has been actually completed for the current year has been satisfactory, and the directors, without departing from the policy, which was approved at the last general meeting, of husbanding their resources, feel justified in declaring the 7 per cent. preferential dividend upon the cumulative participating preference shares, and an interim dividend of 5 per cent. on the ordinary shares, both less income-tax.

Holme (Huddersfield) Electricity Co.—The annual meeting was held recently. It was reported that the scheme of utilising a local stream for power generation was proving a success, and was being watched with interest by neighbouring authorities. The balance sheet showed a profit for the first year's work of £32, after allowing £76 (10 per cent.) for depreciation. A dividend of 3 per cent. was declared, and £25 carried forward. The chairman expressed indebtedness to shareholders and voluntary workers, and said the company would probably be out of debt in eight years.

Marconi International Marine Communication Co., Ltd.—The directors announce an interim dividend of 5 per cent., equal to 1s. per share, less income-tax, on account of the current year.

Humphrey Pump Co., Ltd.—The report for the year ended September 30th last states (says the *Financial Times*) that the conditions produced by the war have continued to seriously prejudice the business of the company. Substantial progress has been made in the development of the new type of small pumps, and the directors are pleased to state that a number of orders has been secured, including contracts. Work is proceeding as rapidly as circumstances will permit, and, in order to facilitate as much as possible the output of pumps, machine tools are being put down at the company's test station at Dudley Port. There is a deficiency on the year of £4,728, making the total debit balance £26,375.

Stock Exchange Notice.—The undermentioned are to be quoted in the Official List:—

Consolidated Gas, Electric Light & Power Co. of Baltimore.—$619,000 additional common stock.

Lima Light, Power & Tramways Co.—A dividend of 1 per cent is announced.

STOCKS AND SHARES.

Tuesday Evening.

Coming back to work after the New Year's Day holiday, the Stock Exchange markets started to prepare decks for an immediate issue of the long-expected War Loan. The withdrawal of the 6 per cent. Exchequer Bonds and War Expenditure Certificates was the obvious forerunner of the new loan. A hum of anticipation pervaded the Consol market. Brokers set their staffs addressing foolscap envelopes by the thousand. Speculators bought 4½ per cent. War Loan in blocks.

It is hoped that the disturbance in other investment markets created by the 4½ per cent. War Loan in June/July, 1915, may be avoided this time. Debenture stocks, particularly in the industrial sections, lost anything from 4 to 10 points. Preference stocks and shares gave way in proportion. The shrinkage came gradually. Much of it was imperceptible until a holder happened to want to realise his stock, when he found that the usual purchasers were prepared to deal only on the basis of the new standard set up by the 4½ per cent. loan. Rumour will probably be set at rest before these notes come out as to the price at which the new loan will be offered to the public; and if the advance guesses are anything to go by, the investor will be generously treated. That this will react upon existing securities is no doubt inevitable; but perhaps it is a little early yet to attempt any forecast as to what the actual influence of the loan will be.

Business has been extremely active in the Consol market, upon which attention has naturally focused at the moment. Home Railway stocks are generally better. There is a little buying going on, and, rather curiously, it is the low-priced stocks of the speculative nature which are being sought more particularly. Districts dipped to 15¼, but rallied to 16½. Underground Electric ordinary shares improved to 2 3/16; the company's 6 per cent. income debentures are ½ up at 93.

The issue of the 4½ per cent. War Loan had the immediate effect of causing markets round the Stock Exchange to be reduced as a whole to something approaching stagnation during the time through which the lists were open; and if the newcomer is offered on the extremely favourable terms rumoured in the City to-night, no one would feel surprised if a somewhat similar state of affairs were to prevail for a month or six weeks.

Electric Lighting shares are quiet. South Londons rose ⅛ to 2⅞, but County of London preference shares at 9⅝ have lost the small fraction which they secured last week. Curiosity is agog as to how the dividends will come out. The West End companies, it may be remembered, fared less successfully in the corresponding period than did those working in the City, and prophets are disposed to think that the electric lighting market may see a repetition of this tendency in respect of the half-year which has just ended.

Amongst telegraph and telephones, there is a demand for the two stocks of the Anglo-American Telegraph Co., and the prices of both are better. The Western Telegraph Co. is making an offer of 25s. per share for the shares of the West Coast of America Co., and this is the middle price of the quotations furnished by the market. West Coast of America shares were formerly of the nominal value of £10, but were written down to £2 10s., so that the present offer is 50 per cent. of their par price.

The last time that the company paid any dividend was in May, 1913, when 1s. per share was distributed in respect of 1912; as there seems to be little prospect of further distribution for some years to come, the assumption is that shareholders will accept the offer which is being made to them by the Western Telegraph Co. The latter guarantees the £150,000 4 per cent. debentures of the West Coast of America Telegraph Co., and is about to pay off this obligation. The West Coast concern has an issued capital of 30,008 shares, out of an authorised 53,008; and we understand that a large proportion of these is already held by the Western Telegraph Co.

Marconi shares are unaffected by the declaration of an interim dividend of 5 per cent. for 1916, the same rate as that paid for the previous twelvemonth. The company has not yet settled with the Government as to the payment which is to be made for the use of the Marconi stations since the outbreak of war, and the directors, therefore, will not declare any bonus. The price of Canadian Marconis keeps about 9s 6d., and that for Americans is 16s. 6d.

Brazilian Tractions have further spurted to 52, making a rise of 5½ points since the middle of December. Other Brazilian things are also in favour. There is a disposition, too, for speculative buyers to pick up Mexican stocks, though so far this has not extended to the issues of the utility companies. British Columbia Electric deferred regained 2 points after its severe fall, the market in the stocks being better as a whole, although the effects of the shock administered by the recent report have not yet worn off. Other foreign tramway issues are generally steady.

The principal feature in the list of manufacturing companies, so far as prices are concerned, is a drop of 1s. 6d. in British Aluminium ordinary. Shares have been offered with a certain amount of freedom by country holders. Castner-Kellners eased off to 3½. Many ex-dividend markings occurred this week, some of them extending to stocks and shares concerned in the electrical industries; apart from these, however, the movements are mostly insignificant. The price of rubber improved to 3s. per lb., and the first business day of the new year produced a fair crop of buying orders, the bulk of which also came from the provinces. The copper group generally remains heavy, and the same remark applies to that for iron, coal, and steel shares.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1914.	Dividend 1915.	Price Jan. 2, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary	5	5	8⅜	—	7 8 2
do. do. do. 4½ Pref.	4½	4½	$8\frac{7}{16}$	—	6 11 0
Chelsea	5	4	3	—	6 18 4
City of London	9	8	11⅜	—	7 0 8
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10⅛	—	6 18 3
do. 6 per cent. Pref.	6	6	9⅞	+ ⅛	6 1 6
Kensington Ordinary	9	7	5⅝	—	6 4 5
London Electric	4	8	1⅜	—	6 10 5
do. do. 6 per cent. Pref.	6	6	$4\frac{7}{16}$	—	6 15 4
Metropolitan	8½	8	2¼	—	6 13 4
do. 4½ per cent. Pref.	4½	4½	9⅛xd	—	7 4 0
St. James' and Pall Mall	10	8	6	—	6 13 4
South London	5	5	2⅞	+ ⅛	6 19 0
South Metropolitan Pref.	7	7	$1\frac{3}{32}$	—	6 7 8
Westminster Ordinary	9	7	5⅝	—	6 4 5

Telegraphs and Telephones.

	Dividend 1914.	Dividend 1915.	Price Jan. 2, 1917.	Rise or fall this week.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	96	+ ½	6 5 0
do. Def.	80/-	83/6	28¾	+ ½	7 8 0
Chile Telephone	8	8	7⅛	—	5 12 8
Cuba Sub. Ord.	5	5	8¼	—	6 8 6
Eastern Extension	7	8	14	—	*5 14 4
Eastern Tel. Ord.	7	8	140½	—	*5 14 0
Globe Tel. and T. Ord.	6	7	12½	—	*5 12 0
do. Pref.	6	6	10	—	5 18 5
Great Northern Tel.	22	22	36xd	—	6 2 3
Indo-European	13	13	49½	—	6 11 4
Marconi	10	10	2⅞	—	8 9 5
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord.	10	10	$2\frac{5}{16}$	—	4 6 6
United R. Plate Tel.	8	8	$6\frac{11}{16}$	—	*5 19 8
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	18	—	*5 15 4

Home Rails.

	Dividend 1914.	Dividend 1915.	Price Jan. 2, 1917.	Rise or fall this week.	Yield p.c.
Central London, Ord. Assented	4	4	65½	—	6 2 2
Metropolitan	1¼	1	25	—	4 0 0
do. District	Nil	Nil	15½	—	Nil
Underground Electric Ordinary	Nil	Nil	$2\frac{3}{16}$	+ $\frac{1}{16}$	Nil
do. do. "A"	Nil	Nil	6/6	—	Nil
do. do. Income	6	6	93	—	*6 9 0

Foreign Trams, &c.

	Dividend 1914.	Dividend 1915.	Price Jan. 2, 1917.	Rise or fall this week.	Yield p.c.
Adelaide Sup. 6 per cent. Pref.	6	6	$4\frac{15}{16}$	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	3	—	9 3 4
do. 2nd Pref.	5½	5½	2¾	—	—
do. 5 Deb.	5	5	62½	—	8 0 0
Brazil Tractions	4	4	52	+3	7 13 10
Bombay Electric Pref.	6	6	10¼	—	5 17 8
British Columbia Elec. Rly. Pfce.	5	5	62½	—	8 0 0
do. do. Preferred	—	Nil	40½	—	Nil
do. do. Deferred	—	Nil	37½	—	Nil
do. do. Deb.	4¼	4¼	62	—	6 17 4
Mexico Trams 5 per cent. Bonds	—	Nil	33½	—	Nil
do. 6 per cent. Bonds	—	Nil	27½	—	Nil
Mexican Light Common	Nil	Nil	7½	—5	Nil
do. Pref.	Nil	Nil	15½	—2	Nil
do. 1st Bonds	Nil	Nil	27½	- 5	—

Manufacturing Companies.

	Dividend 1914.	Dividend 1915.	Price Jan. 2, 1917.	Rise or fall this week.	Yield p.c.
Babcock & Wilcox	14	15	$2\frac{13}{16}$	—	5 6 9
British Aluminium Ord.	5	7	28 6	—1/6	5 12 3
British Insulated Ord.	15	17½	11¾	—	7 5 10
British Westinghouse Pref.	7½	7½	2⅝	—	6 6 4
Callenders	15	20	13	—	7 13 10
do. 5 Pref.	5	5	4¼	—	5 17 8
Castner-Kellner	20	22	3½	+ $\frac{1}{16}$	6 5 7
Edison & Swan, £3 paid	Nil	—	$\frac{7}{16}$	—	Nil
do. do. fully paid	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	5	5	61½xd	—	8 2 8
Electric Construction	6	7½	$1\frac{1}{16}$	—	7 1 2
Gen. Elec. Pref.	6	6	9¾xd	—	6 3 1
do. Ord.	10	10	13¾	—	7 5 6
Henley	20	25	16	— ¼	7 13 10
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12¾xd	—	*7 17 0
Telegraph Con.	20	20	38	—	*6 5 0

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, January 3rd.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	1d. dec.
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	,,	£54	..
a Bisulphide of Carbon	,,	£28	..
a Borax	,,	£34	..
a Copper Sulphate	,,	£66	£3 inc.
a Potash, Chlorate	per lb.	2/6	..
a ,, Perchlorate	,,	2/-	..
a Shellac	per cwt.	142/-	..
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers	,,	£19	..
a ,, Lump	,,	£16	..
a Soda, Chlorate	per lb.	1/-	..
a ,, Crystals	per ton	120/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c ,, Tubes (solid drawn)	,,	..	..
c ,, Wire, basis	,,	..	..
c Copper Tubes (solid drawn)	,,	1/8½ to 1/9	1½d. dec.
g ,, Bars (best selected)	per ton	£175	£10 dec.
g ,, Sheet	,,	£175	£10 dec.
g ,, Rod	,,	£175	£10 dec.
d ,, (Electrolytic) Bars	,,	..	..
d ,, ,, Sheets	,,	..	..
d ,, ,, Rods	,,	..	..
d ,, ,, H.C. Wire	per lb.	..	..
f Ebonite Rod	,,	3/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/3	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	3/3	½d. dec.
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
l ,, Wire, galv. No. 8, P.O. qual.	,,	£36	..
g Lead, English Pig	,,	£32 5	..
g Mercury	per bot.	£18 15	..
e Mica (in original cases) small	per lb.	6d. to 3/-	..
e ,, ,, ,, medium	,,	3/6 to 6/-	..
e ,, ,, ,, large	,,	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/11	..
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	,,	..	..
n ,, Wire, Nos. 1 to 16	per lb.	2/11	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons
r W. F. Dennis & Co.

"America's Electrical Week." — From information supplied to us by the Society for Electrical Development, it appears that the results of the "Electrical Week" surpassed those of the "Electrical Prosperity Week" of last year. The flood-lighting of the statue of Liberty opened the week with spectacular effect, and gained universal publicity, but, as a rule, the celebration was more of an educational character than in 1915. Some of the methods adopted for exciting public interest were very striking, and expense appears to have been a minor consideration. At Portland, O., a great Christmas tree, 100 ft. high, "blossomed into a jewelled fire of incandescence" on the opening night of the week, while electrical genii ran up and down the streets turning on festoons of lights which illuminated the city's shopping sections. Search lights played in varied colours on steam curtains sent up from the North-Western Building. At Chicago, Ill., many of the city's noted electrical engineers and merchants addressed crowds in the High Schools; the lectures were illustrated, and treated of various topics of electrical interest.

Coloured slides appeared all the week in 750 Chicago motion picture theatres. One thousand delivery wagons carried muslin signs. Every department store and dealer displayed the "Aladdin" poster, and 4,500 cars on the surface lines carried the design. The Commonwealth Edison Co. distributed $1,000 in prizes for essays to Chicago High School students on "The Comforts and Conveniences of Electricity in the Home." Contractors were awarded cash prizes for the highest total of contracts for wiring old and new residences under a co-operative plan.

At 46 towns electrical exhibitions were held, and hundreds of thousands of booklets and other advertising matter were distributed by post. At Pueblo, Colo., the Arkansas Valley Railway, Light and Power Co. held an electrical show; novel indoor and outdoor features advertised the show, one of the street features being a "talking lamp-post" connected with a phonograph in the company's office, by means of which selections from grand opera, political speeches, and lectures on electricity were heard by crowds in the street. Certainly it was some week. A special article in *Leslie's Illustrated Weekly*, which claims to be read in 420,000 homes, admirably set forth the advantages of electricity in housekeeping, with the aid of eloquent illustrations, and the Press generally supported the campaign with enthusiasm.

SMALL ELECTRIC MOTORS.

By "BOOSTER."

The use of small electric motors might, in the opinion of the writer, be much more general if greater endeavours were made to demonstrate to householders, shopkeepers, and others the advantages they offer in connection with the operation of small machines. There are, for instance, numerous hairdressers who still adhere to a manually-operated wheel for working their machine brushes, whilst it is not uncommon to find gas engines and other primitive forms of motive power employed for grinding coffee in large grocers' shops. The uses to which small electric motors may be put in the home and in various businesses are innumerable, and these motors provide a highly desirable, convenient, and economical method of performing many operations ordinarily done by hand. For driving sewing machines, washing machines and wringers, coffee grinders, meat choppers, vacuum cleaners, and other household appliances, there is still an immense field for the electric motor. What is wanted to accelerate this branch of the industry is more vigorous propaganda on the part of central station authorities. Motor manufacturers particularly American manufacturers, have developed a large variety of sizes and types of small motors to meet the requirements of various devices and machines, and the varying frequencies and voltages met with on ordinary commercial circuits. Thoroughly reliable motors can be obtained for all outputs and all ordinary voltages down to about $\frac{1}{30}$ H.P., and, so far as the writer can see, there is no very logical reason while these small motors should not be employed more extensively in business establishments and in the home.

In the middle-class and wealthy residential areas every endeavour ought to be made to encourage the use of electric motive power: for although fractional horse-power motors consume little current, they will, if connected to electric lighting mains in large numbers, materially increase the day loads.

The difficulties involved in applying small motors to household appliances are not, as a rule, very formidable, although certain points must be observed. In some cases, for instance, the absence of noise is of vital importance, and if proper precautions are not taken in this direction small motor applications are apt to fail lamentably. The writer experienced, some time back, considerable trouble with a small motor, owing to excessive noise which emanated from the gearing between the motor and the driven machine, and it would appear that if quiet running is essential, as, for instance, when motors are used for driving talking machines and musical instruments, gearing in the form of ordinary spur wheels should be avoided. As an alternative to such gearing a belt, chain, or friction drive may be used; but, of course, where speed reduction is unnecessary, the motor may be directly coupled to the driven machine, preferably through a flexible coupling. Worm gear may also often be used with advantage, especially where the required speed reduction is large. The advantage of the friction drive, which has been applied with success to moving picture machines, is that it allows of speed variation without altering the speed of the motor, whilst the advantages of a chain drive over a belt are that the drive in the latter case is positive, and large speed reductions can be obtained with a comparatively short distance between the driving sprockets. Hence the method of driving is determined, not only by the question of noise, but also by the amount of space available, the general character of the machine to be driven and the ratio of the reduction desired. As many small motor-driven machines are connected to the circuit only for short intervals, and are idle the greater part of the time, it may be possible to use a very small intermittently rated motor, but it is far better, if immunity from breakdown is desired, to employ a motor that will work the machine continuously at full load, for it is to be remembered that in private houses and business establishments motors will, as a rule, be left to the mercy of people who are not electricians in any sense of the word, and machines are apt to be left running for indefinite periods.

On direct-current circuits a simple shunt motor will in many cases serve quite well, although, of course, when the required starting torque is excessive, use may have to be made of a compound motor. Co-operation between the makers of household appliances and manufacturing electrical firms would, it seems, be beneficial. The makers of coffee-grinders and roasters, meat-choppers, washing and wringing machines, and other machines and appliances of a kindred nature might be approached with advantage, with a view to getting them to adapt their machines to the electric drive, for it is owing in no small measure to the co-operation of machine tool makers and electrical manufacturers that electric driving has, of late years, made such excellent progress in engineering workshops. If household appliances were turned out complete with electric motors in the same way as machine tools and certain other contrivances, the effect would, in all probability, be beneficial to central station engineers and everyone concerned. In America a great deal more has been done in this direction than has been done here. Motors are combined with all kinds of household machines and appliances, with the result that all that has to be done when they are delivered, is to connect them up to the supply circuit. A machine that is designed to be worked by electricity is, as a rule, infinitely better than one that is fitted with a motor as an after thought. Such machines are usually very compact, for the motor is placed in the best possible position, and owing to the accumulated experience of the firms that supply the motors, trouble is unlikely to arise. Just as an engineer who is in the habit of electrifying factories can determine with little trouble what type and size of motor is required to drive a given machine, so can those who are accustomed to household appliances easily pick out a motor that will, under given conditions, perform the work in the best possible manner.

As regards the special features that small motors should possess, lightness is not infrequently a matter not to be ignored, for many small motor-driven machines are of a portable or semi-portable character. Maximum output with minimum space is another desirable feature.

On single-phase alternating-current circuits two distinct types of motors may be used—the so-called split-phase induction motor and the series-commutator motor with laminated poles. On an alternating-current circuit an ordinary shunt motor will not, of course, work. The series motor develops a good starting torque, and is used very largely for working small electric tools, fans, and vacuum cleaners. The early split-phase induction motors developed a very poor starting torque, and not infrequently a clutch was fitted which allowed the rotor to run idle until a predetermined speed had been reached. In this direction, however, considerable improvements have of late years been made, and motors are now built by American manufacturers that are said to exert at starting a torque equal to the full load torque. Motors with clutches are, however, still occasionally used. The advantage is, of course, that the machine develops a maximum starting torque with a minimum starting current. Motors of the induction type are very sensitive to variations in the supply pressure, since the torque varies approximately as the square of the applied pressure. It is, therefore, advisable when purchasing small induction motors to be connected to ordinary lighting circuits to select a machine that will develop the maximum torque likely to be required with a reduction in the voltage of 10 or 15 per cent.

Perhaps the most useful service to which small electric motors can be put is that of driving small tools—such as drills, grinders, polishing buffs, and so forth; and for this class of service a series motor is, as already indicated, usually employed. Although the electric tool industry has made remarkable headway within recent years, these tools have not as yet by any means entirely displaced small tools, such as drills, &c., worked with compressed air. Of course, in the early days, small electric tools were rather troublesome, especially those made abroad, and the bad reputation they gained is not to be wondered at. For a long time past, however, excellent portable electric tools have been made in this country, and they are now used in many engineering factories and shipyards. There are, however, many works in which compressed air remains in vogue, and the electrical tool industry has undoubtedly still to be developed. With modern portable electric tools most electrical engineers are now quite familiar, and it is unnecessary to describe them. It will suffice to say that the old trouble in the way of heating has been overcome, in a large measure, by fitting a fan to the armature shaft, which ventilates the armature windings. As the motors are series-wound, the speed increases considerably when the tool is removed from the work, with the result that the fan delivers at these periods a large volume of air. For many classes of work, the scheme of combining the motor with the tool leaves little to be desired. Since aluminium can be used in the construction of some of the mechanical parts, powerful tools can be made without undue weight. When large powers are required, however, power from a motor can be transmitted to the tool through a flexible shaft. The motor can then, of course, have any desired capacity, for it can be mounted on a truck to facilitate its removal from place to place. The weight of the motor in this case does not count. Upon the other hand, a certain amount of power is lost in the flexible shaft, hence the efficiency of the unit is not so high as when the tool and motor are combined. But when a powerful motor is required for drilling, grinding, or other work, the flexible shaft arrangement enables such a motor to be employed.

There is, it seems, a considerable field for portable electric tools and small motor applications in garages where motor-cars are cleaned and repaired. For inflating tires, for instance, the use of small motor-driven air compressors might be encouraged. Incidentally, compressed air is also useful for cleaning upholstery. For heating garages, moreover, there is nothing safer or cleaner than an electric heater, so that altogether motor garages would appear to offer excellent opportunities for the sale of electrical energy. So far, the majority of motor-car repairers in this country have failed to recognise the ways in which electricity can be used in their business, and steps ought to be taken to enlighten them.

IMPORT TRADE OF CHINA.

The Chinese Imperial Maritime Customs have just issued a volume giving the countries of origin of the principal imports into China during 1913-15. The following figures, showing the value of imports in 1914 and 1915 of goods of interest to the electrical engineering industry, have been extracted from this volume, and the increases and decreases shown. It is to be noted that the average value of the Haikwan Tael in 1914 was 2s. 8¾d., and in 1915 was 2s. 7⅛d.

Machine belting.—	Hk. Tls. 1914.	Hk. Tls. 1915.		Hk. Tls. Inc. or dec.
From Great Britain ...	144,000	198,000	+	54,000
,, Germany	31,000	—	–	31,000
,, Belgium	7,000	—	–	7,000
,, France	500	—	–	500
,, Russia	16,000	9,000	–	7,000
,, Japan ...	57,000	64,000	+	7,000
,, Other countries ...	30,500	86,000	–	55,500
Total	286,000*	357,000†	+	71,000

* Includes 8,000 Hk. Tls. re-exported.
†Includes 2,000 Hk. Tls. re-exported.

Electrical materials and fittings.—				
From Great Britain ...	736,000	404,000	–	332,000
,, Hong-Kong ...	244,000	260,000	+	16,000
,, Germany	735,000	1,000	–	734,000
,, Belgium	71,000	8,000	–	63,000
,, Italy	30,000	20,000	–	10,000
,, Japan	688,000	845,000	+	157,000
,, United States ...	135,000	285,000	+	150,000
,, Other countries ...	154,000	262,000	+	108,000
Total	2,793,000*	2,085,000	–	708,000

* Includes 37,000 Hk. Tls. re-exported.

Asbestos.—				
From Great Britain ...	24,000	33,000	+	9,000
,, Germany	8,000	—	–	8,000
,, Belgium	16,000	—	–	16,000
,, Russia	16,000	24,000	+	8,000
,, Japan	19,000	16,000	–	3,000
,, Other countries ...	9,000	8,000	–	1,000
Total	92,000	81,000	–	11,000

Aluminium, manufactures of. –	Hk. Tls. 1914.	Hk. Tls. 1915.		Hk. Tls. Inc. or dec.
From Great Britain ...	2,500	1,000	–	1,500
,, Germany	5,000	—	–	5,000
,, Belgium	1,500	—	–	1,500
,, Russia	2,000	1,000	–	1,000
,, Japan	22,000	7,000	–	15,000
,, Other countries ...	2,000	—	–	2,000
Total	35,000	9,000	–	26,000

Copper wire.—				
From Great Britain ...	7,000	3,000	–	4,000
,, Germany	29,000	—	–	29,000
,, Belgium	1,500	—	–	1,500
,, Japan	143,000	123,000	–	20,000
,, Other countries .	6,500	12,000*	+	5,500
Total	187,000*	138,000*	–	49,000

* Includes about 5,000 Hk. Tls. re-exported.

Copper, bars, rods, sheets, plates, and nails.—				
From Great Britain ...	12,000	11,000	–	1,000
,, India	3,000	3,000		—
,, Germany	4,000	—	–	4,000
,, Belgium	13,000	—	–	13,000
,, Japan	542,000	81,000	–	461,000
,, Other countries ...	11,000	22,000	+	11,000
Total	585,000	117,000	–	468,000

India-rubber and gutta-percha manufactures.—				
From Great Britain ...	40,000	31,000	–	9,000
,, Germany	9,000	—	–	9,000
,, France	14,000	21,000	+	7,000
,, Russia	186,000	90,000	–	96,000
,, Japan	47,000	202,000	+	155,000
,, Other countries ...	34,000	41,000	+	7,000
Total	330,000*	385,000	+	55,000

* Includes 58,000 Hk. Tls. re-exported.

Telegraph and telephone materials.—				
From Hong-Kong ...	97,000	79,000	–	18,000
,, Great Britain ...	59,000	171,000	+	112,000
,, Germany	224,000	—	–	224,000
,, Belgium	56,000	—	–	56,000
,, Japan	78,000	65,000	–	13,000
,, Other countries ...	53,000	95,000	+	42,000
Total	567,000*	410,000	–	157,000

* Includes 32,000 Hk. Tls. re-exported.

Railway carriages and wagons, including tramcars.—				
From Great Britain ...	603,000	100,000	–	503,000
,, Germany	75,000	—	–	75,000
,, Belgium	1,470,000	10,000	–	1,460,000
,, Russia	28,000	13,000	–	15,000
,, United States ...	86,000	172,000	+	86,000
,, Other countries ...	78,000	335,000	+	257,000
Total	2,340,000*	630,000	–	1,710,000

* Includes 117,000 Hk. Tls. re-exported.

NATIONAL INSURANCE (UNEMPLOYMENT) ACTS 1911 TO 1916.

UNEMPLOYMENT INSURANCE.

Decisions by the Umpire.

CONTRIBUTIONS ARE PAYABLE IN RESPECT OF :—

2,088 X. All workmen engaged wholly or mainly in sawmilling or machine woodwork, whether in connection with insured or uninsured trades or independently, with the exception of those already insurable under Part II of the National Insurance Act, 1911.*

487 X. Workmen engaged in the installation or erection of accumulators in buildings, ships, or vehicles.

(This involves reconsideration of Decision 1,962 X.)

NOTE.—Decision 1,962 states that the Umpire has decided that contributions are not payable in respect of :—

Workmen described as out-door erectors and engaged wholly or mainly in the installation of accumulators.

CONTRIBUTIONS ARE *not* PAYABLE IN RESPECT OF :—

2,087. Volunteer workers employed on munitions work in their spare time and engaged for less than the normal factory hours of the place where they work, provided that they are :—

1. Free to come and go or stay as they please.
2. Are not dependent upon earnings at munitions work.
3. Are not badged in respect of the munitions work.

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* The term "sawmilling and machine woodwork" includes the cross-cutting, boring, turning, polishing, or sandpapering of wood by power-driven machinery.

COLONIAL TELEGRAPHS AND TELEPHONES.

By R. W. WEIGHTMAN, M.I.E.E.

(Abstract of paper read before the Institution of Electrical Engineers.)

(Continued from page 713.)

Engineering.

There is practically no overhouse construction in any of the Dominions or Colonies, and the chief difference in the construction of pole lines lies in the character of the pole employed. Where timber is plentiful and there are no local drawbacks to its use, wood poles are the rule, but where it is scarce or not of suitable size or quality, or where it is liable to be attacked by white ants, or destroyed by grass or bush fires, iron poles are used.

White ants abound in practically all the tropical Colonies, and while it is usual in such countries to find an indigenous wood which is more or less immune from their attacks, like the teak-wood of Burmah, the cedar of British East Africa, and the sneeze-wood of South Africa, it is not always suitable for use as telegraph poles.

There are two types of tubular iron poles with cast-iron bases and wrought-iron taper upper tubes in general use in the Crown Colonies. The advantage in the tapering top is that it combines strength with lightness. The taper is lap-welded in machines specially designed for the purpose. In the original joint the space between the tube and the base was filled with a sulphur-oxide-of-iron cement, but in nearly all poles ordered now either the screw ring joint, or the taper ring joint is used. The author prefers the latter because it fits automatically, and it eliminates two items from the stores list, namely, the separate screw ring and the screw-ring spanner.

In all these poles the cast-iron base is of sufficient length to keep the wrought-iron tube out of the ground when the pole is planted to its proper depth. The depth of the socket varies from 6 in. in a 20-ft. pole to 12 in. in a 30-ft. pole.

All cast-iron bases were originally made without the wrought-iron band which is now shrunk on to the top end of the base. Before the band was brought into use it was a common thing for a base to split at the socket in cold, gusty weather, but the band entirely prevents this.

The top end of each pole is bossed and a wrought-iron lightning rod about 18 in. long by ½ in. diameter is usually driven into a tapered hole in the boss. Sometimes, however, an insulator spindle is screwed in, but this is a practice not to be recommended. Where lightning storms are frequent the insulator runs great risk of being struck, and in any case a wire running along the tops of poles is very much in the way of the lineman.

One type of pole has its base pointed, the point being solid for about 5 in., so that it can be driven into the ground by means of a special rammer which is dropped inside the base. A wooden disk about 2 in. in thickness is first put into the base to take the impact of the blows from the rammer off the cast iron. Where the ground is at all sandy or marshy a ground plate can be used. It is slipped over the bottom end of the base and wedges up against a narrow bead on the casting about 12 in. from the top. This pole will carry a horizontal load of about 80 lb. at a point 12 in. from the top.

The standard type of pole used has a cylindrical cast-iron (parallel) base with square flange at the bottom end to which a buckled base plate is bolted.

Poles of this type are made in a number of standard lengths and strengths. Where the length is 40 ft. or over, the upper part is made in two or more sections. The cast-iron bases and buckled plates are usually dipped in Angus Smith's compound, while the tubes are dipped while hot in hot linseed oil. A factor of safety of 2 based on a wind pressure of 17 lb. per square foot is sufficient for these poles in countries where there are no snow and ice accumulations to be taken into account. Where snow and ice occur a factor of safety of 4 should be allowed.

The cast-iron bases used in South Africa have circular flanges at their bottom ends, with four strengthening webs extending from the flanges about 18 in. up the base. This flange is of larger area than the square flange, and can be used without a base plate where the ground is sufficiently firm. Fig. 1 shows a light pole specially designed for South Africa. It is used on farmers' lines and carries one or two pairs of wires between main routes and the homesteads. It is 18 ft. in length and has a wedge joint. It will carry wires having a total lateral stress of about 80 lb., 12 in. from the top. It is probably the lightest and cheapest pole used in telephone practice anywhere. The upper tube is high-grade steel galvanised, and the lower section is cast iron. The cap is of cast-iron and the lightning rod wrought-iron. The bracket, spindle, and insulator used with this pole are also shown in the figure.

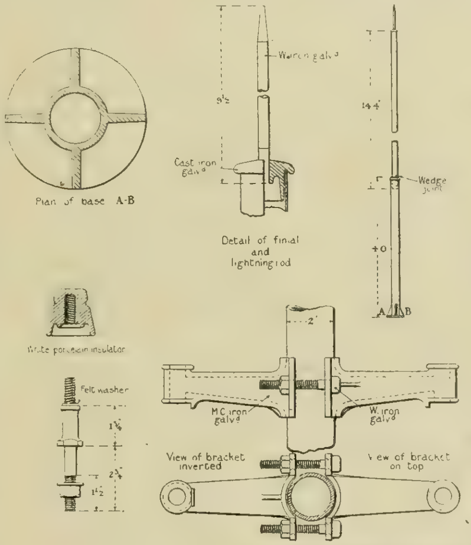
There is a parallel pole of a more ornamental type which is used for special street work in South Africa. There is no cast-iron base with it, but it is protected from corrosion at the ground line by means of a sleeve which is shrunk on. It is 26 ft. in length, and will bear a maximum load of about 300 lb. at the top when planted 4 ft. in the ground. Where poles of similar type have been planted without the sleeve protection, corrosion has often taken place at and above the ground line. This has been prevented by the use of cast-iron sleeves made in two longitudinal half-sections with their edges overlapping. When the two half-sections are screwed together they have a neat cylindrical appearance. The small space between the sleeve and the pole is caulked with yarn and red lead and painted over.

In some of the Crown Colonies tubular poles of the type introduced by the Indian Government, and known as the Hamilton pole are used. These consist of riveted tubes of steel sheet fitting into cast-iron sockets having cast-iron sole plates. A full-length pole is about 58 ft. out of the ground, and comprises eight sections, each 8 ft. long. The poles taper from about 12 in. at the bottom to 3 in. at the top. They are jointed together by the upper tube in each case being driven over the next lower one, and each joint is strengthened by a stiffening hoop shrunk on. Each section has its own cast-iron socket with sole plate, which is known by the letter corresponding with the tube it fits. The sole plate screws on to the socket. The top of the pole is fitted with a cast-iron cap with lightning rod, which is driven into the top of the tube. The above-ground parts are always galvanised, while the sockets and plates are dipped in Angus Smith's compound.

The number of poles to the mile varies with the class of line, from 20 to 40 to the mile. The author has had experience of spans up to 800 yds. in length over rivers and ravines standing quite satisfactorily for many years. Hard-drawn copper wire was used on spans up to 300 yds., whilst above that length bronze was used. Copper wire can be fully relied upon for long spans so long as a reasonable factor of safety is allowed. In a country where snow is almost unknown this may be as low as two, but it should include full allowance for wind pressure. The poles are specially stayed, double width spacing is given on the arms, only one quality and gauge of wire is erected, every care being taken to adjust all the wires to the same dip, and no joints are made in the spans. With these precautions the wires all swing in unison and there is no trouble.

The stays used throughout these countries are of British Standard types with tighteners and with iron anchor plates, which are usually tarred. Where the stay wire is fixed to an iron pole it is made off over a special clip. It is bad practice to fix it over an arm or bracket, as is often done.

Where iron poles are employed near the sea they can only



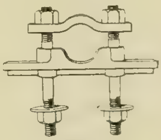


Fig. 2.

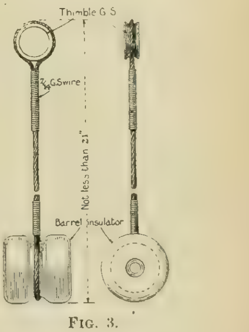


Fig. 3.

Fig. 1.—Light Pole with Double Bracket, Spindle, and Insulator (South Africa).

Fig. 2.—Combination Bracket with Shoulder Bolts for Tubular Iron Pole.

Fig. 3.—Barrel Insulator with Sling (Australia).

be preserved from corrosion by being frequently painted or tarred. The author has tried every kind of paint for this purpose, but he found none to stand any better than coal tar applied in the heated state. It is much cheaper than paint, and where native painters do the work the waste which is inevitable is not so serious a loss.

Discarded railway rails are used at certain places, the rails being set with the web of the rail at right angles to the direction of the line. Planted the other way about they are liable to bend over in very windy weather.

In Canada wood poles and arms obtained from timber grown in the country are used on both telegraph and telephone lines. There are no iron or reinforced concrete poles in use. The poles are generally of cedar. They are generally cut to an apex at the top, the apex being at right angles to the arm, but they are not fitted with pole roofs.

The practice in respect of the providing of earth wires on poles varies, but it is nowhere the rule to earth-wire every pole.

At road and railway crossings poles of suitable length are used to give clearances of 16 ft. over roads and 25 ft. over railways when the ultimate lowest cross-arm has been fitted. A clearance of 3 ft. is allowed either over or under when the wires of another administration are crossed.

In Australia both wood and iron poles are used, the selection depending generally upon whether or not dangers from white ants or bush fires have to be met. Several types of iron poles are employed, the principal being the Siemens taper pole with cast-iron base and screw ring joint. For light lines the Oppenheimer iron pole, iron tubing, and old railway rails are also used. The Oppenheimer pole has a cast-iron base shaped like a dart, with moderately sharp cutting edges, which permit of its being driven into the ground. In the upper part a socket is formed into which the wrought-iron tube is fixed by means of iron wedges.

All the wood poles used are obtained from trees indigenous to the country. In districts infested with white ants all poles are protected from their attacks by the application of a solution of arsenic (1 lb.) and caustic soda (2 lb.) dissolved in one gallon of water. The pole is well coated with this mixture by means of a long-handled tar brush for a distance of 18. in. above and 18 in. below the ground-level. The solution is given a few hours in which to soak into the timber, when it is given a coating of coal tar composition consisting of gas tar (7 parts), Stockholm tar (3 parts), and fresh-slaked lime (3 parts). The ground for a distance of 1 ft. around the pole is well sprinkled with the exterminator, and this is covered with 9 in. of unpoisoned earth. Another method is to bore one or more holes with a ⅜ in. auger in a downward direction to the centre of the pole, and to fill the holes with the exterminator, the holes afterwards being plugged with hard wood plugs which are gently driven in and then cut off flush with the pole.

The minimum height from the ground of the lowest wires along the road is 12 ft., and at the road crossings 18 ft. All wood poles are provided with lightning conductors of No. 8 galvanised iron wire fixed with staples 2 ft. apart. The top of each pole is cut to an apex, which is placed at right angles to the line. It is coated with coal-tar composition and fitted with a galvanised iron roof of sufficient size to project 2 in. beyond the pole on all sides.

New Zealand has a greater variety of types of poles than most countries. Poles of wood, tubular iron, reinforced concrete, and discarded railway rails are in use. The wood poles are mainly got from indigenous trees. There are no white ants in New Zealand, and poles are but rarely damaged by fires. The poles are not earth-wired.

Tubular iron and steel poles have come more into use within the past few years. They are of both solid drawn and lap-welded types, although not of the standard taper pattern so much employed in South Africa and other countries. They are used in the larger towns for telephone exchange distribution purposes, also in the lighter sizes on some light country lines, where it is advantageous to use them owing to the ease with which they can be transported and handled over rough country.

The reinforced concrete pole used is of solid construction, the cross-section being rectangular. When erected the longest side of the pole is placed at right angles to the line, a factor of safety of 2.5 being allowed. Hollow concrete poles are not employed.

Poles of 52-lb. and 70-lb. discarded railway rails are largely used, and are said to make splendid lines. Where extra strength is required, as at angles, two rails with their flanges bolted together are often used, and where a line is required to be specially strong every fifth pole is doubled in this way. Poles of this type have been used for a great many years, and are so favoured that they would be in general use but for the fact that they are not available in the quantities required. Special castings are made to attach the arms to these poles.

POLE FITTINGS.

There are many types of iron brackets and arms available for use with iron poles, and South Africa may take some credit for having helped to evolve a number of useful improvements to these fittings.

The bracket shown in fig. 1, p. 25, is of malleable cast iron. It is typical of many other patterns which vary mainly in the size of the seat. A similar bracket is made for four wires. For one wire only a single bracket with a back strap is used. On this bracket there is a small projection which locks the spindle nut, and so prevents it from getting loose owing to vibration.

For a wood arm Jobson's combination bracket is a useful fitting. This was originally made with straight fixing bolts, and it is still used in this form by some administrations. In South Africa it gave much trouble owing to the arm shrinking in dry weather and causing the clamp to become loose. On angle poles this often allowed the arm to cant, and even to twist right round. To prevent this, and to enable the clamp to be tightened up on the pole independently of the arm, the author's old chief in Natal, the late Mr. T. T. Hardaker, devised the shoulder bolt shown in fig. 2. With this bracket the clamp is first tightened up against the shoulders of the fixing bolts, and not till this is done are the nuts on the arms screwed up. This improvement made the Jobson bracket a thoroughly reliable one, and many thousands have been used in South Africa and elsewhere.

With the introduction of the tubular iron arm by the Post Office in England several of the Colonies quickly took it up, and with some of these it is now the standard arm.

Tubular arms are made of different diameters and thicknesses of iron, but the sizes most commonly used are all 1 11/16 in. diameter by Nos. 7, 9, and 12 S.W.G. thick. They are always galvanised. Tests show that the No. 9 gauge tube is sufficiently strong for all practical purposes.

If line construction is good the maintenance costs will be low, and the great advantage of freedom from faults is gained. Loss of time to telegraphists, delays to telegrams, and annoyance to subscribers to telephone systems which result from interruption to wires are reduced to a minimum if the constructional work is of the best. Probably in no other class of engineering is the success of a work dependent upon factors of such low values mechanically as in telegraph and telephone engineering. A telegraph line may be 1,000 miles in length, and its good working depend not only upon a thin wire having a breaking strain of 500 or 600 lb., but even more so upon scores of little joints and connections spread over its entire length. Good materials, properly standardised for the different classes of lines and work, and good workmanship are of the greatest importance. They may cost more initially, but they pay in the end.

Double-shed white porcelain insulators of Post Office types are generally used in these Colonies and in South Africa. On the farmers' lines in South Africa and on some lines in British East Africa a small single-shed porcelain cup is used. It is quite a satisfactory light line insulator for use where the climate is dry. The spindles and cupholders used with these cups are generally of the standard types adopted by the British Engineering Standards Committee.

Black insulators of the large P.O. pattern made from a bituminous composition have been given a trial in several of the Colonies, but are not highly spoken of.

Glass insulators, so much used in the United States and Canada, where the climate is dry, are not used to any extent in the Crown Colonies, and not at all in South Africa. The inferior insulation of glass as compared with porcelain has been against its adoption. Some insulation tests of porcelain and glass insulators of the same size and shape, carried out for the author recently, gave an average of 50,000 megohms for the former and 3,500 for the latter. Glass insulators are much affected by changes of temperature, and are liable to fly to pieces even when these changes are comparatively slow. In India, where glass insulators were tried, they had to be abandoned because of this weakness. Porcelain insulators are less affected by temperature changes. They are tougher, and when used in the standard manner on screwed spindles with elastic washers of felt or india-rubber they are quite reliable. Felt washers are generally used to-day. They are cheaper than rubber and equally efficient. Where porcelain insulators are fixed to the spindles by a non-elastic cement they are liable to be shattered during rapid changes of temperature. Porcelain insulators of Continental make have been used in some of the Colonies, but they are extremely brittle, and it is no uncommon thing for the internal threads to be completely broken away by the swaying of the line wire after the insulators have been in use a few months. The insulation of a line is a matter of the first importance. The best insulator gives the best service, and the author is prepared to say that no insulators made are to be compared either for insulation, strength, or general serviceableness with the British Post Office standard porcelain types as made in England.

In Canada both porcelain and glass insulators are used on both telegraph and telephone lines; but, owing to the wonderful dryness of the climate, glass is found to give sufficient insulation in most localities and is largely used, mainly in the single-shed form. Where high insulation is required on both telephone and telegraph circuits, as on long-distance lines and in wet districts, porcelain is used. The insulators are usually held on wood pins, screwed with a large thread to take a corresponding thread in the insulator. This pin has a tapering shank which fits rigidly into the hole in the arm. In some cases a steel pin is used with iron washer and nut at the arm end, and with a wood thimble on the top end to take the insulator.

In Australia wood arms and single iron brackets are used on both wood and iron poles.

The standard insulators used are of porcelain or stoneware of double-shed type and made in two sizes. They are threaded internally and are usually carried on wood pins similarly threaded, although iron spindles with lead-screw tops are also used. The wood pins are made to fit tightly into the wood arms. Where there is a possibility of the wire lifting the pins out of the arm or bracket a piece of 200-lb. galvanised iron wire is passed through a hole in the shank of the pin, and the ends are twisted together.

The "cheaply constructed line" is a novel feature authorised by the Commonwealth Department. Such a line is only erected when the cost of a standard pole line is prohibitive, and it is erected on trees, saplings, scantlings, and fences. Owing to the low efficiency of the insulation this class of line is used almost exclusively for local telephone services. Where saplings are used they must not be less than 12 ft. long and 3½ in. in diameter at the top end. Scantlings must be of hard wood not less than 2 in. by 3 in. in section and 10 ft. long. Swan-neck spindles with pattern A or B insulators are the standard on straight sections of line. Where the wire is attached to a tree a sling insulator as illustrated in fig. 3 is used. This is bound to the tree by means of a strand of four No. 14 gauge galvanised iron wires which is passed through the hole in the barrel insulator, and the tension on the wire is always in such a direction as to draw the insulator away from the tree. Similar slings 12 in. in length are used on angle poles. Where the wire is carried on fencing posts barrel insulators of the same type are employed. They are fixed with spikes, and the wire is taken over the top of the insulator and bound thereto.

In New Zealand the insulators used are of standard Post Office white porcelain types, the large size on heavy lines and the small size on exchange distribution work. Iron arms are not used.

(To be continued.)

Discussion.

Col. A. M. J. Ogilvie, in opening the discussion, said the paper was an excellent supplement to Mr. Preece's paper on a similar subject, and covered the general standard practice of a number of Colonies. It was extraordinary what difficulty was met with in Colonial telegraph work, in keeping abreast of standard practice and in getting the best equipment, and this revealed a weak point in our national organisation, which should be overcome after the war. Steps were being taken in this country before the war to secure general standardisation, and the idea should be extended to include the Colonies after the war.

Mr. Llewellyn Preece said the paper told of practice throughout the world, and it would be welcomed by colonial engineers as an assistance in overcoming their difficulties. The most important section, he thought, was on administration; engineers were not often interested in it, but it was most important that they should study it. The engineer, purely, was of little use in the higher positions, which became more and more managerial. The New Zealand telephone department in the early days used to char the butts of the poles, but in one case a contractor forgot to do this, and ten years after, investigation showed that the only poles which were not falling down were those which were uncharred, and as a result it was decided to abandon the practice of charring. In regard to pole life, an instance occurred to him of poles which had been standing 38 years being found in good condition, and moved for use again. These poles had been erected only six weeks after they were growing, and their life was unprecedented in this country.

Mr. F. R. McBerty said that in Western Canada and New Zealand telephonic development had been very rapid; in New Zealand machine switching had been largely adopted, and as a result of the extensive progress the telephone saturation in the Dominion was 5 per cent., and in individual cities it was 8 or 9 per cent. It was decided to adopt automatic switching in 1912, and contracts had been entered into for about 30,000 lines. These developments would in a short time result in one area having the largest automatically-worked system in the world. A reason for automatic working was high wages, but the main purpose in view was the improved quality of the service—not economy, although it was estimated there would be from 25 to 50 per cent. saving.

Sir Wm. Slingo said he felt exceedingly proud that engineers the world over could fall back on British Post Office practice. In this country there had been poles 40 years in one position, but the average was much less, as most poles were removed before their utility ceased, to make room for larger ones, or in the course of alterations. The question of waiting for material in the Colonies would not arise if a reserve stock were carried; in this country the P.O. held a large stock based on one year's consumption. Not many iron poles were used here, as they were not necessary. He asked why experiments were made with solid as against tubular reinforced concrete poles.

Mr. E. O. Walker asked whether aluminium wire was used at all; he considered iron wire preferable to copper or bronze in tropical conditions, as if a tree fell on iron wire and brought it down, it was still possible to work through it.

Mr. A. Moir said three types of cable joints were employed in telephone work: the air space joint, the boiled-out joint—which was not a solid joint, there being space for air to pass—and the solid joint, which was hermetically sealed. All engineers were agreed about the latter; it was usually introduced at the end of an air-space cable before the wires spread out at the exchange. He thought the air-space joint had some virtues; in crowded city streets there were considerable risks in handling the boiled-out joint, though it might be quite safe on a country road. The practice in desiccation in this country was to apply it at the point of trouble; originally the plant was installed at the exchanges, but it was found not to have a very efficient range.

Mr. Crawter could not understand anyone complaining about the complexity of an ordinary lighting job, when familiar with automatic telephone plant. Colonial engineers were to be congratulated on the life of their storage plant; personally, he thought it better to charge from the mains than use a motor generator in the small sizes.

Mr. C. C. F. Monckton, speaking as a visitor from Fiji, thought that some variation might be required in standard methods in each Colony due to labour and climatic conditions. As regarded delays in delivery of material, in Fiji it was at least a year before it was received, and work thought out in 1912 was finished in 1914 or 1915. They had separate telegraph and telephone departments. Labour was expensive, and hurricanes were frequent, but a governing factor was the poor house construction. Iron-bark poles were used, and some lasted 15 years; in narrow streets the lines were carried on iron brackets attached to balconies. During hurricanes, the galvanised roofs were often blown off, and in their flight would cut through whole groups of wires, so an attempt was being made to use cable instead of numerous wires. In the country tubular metal poles were used instead of iron-bark poles, being lighter to transport. It was found that no creepers grew up the square iron-bark poles, but if a stay were put up, the creepers had to be cleared off it about once a month. The Siemens vacuum arrester was used for protection against lightning.

Mr. D. H. Kennedy assumed from his remarks on Canada that the author commended the dry-core joint; in London they had some doubt as to the boiled-out joint. The cost of desiccating in a large city was considerable for air-space joints.

Mr. W. Aitken believed he was the first to point out the need of a leading-in insulator, but it seemed that with two wires on the same insulator, its function of preventing leakage might be defeated. He did not believe in giving the telephone subscriber anything to do after he had got his connection, and he thought it was a mistake to ask him to depress a key when he had finished, as was the practice in some cases. The American train dispatching telephone system in a modified form had, he thought, been adopted in English railway practice, but not for train dispatching.

Mr. Frank Gill said, as regarded joints, the boiled-out type was far ahead of the dry joint. It would stand more bad usage than the latter, and did not develop its faults; they could, therefore, do without expensive drying-out plant, which was, or should be, idle most of the year.

Major A. C. Booth expressed surprise at the use of the barrel insulator (in Australia); it had dropped out of home practice. All the systems of high-speed apparatus were now in competition, and it was very interesting to hear anything about them; figures as regards maintenance ought to be available now. The only difference between the Baudot system in use in Ceylon and home practice was that it was worked duplex.

Mr. H. W. Pendry said the Baudot system in Ceylon just doubled the duty which was originally intended. The alphabet was very simple, and it was found that operators began to pick it up in a few hours, and became skilled in three months.

Mr. G. F. Mansbridge thought it rather hard to talk about the dilatoriness of the manufacturer in forwarding material, because this was often different in some slight detail from the usual standard article; he hoped the paper would lead to some better understanding of the conditions. He did not consider that increased power would help the Wheatstone apparatus, which was driven by clockwork.

Mr. J. E. Kingsbury also drew attention to the manufacturing side and the demand for special articles, &c., suggesting that he would like to see engineers devote attention to seeing what special modifications could be made to meet the required conditions, rather than that they should agree to accept things for better or for worse.

Mr. E. T. Williams said that in some Eastern Colonies the typhoons brought down the best constructed lines. He had found that lead-covered wires used in rooms, where the walls ran with moisture, overcame many of the usual troubles in such situations. The Chinese stole copper or bronze wire, and so it was not often used there. In North China there was intense cold and much humidity; the wires got very big owing to the frost, and this was worse than snow. He recollected a cable laid in a Chinese harbour which was specially designed to hold the largest junk which dragged its anchor.

Lieut. McArthur said the functional organisation in South Africa had been found very successful indeed. He was afraid there was still doubt as to the actual protector to adopt for lightning protection, but so far the carbon-vacuum protector was the best for inside use. With long-distance lines in South Africa it was found that they could have too much protection. The Germans had also adopted the carbon-vacuum protector in conjunction with other apparatus in German West Africa.

The author, owing to the lateness of the hour, commented very briefly on the discussion.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

UNITED KINGDOM—FRANCE.—The text of an Agreement between this country and France, respecting trade with Morocco and Egypt in transit through British and French Territories in Africa, has recently been published by the Foreign Office. Copies of the Agreement (Treaty Series No. 7 of 1916) can be obtained price ½d. (post free 1d.) from H.M. Stationery Office, Imperial House, Kingsway, W.C.

FRANCE.—A recent Presidential Decree provides that, as from January 1st, importers of goods produced in or exported from foreign counties must state in their Customs declarations the names and addresses of the persons for whom the goods are intended, and must indicate whether the goods are or are not destined for Government supplies, or work on account of the State. The Customs Authorities may demand the production of the waybills, shipping documents, invoices, &c., to check the accuracy of the statements made.

SWEDEN.—The exportation of sal ammoniac has been prohibited as from December 1st, and of lead packings as from December 9th.

ARGENTINA.—The procedure to be adopted in the case of under-valuation of imported goods has been laid down by a recent Presidential Decree, which provides that when there are presented for clearance goods which are not covered by any heading in the Valuation Tariff, and on which, therefore, duty is leviable on the declared value, such goods shall, if in the opinion of the Customs Appraisers the declared value is less than the real value, be retained by the Fiscal Authorities, and there shall be paid to the importer the declared value of the goods increased by 10 per cent.

The Decree also provides that in the case of goods dutiable according to the declared value, the Customs authorities are not to allow any application for direct clearance or for warehousing to go forward unless the consignees of the goods make a signed statement at the foot of the respective documents to the effect that they agree with the value declared.

A long over-due improvement in the conditions under which commercial travellers may exercise their calling in Argentina is foreshadowed by a Bill which was presented to Congress by the late Government of the Republic. In place of the 15 separate licences which are at present required in order to cover the whole country, the Bill proposes the use of a single licence, to be valid for one year from the date of issue. If only one branch of trade is represented the licence fee will be 400 pesos (£35), with an addition of 200 pesos for each additional branch, the maximum fee payable being 1,000 pesos (£87 10s.), which will entitle the holder of the licence to do business in all branches of trade.

Provisions are also included in the Bill to the effect that samples, sample cases, and patterns brought from abroad may be cleared through the Custom House by the presentation of a written application, stating complete and minute details of the goods, a bond being given for the value of the duties, to hold good for 30 days.

PERU.—New export duties on rubber exported *viâ* Madre de Dios and Mollendo are imposed by a recent Presidential Decree, as follows:—

Rubbers of which the price quoted in London fluctuates between 25d. and 36d. per lb.	2 per cent.
Do., do., 37d. to 40d. per lb.	4 per cent.
Do., do., 49d. or more per lb.	6 per cent.

The tax is to be assessed on 70 per cent. of the value of the rubber exported. Ordinary rubber is to pay duty on the same scale, with a reduction of 30 per cent., calculated on the 70 per cent. paid by fine rubbers.

BRAZIL.—His Majesty's Minister at Rio de Janeiro reports the inclusion in the Budget Bill for 1917 of a provision to the effect that a fourth copy of Consular invoices for shipments of merchandise to Brazil is to be made out, and forwarded by Brazilian Consuls to the Custom House of the port of destination.

MEXICO.—A copy of the official edition of the new Mexican Customs Tariff, which came into force on November 1st, has been received at the Board of Trade. This edition comprises (1) the text of the revised Tariff, (2) General Rules for its application, (3) Explanatory Notes, and (4) an Index. Particulars of the rates of duty payable on electrical goods were given in the Electrical Review of November 17th. These rates are correct with one exception, viz., the duty on "belts for machinery, of rubber, and of tarred cotton or hemp," which should read 25 centavos per kilog. gross instead of 20. The duties are fixed in national gold, and in payment thereof only national gold or American dollars will be accepted. In cases where payment is made in American currency, the American dollar will be received as the equivalent of two pesos national gold. If payment is made in Mexican silver, the Mexican peso will be received at its par value. The smaller silver currency will, however, be received at the rate of 90 centavos for each peso national gold.

A complete translation of the General Rules for the application of the Tariff appears in the *Board of Trade Journal* for December 21st, while the official edition of the Tariff (in Spanish) may be consulted at the Department of Commercial Intelligence.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Published expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

18,113. "Galvanic cells." R. Schuster. December 18th.

18,144. "Magnetos with fixed armatures." E. C. R. Marks (Soc. Anon. des Etablissements L. Blériot). December 18th.

18,145. "Terminals for electric wires." Burney & Blackburne and E. M. Cobb. December 18th.

18,158. "Electric lampholders." H. Garde. December 18th.

18,160. "Arrangement for automatically advancing ignition in explosion engines." Soc. Anon. pour l'Eclairage Electriques des Vehicules. December 18th. (France, December 29th, 1915.)

18,173. "Electric telegraphs." R. M. Sayers. December 19th.

18,184. "Insulating, &c., slabs or units." J. Davies & W. H. Jones. December 19th.

18,193. "Protective devices for electric circuits." British Thomson-Houston Co. (General Electric Co., U.S.A.). December 19th.

18,194. "Ignition magnetos for internal-combustion engines." Abingdon-Ecco, Ltd., & G. B. Bianco. December 19th.

18,208. "Dynamo-electric machinery." A. H. Neuland. December 19th.

18,225. "Flash-lamp shade." H. S. Littlehales. December 20th.

18,238. "Combined carton and shade for electric incandescent lamps." W. G. Newberry. December 20th.

18,255. "Electric voltage regulation." B. Davies & Eastern Telegraph Co. December 20th.

18,257. "Electric switches for switchboards, &c." A. H. Midgley & C. A. Vandervell & Co. December 20th.

18,285. "Electrical generator, motor or motor transformer." E. L. Davies. December 21st.

18,287. "Apparatus for electro-deposition of metals." F. R Tubbs. December 21st.

18,300. "Automatic telephone systems." Automatic Telephone Manufacturing Co. December 21st. (U.S.A., December 31st, 1915.)

18,301. "Protective devices for electric circuits." British Thomson-Houston Co. (General Electric Co., U.S.A.). December 21st.

18,307. "Operating electric switches from a distance." A. H. Francks and Telephos Domestic & Street Lighting Co. December 21st.

18,323. "Manufacture of filaments for incandescent electric lamps." Westinghouse Metal Filament Lamp Co. (Westinghouse Lamp Co.). December 21st.

18,324. "Distribution boards." Soc. Anon. pour l'Eclairage Electrique des Vehicules. December 21st, 1916. France, January 21st.)

18,341. "Electric motor mechanism." G. Jones. December 21st.

18,366, 18,367. "Hand-driven portable dynamo-electric machines." A. E. Angold & A. H Railing. December 22nd.

18,374. "Electro-pneumatic brakes for railway vehicles." E. H. Dewson. December 22nd. (U.S.A., June 1st.)

18,381. "Device for electrically controlling helms of ships." Fiat-San Giorgio Soc. Anon. December 22nd. (Italy, December 22nd, 1915.)

18,386. "Aerial conductors." G. Plaisant. December 22nd.

18,387. "Dynamo-electric machines." G. Plaisant. December 22nd.

18,389. "Safety apparatus for preventing increases of potential in electric installations." E. C. R. Marks (Uytborck). December 22nd.

18,398. "System of X-ray tube operation." G. R. Hogan & H. P. MacLagan. December 22nd.

18,402. "Transmission of electric currents of varying potential." M. B. Rodriguez. December 22nd.

18,411. "Method of operating electrodes for searchlights." E. A. Sperry. December 22nd. (U.S.A., December 22nd, 1915.)

18,423. "Current-saving devices for electric welding." C. Roulland. December 22nd.

18,425. "Electric transformers for electric furnaces, &c." J. Bibby. December 22nd.

PUBLISHED SPECIFICATIONS.

1915.

12,748. Dynamo-electric Machines. H Chitty. (Cognate application, 3,192/16.) September 6th.

14,026. Electro-magnetically-operated Clutches, particularly applicable to Reversing Gear for Reciprocating Machines. Lancashire Dynamo & Motor Co. and W. Hargreaves. October 4th.

15,555. Electric Vacuum Devices. British Thomson-Houston Co. (General Electric Co., U.S.A.). November 4th.

16,992. Electrical Signalling Systems or Annunciators, chiefly for hotels. International Electric Co. & R. G. le Noir. December 2nd.

16,993. Electric Switches. International Electric Co. & R. G. le Noir. December 2nd.

17,000. Audible Signal Devices. International Electric Co. & R. G. le Noir. December 2nd.

17,002. Displaying Stands or Supports for various articles. International Electric Co. & R. G le Noir. December 2nd.

17,155. Electrical Rotary Converters. G. Schroeder. December 6th.

17,195. Electro-magnetic Switches. British Thomson-Houston Co. (Electric Controller & Manufacturing Co., U.S.A.). December 7th. (Addition to 20,534 11.)

17,260. Apparatus for Reversing the Polarity of Electric Circuits for Telegraphic and other purposes. A. Orling & Orling's Telegraph Instruments Syndicate, Ltd. December 8th.

17,265. Means for Effecting Remote Control of Apparatus Driven by Electric Motors. F. A. Pickett & Igranic Electric Co. December 8th.

17,338. Signalling Instruments based upon the Action of a Liquid Column contained in a Tube of Insulating Material. O. Cornaz & C. Perrin-Mercier. December 10th (November 17th, 1915.)

17,386. Automatic and Semi-automatic Telephone Systems. Relay Automatic Telephone Co., Ltd., & H. J. Herink. December 11th.

17,742. Method of and Means for Attaching Fittings to Sheet Metal or other Sheet or Strip Material, applicable also for Reinforcing, Finishing, or Insulating the Marginal Edges of Holes or Apertures in Sheet Metal or other Sheet Materials. O. Wickham. December 18th.

1916.

The numbers in brackets are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

203. Casings for Electric Wires. A. K. Modi. January 5th, 1916 [102,387.]

440. Means for Applying Electrical Treatment to the Body. A. Vernon-Ware. January 11th, 1916. [100,770.]

THE
ELECTRICAL REVIEW.

Vol. LXXX. JANUARY 12, 1917. No. 2,042.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: January 12, 1917. [No. 2,042.

Page
Preference for British Manufactures 29
Nottingham's Electricity Policy 30
Cable Junction Boxes, by S. G. (*illus.*) 31
New Polyphase Commutator Motors (*illus.*) 32
American Electric Cooking Conditions (*illus.*) 34
The Parallel Operation of Electric Power Stations 35
War Items 36
Business Notes 37
The Condensation Pump (*illus.*) 41
The Position of the Shift Engineer after the War, by J. Marks 43
Notes 45
City Notes 47
Stocks and Shares 49
Electric Tramway and Railway Traffic Returns 50
Colonial Telegraphs and Telephones, by R. W. Weightman (*continued*) 51
Reviews 53
New Electrical Devices, Fittings and Plant (*illus.*) 54
The Electrical Precipitation of Smoke and Fumes 55
The Röntgen Society 56
New Patents Applied for, 1916 56
Abstracts of Published Specifications 56
Contractors' Column ... ... Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

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TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE :—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.
Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.

AUCKLAND N.Z: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.

BRISBANE: Gordon & Gotch, Queen St.

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MELBOURNE: The Mining & Engineering Review, 90, William Street. Gordon & Gotch, Queen Street.

MILAN: Fratelli Treves.

NEW YORK: D. Van Nostrand, 25, Park Place.

PARIS: Boyveau & Chevillet, 22, Rue de la Banque.

PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Loescher & Co., Corso Umberto 1° 307.

SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.

TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE UNIVERSAL ELECTRICAL DIRECTORY

(J. A. Berly's).

1916 EDITION.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

PREFERENCE FOR BRITISH MANUFACTURES.

FOR many years past we have advocated the meting out of preferential treatment to British manufactures by our authorities who have the spending of public money. Not only have we urged it in respect of municipal councils, whose contract proceedings the Law requires to be conducted without secrecy, but we have also emphasised the need for greater patriotism on the part of those having the specifying and ordering of plant and equipment for railway works, collieries, docks and harbours, &c., whose proceedings are not so openly conducted, the matter resting between engineers and directors, who have been presumed to act with a single eye to the dividend interests of shareholders. It may have happened that personal predilections have been allowed to come into play, or that there has been an over-zeal for an initial economy in capital outlay at the expense of subsequent efficiency. Cases can be recalled where contracts have been placed abroad by engineers whose sympathies were not suspected of being particularly pro-British; others will be remembered where the fact that a special design or type of plant had not hitherto been made in British works settled the fate of contracts because the specifying engineer or his authority was not inclined to "run risks" or to give British firms an opportunity to launch out in a new direction. There is little room for question now that by such action we were sometimes, as an industry, the long losers, and were deprived of opportunities which might have led to considerable technical developments. There was, however, no restraint imposed, either by law or by general patriotic policy, which required engineers, directors, or municipal councillors to put patriotism before seriously-expected economies or profits, but the imposition of Trade-Union labour conditions here, and their absence in foreign factories, ought to have been more fairly considered in making comparisons. It was not only here, in the British Isles, that these things happened, but in some of our Colonial possessions and dependencies orders were sent from British territory to foreign manufacturers, partly because the engineers responsible either for the installation or for the running of such enterprises were of other nationalities. Perhaps one other factor, concerning which more has been heard in war-time than in the days of Teutonic peaceful penetration, was the readiness with which British purchasers allowed themselves to be fêted as deputations to the land of Electrical Trusts. We are unable to say how far this factor seriously decided the course of business, but we used to hear things said and we read many an interesting Council Chamber discussion, concerning old-time deputations. We spent too much time visiting countries which manufactured, and too little in visiting the purchasing markets of the world.

The above, however, are things of the past. The future will not, we trust, find history repeating itself in any of these respects. We are in the main all agreed that, whatever may happen to Germany, British support of British electrical and engineering industries will be one of the first essentials henceforth. It is as obvious as anything well can be that there will have to be safeguards of various kinds introduced for the protection of our industries against any of the old kind of Teutonic aggressiveness, and we shall have to be alert for the detection of new devices having the same end in view by more circuitous routes. Some of these safeguards are the subject of deliberations to-day in the meetings of Government Committees, and after all that we have said there is little need to discuss them further at this juncture. There are, however, two matters, on which we have written much at different times, to which we feel drawn to refer again just now. One is that old question of Trade-Union conditions of contract imposed by municipal corporations and some other authorities. In this matter we venture to hope for useful influence to be brought into the scale by Labour which, owing to the war, has gained a new insight into the problems of industry, and especially into the effects of foreign competition. To us, one of the most manifestly unfair features of municipal contracting in days gone by has been the specifying of Trade-Union hours and rates of wages for tenderers, and permitting foreign firms to compete who could not be expected to comply with such conditions. We hardly think that even municipal corporations themselves will consent to the imposition of such inequalities in the future; but if they do Labour will surely lift its voice in regard to a public policy which allows work to go out of Britain to the detriment of British industry and British workpeople.

In view of the heavy financial burdens that we shall have to bear in the future, it will be important to ensure the spending of all public moneys in such a way as shall best conserve the interests of the British Empire, and, so far as these expenditures are concerned, it would almost seem desirable that some authority or other should be set up whose duty it should be to decide whether or not the actual necessities of a particular situation or set of circumstances required the placing of contracts of considerable value abroad in certain specified countries. We should be the last to place anything in the nature of restrictions in the path of free technical development, but we have at times been too free and haphazard in some of our doings, and must look more closely after our own and allied industrial interests henceforth. What, as an industry, we may have to guard against, if we are to carry with us the co-operation of the public authorities, is the temptation to raise our prices to such an extent as to play into enemy hands. This note of warning was sounded, though only, perhaps, parenthetically, at the Mansion House engineering meeting. We are sure that it will be considered judiciously in conjunction with the question of quality.

The efforts which are being made to induce municipal and other public authorities at home and throughout the Empire to register their determination to give a strong preferential treatment to British manufacturers, should be of real benefit to our industries when war pressure is removed. The Trade and Industry Committee of the Royal Colonial Institute has rendered excellent service in this manner of late, and in our "War Items" to-day we record a series of resolutions which have been adopted in Natal. Other organisations are also at work with the object of establishing a very sound sentiment, or, shall we say, of focusing or definitely registering an already existing sentiment, in favour of British products. If we can secure the goodwill and support of Labour at home, and prevent any weakening of policy among purchasers here as municipal councils undergo election changes from time to time, and if we can be assured of the existence of a healthy demand from public authorities throughout other parts of the Empire, we shall have good reason for satisfaction on these grounds alone, apart from whatever other safeguards are secured to us as a result of present deliberations.

Nottingham's Electricity Policy.

Recently, in the course of a lecture on the subject of fuel economy, delivered by Prof. Armstrong at the University College, Nottingham, the lecturer mentioned, in introducing the subject, that he was not till then "aware that Nottingham was the most sinful place in the Kingdom so far as its fuel and power policy were concerned," and went on to comment unfavourably on the city's position as regards electricity supply, pointing out that it was merely "an accident that he lighted on Nottingham as a crying example of the need of reform, and especially of a national policy" (*i.e.*, in regard to fuel and power).

Although it is quite possible that the Professor's remarks were only intended as a general confirmation of the importance of his subject, they incidentally revived a controversy of long standing, locally, as to the judiciousness or otherwise of the policy pursued by the Corporation Electricity Department. Sir John Turney, Chairman of the Electricity Committee, interpreted the lecturer's remarks as an attack on his department, and replied at some length in the Council, while, on the other hand, numerous correspondents resident both locally and in other parts of the Kingdom, have supported and amplified Prof. Armstrong's statement.

So far as we are aware, the outstanding feature of the city's electrical undertaking is the regularity with which it hands a substantial surplus over for the relief of the rates; this in itself is not a criterion of successful electricity supply, but, rather, of astute profiteering (and possibly electioneering). In any case, it is a reversal of what we had supposed to be the municipal ideal, *i.e.*, to supply at the lowest possible price, consistent with financial stability.

Whatever may be the policy of the Committee presided over by Sir John Turney, it has undoubtedly placed Nottingham at a disadvantage in regard to modern means of producing electricity in bulk cheaply—which is the necessity of modern industry—as compared with other cities of similar standing, and if we can trust the statements made in the local Press, the Corporation is even now reaping the fruits of its policy in the number of firms which are apparently installing their own generating plants. Needless to add, the multiplication of minor generating stations is distinctly against the national interests, however it may be regarded by the City Council. It is, of course, not easy at any time, especially for an outsider, to account for the attitude of a municipal committee, and some of them have been known to favour supplying electricity at a loss, ostensibly because of the indirect advantages to the town revenues resulting from the attraction of new, and development of existing, industries; no such accusation can be levelled at the Nottingham Committee, which has evidently gone to the other extreme, much to the disgust and disadvantage, judging by Press comments, of local power-users.

CABLE JUNCTION BOXES.

By S. G.

Much has already been written about electric cables, but very little has been said regarding the various accessories used in connection with them, which are of vital importance to their upkeep.

The heavy first cost of the cables should on no account be overlooked when the question of accessories is under consideration; and in order to maintain the cable network efficiently, it is absolutely essential that the greatest care should be taken in the choice of suitable accessories.

There are several manufacturers of repute who specialise in cable accessories, and engineers should have little or no trouble in getting their demands satisfied. One might say, "But the cost?" In reply, it is only necessary to refer to the ordinary commodities in the household. I am sure the majority would agree that it does not pay to buy cheap stuff.

A word of advice here would be in place: Choose a good firm of high standing, and keep to them; they will get to know your likes and dislikes, just as your tailor does your clothes. Of course, it is up to you to see that you don't get overcharged. The real object of this article is to deal on a small scale with some of the designs already in use, and with which the writer has had experience. It is the small details that make up the complete junction and network box which will be dealt with, and not complete boxes, which the majority of those interested are acquainted with.

Owing to the keen competition which prevails, the users of cable accessories often accept the lowest tender. This may turn out all right in some instances, but there are cases, and not a few, where by paying a little extra a decided saving can be effected; this point is very often discovered by the jointer when it is too late to rectify it.

The choice of accessories requires very careful consideration, and care should be taken to obtain material of good quality, design, and workmanship.

General.—In the first place, junction and network boxes should not be skimped in design. Ample room should be provided for making the joints of the cables, and the box should be of such dimensions that it takes the necessary gear comfortably.

The designer should put himself in the place of the jointer, and consider if he could joint the cables up properly, and, in the case of a network box, he should also place himself in the position of the mains engineer—that is, after the box has been connected up; can the gear, links, or fuses be disconnected easily?

There is one special point which should not be overlooked in the design of a link-disconnecting box, and that is, the connections should be read easily when the links are in position. It should be possible at a glance to tell which is, say, positive, negative, or neutral, or, in the case of three-phase work, the phases A, B, and C should each have a distinctive mark, so that they can be easily recognised.

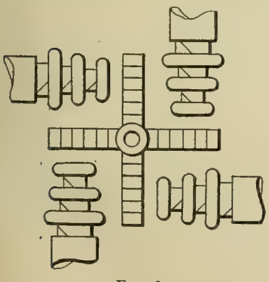


Fig. 1.

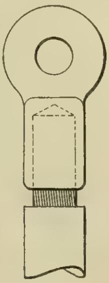


Fig. 2.

Fig. 1 illustrates diagrammatically a four-way disconnecting-box for triple-concentric cable; it will be observed that "like poles" can be easily traced.

Sweating Sockets.—The importance of sweating cables into cable sockets properly cannot be over-estimated; the following incident is a case in point. Whilst I was engaged upon a large cable contract, I had occasion to connect up some extra cables into an existing street pillar. It was not until about 3 o'clock in the morning that I could go along with my men to this pillar, as we had been working all night on other points of the system. It was mid-winter, and the most severe experienced for many years. In order to support these additional cables, which, by the way, were very small ones, I "taped" them temporarily to one of the larger existing cables, about ·5 sq. in. area. Imagine my surprise when this large cable came out of its sweating socket. Upon examination, it was found that the end of the cable only entered the socket by about $\frac{1}{8}$ in., although the sweating hole was about $3\frac{1}{2}$ in. to 4 in. long. By the time our small connections were made, it was time for the "workman's car" to commence running, so the best we could do for the time being was to bind the cable to the socket temporarily to prevent it from coming out again.

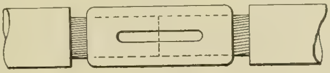
About noon on the same day the police came to my hotel with a report to the effect that there was a strong smell of gas near this pillar. I immediately went to the spot, and discovered a very bad leakage—so bad, in fact, that when I opened the door it flew out of my hand, and I staggered back, the smell being so strong.

After I had regained my composure, I came to the conclusion that a very serious explosion had been averted by the timely discovery of the badly sweated-in cable. There is no telling what might be the outcome of bad work like this; therefore, my advice is "make a good job of it," and see that the fittings are properly tinned before applying the cable.

Design of Fittings.—The design of cable fittings is a matter which requires special attention, and if the following remarks are of no value to the cable engineer who is fairly advanced in his work, they may be of use to the designer or draughtsman.

To commence with, the most simple form of connection is one single cable sweated into a cable socket, or one cable connected to a similar cable by means of a sleeve. Although these appear very simple, there are important points to be observed in the design of the same. For instance, the sweating length for each cable should be at least one and a-half times to twice the diameter of the strand (some engineers insist upon even three or four times the diameter); also in order to make a sound job the cross-section of the sleeve should be so designed that it will carry the full current which the cable is carrying (assumed at 1,000 amperes per sq. in.) at 800 amperes per sq. in. in copper, and means should be provided for pouring in the solder. See figs. 2 and 3. A good supply of grub screws could be provided to make a good job.

Fig. 3.



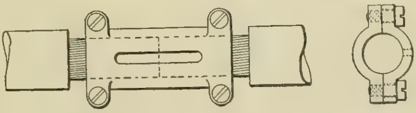


Fig. 4.

A "split" sleeve is sometimes preferred to the above, in which case the same remarks apply. The screws for fixing the two halves together must be mechanically strong. See fig. 4.

Another type of sleeve is the "clamping" type. See fig. 5. This is different to the "split" type, as it is used for clamping the cable without the need of soldering. To make a good job of the joint, the sleeve must be drilled with a packing-piece placed between the two halves, say about $\frac{1}{16}$ in. thick, the size of the drill being just a shade smaller than the diameter of the strand of the cable. The result is that a slightly eccentric hole is formed, and a good grip on the strand is ensured. The same remarks regarding carrying capacity, &c., apply here also, with the exception that with this type of fitting, when used for mining work, the total length should be equal to at least four times the diameter of the strand.

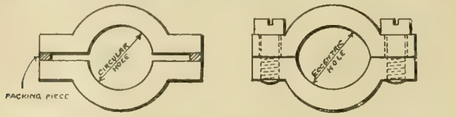


Fig. 5.

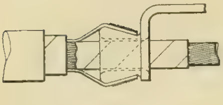


Fig. 6.

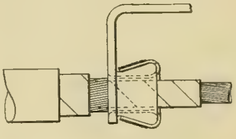


Fig. 7.

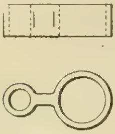


Fig. 8.

The middle and outer conductors of concentric and triple-concentric cables are secured to fittings in various ways. Figs. 6 and 7 illustrate what are termed "binding" fittings. The strands are bent over the conical projection, and secured by means of binding wire, then sweated. One advantage of this type of fitting is its cheapness.

Another type of fitting is illustrated in fig. 8; this is termed a "barrel" or "eye" fitting. The outer conductors are sweated to the inside of the barrel. Although a great number are used, this device cannot be compared to the "clamp" fitting, fig. 9. This is, perhaps, the best of all for concentric cables. As will be seen, a brass sleeve is slipped between the insulation and the outer conductors, then the strands are clamped round the sleeve and finally sweated. This fitting is specially adapted for use with paper-insulated cables, there being little likelihood of damaging the paper during the process of sweating.

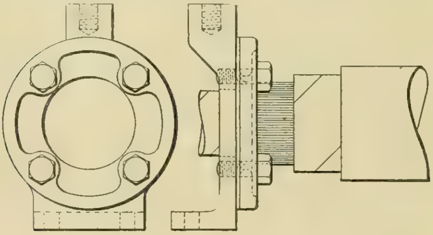


Fig. 10.

The length of clamp fittings, as shown in fig. 9, for general use, is a point which is sometimes overlooked. The following dimensions are suggested for clamp fittings which are also sweated:—Length of fitting = D × ·75, and for fittings which are not sweated D × 1, where D = the bore.

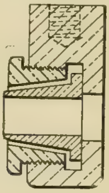


Fig. 11.

With clamp fittings of the above description, too much reliance is often placed upon the soldering. A clamp fitting is a "clamp" fitting, and it should be bored to such a diameter that when the two parts are screwed together the faces should fit properly, and, at the same time, the conductors should also be gripped securely.

Fig. 10 illustrates what is termed a "ring clamp" fitting, used for concentric and triple-concentric cables. Although this fitting was first introduced about the year 1899, it takes some beating for making a good mechanical as well as electrical connection.

As will be observed, all the strands are clamped on to the main pillar by means of a ring fixed with set screws. The one disadvantage about this fitting when used in boxes is that it takes up a lot of room, and, consequently, the box has to be made much larger than if the fittings shown in fig. 9 were used.

Another type of fitting for concentric cables, and one which makes a really good job, is that shown in fig 11, and known as the "cone" type. The sketch illustrates a fitting to take the end of a concentric cable; but, of course, it can be designed "double ended" to make a straight-through connection, or three-way if desired. This type of fitting can also be used for a single cable by placing some of the strands in the hole and the remainder over the cone.

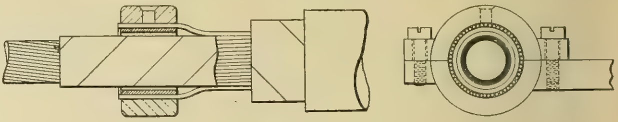


Fig. 9.

(To be continued.)

NEW POLYPHASE COMMUTATOR MOTORS.

Alternating-current motors for driving machine tools and for similar service should have practically the same characteristics as the adjustable-speed shunt-wound D.C. motor. The features which make the D.C. motor so desirable for machine tool work are:—

1. The practical constancy of its speed under varying loads.
2. The simplicity and ease with which the speed may be altered to meet requirements.
3. The wide range over which such adjustment is possible.

The first of these is also characteristic of the squirrel-cage induction motor, which in its simplest form is essentially a single-speed machine. It can be designed to run at either of two speeds, one of which is just twice the other, and, by providing an additional winding, at two other speeds bearing the same ratio to each other. A motor of this kind for use on a 50-cycle circuit, for example, might have windings designed for synchronous speeds of 1,500, 1,000, 750 and 500 R.P.M., but no intermediate speeds would be possible without considerable and complicated additions to both motor and control gear. In cases where it is desired to run a machine at two, three, or four definite speeds bearing a simple ratio to each other, and frequent changes from one speed to another are not necessary, this type of motor is quite satisfactory. Like all squirrel-cage motors, it is not adapted for starting under heavy loads. This type of motor has been extensively used for driving small machine tools, and in larger sizes for textile printing machines, &c. The larger sizes are, however, open to objection on account of the occurrence of relatively heavy current rushes when a change is made from one speed to the next.

The normal slip-ring type of induction motor is also essentially a single-speed machine, although the speed can be varied over a wide range with the greatest ease by introducing and regulating suitable resistances in the rotor circuit. When operated near synchronism, its characteristics are similar to those of a shunt-wound D.C. motor. At lower speeds they partake more and more of those of heavily-compounded and series motors, and the plain slip-ring motor is, therefore, unsatisfactory in cases where it is desirable to have practical constancy of speed under varying load, such as is obtained with the adjustable-speed shunt-wound D.C. motor.

Like the squirrel-cage motor, the slip-ring motor can be designed to run steadily at either of two speeds, one of which is twice the other, but this generally involves the use of three additional slip-rings and a more complicated controller. Such a motor has good starting properties, and can often be used where only two steady speeds are required. As in the case of the squirrel-cage motor, additional windings may be fitted to give a further choice of steady running speeds, but the complication and cost of the motor and its control gear then become excessive.

The use of a changeable pole squirrel-cage motor in cascade with a slip-ring motor affords a means of obtaining three definite running speeds, the ratios of which will depend on the numbers of poles in the machines. For instance, a 12-pole slip-ring motor in combination with a squirrel-cage motor designed for four and eight poles will have synchronous speeds of 500, 375, and 300 R.P.M. when operated on a 50-cycle circuit. Combinations of this kind are generally too expensive and complicated for use in small sizes, but the main and auxiliary motor may be combined in one machine with considerable advantage. This has been done under Hunt's patents, and Cascade motors of this kind are on the market. They are subject to the limitation that one number of pairs of poles must be twice the other, so that the maximum and minimum speeds are in the ratio of three to two. These machines are generally arranged for operation at the minimum speed; intermediate speeds can only be obtained by the use of regulating resistances, as in the case of the ordinary slip-ring motor, and therefore at the expense of constancy of speed under varying load and with greatly reduced efficiency.

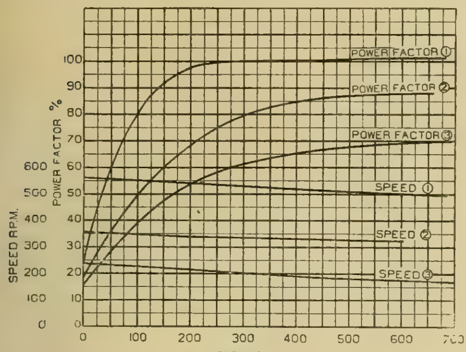


Fig. 1.—B.T.H. Polyphase Commutating Motor: Power Factor and Speed Curves, full-load torque 485 lb. ft.

Each of the motors and combinations described above has its own special field of application, but none has the same operating features as the adjustable-speed D.C. motor, and in view of the very general distribution of electric power by alternating-current systems there is a wide field for an A.C. motor with the same characteristics.

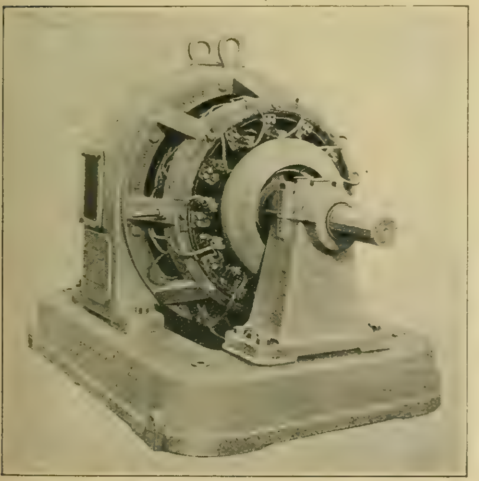


Fig. 3.—50-h.p. B.T.H. Motor, 540-180 r.p.m.

To meet this requirement, the British Thomson-Houston Co., Ltd., has introduced an improved type of commutator motor which can be built for pressures up to 600 volts and frequencies up to 60 cycles. Speed adjustment is effected by moving the brushes by means of a large hand wheel, and may therefore be carried on continuously from the lowest to the highest speed, as would be the case with a shunt-wound D.C. motor if it could be provided with a field rheostat having an infinite number of steps.

When the brushes are adjusted for the minimum running speed, the motor may be started by switching it straight on to the supply system: under these conditions the starting current is about one and a half times the normal full-load current, and the starting torque approximately twice the normal full-load torque. The starting properties of this motor are, therefore, superior to those of a standard slip-ring machine, and there is the advantage that a starting rheostat is quite unnecessary. There are no separate resistances or transformers, and the motor is quite self-contained, the only accessory required being the ordinary switch with overload and low-voltage release, or other standard protective devices.

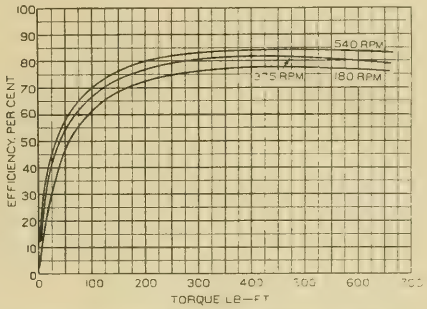


Fig. 2.—B.T.H. Motor Efficiency Curves.

The efficiency at the maximum speed is slightly lower than that of a standard induction motor, but at the minimum speed it is much higher than that of an induction motor of the same speed and power.

The power factor is uniformly higher than that of an induction motor, and at the maximum speed the machine will even draw a slight leading current over a wide range of load.

The output is proportional to the speed, and in this respect alone the new motor differs from the adjustable-speed D.C. machine, which is only capable of giving the same output over its whole speed range.

The curves in figs. 1 and 2 show the results obtained by brake tests of a 400-volt, three-phase motor designed for an output of 50 H.P. at 540 R.P.M., and for speed adjustment down to 180 R.P.M. They are self-explanatory and quite typical. It is interesting to note that with its armature locked and an input of 110 amperes per phase, this machine exerted a torque of 1,020 lb. ft., or more than twice the normal full-load torque with one and three-quarter times full-load current. The motor from which these results were obtained is shown in fig. 3, from which it will be noted that the brush spacing is much more open than is usually the case in polyphase commutating motors. The standard number of brush studs for motors of smaller output than 50 B.H.P. is nine, and for larger motors twelve, and these numbers are quite independent of both frequency and speed range.

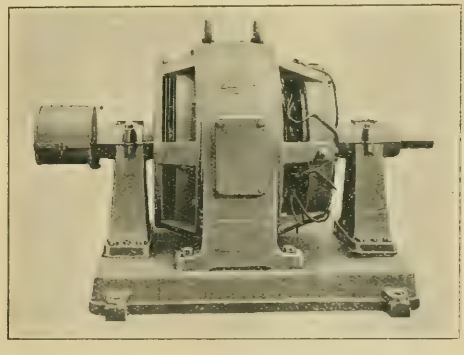


Fig. 4.—30-h.p. B.T.H. Motor, 720-240 r.p.m.

Standard machines are designed for speed adjustment between maximum and minimum speeds having a ratio of three to one, but this range may be increased to four to one at slight extra cost, provided there is no objection to the standard temperature rise being exceeded at the lower speeds. Motors for use on 25-cycle circuits may even be regulated from the maximum speed right down to standstill.

Fig. 4 shows a motor designed for an output of 30 H.P. at 720 R.P.M., with speed adjustment down to 240 R.P.M., and indicates the method of securing satisfactory ventilation at the lower speed. Air is drawn over the commutator surface and through the machine in an axial direction, and then delivered radially through the openings in the end-shield by a fan of large diameter.

These motors may be reversed in the same way as an induction motor; that is, by interchanging two of the primary leads. Like the induction motor and the D.C. shunt-wound motor, this motor acts as a generator, and returns energy to the line when driven above the no-load speed for which it happens to be adjusted.

Dynamic braking can thus be carried out at any speed within the range of adjustment for which a motor is designed, a property which makes this type particularly suitable for the driving of hoists and small winding gears.

AMERICAN ELECTRIC COOKING CONDITIONS.

In a recent article in the *Electrical Review and Western Electrician*, Mr. H. O. Swoboda gave an analysis of electric cooking rates and conditions in the States and Canada. He pointed out that the use of nickel-chromium alloy had solved the difficulty of a suitable material for electric heating purposes. Another difficulty was the high cost of electrical energy; the cost was not in many cases sufficiently low to warrant a rapid introduction of the art, although the price was steadily falling, and in many cases special low rates for off-peak loads for installations with electric ranges were being offered.

The author predicts that in a comparatively short time electrical energy will be offered not only in the States, but all over the civilised world at such rates that electric cooking can be universally adopted, and mentions that in England, in quite a number of cities, a rate equivalent to 2 cents per KW.-hour is charged, which is far lower than those in the States, which range from 3 to 6 cents per KW.-hour.

The author goes on to study the data as to rates for domestic cooking in 80 cities, these being situated in 28 different States in the U.S. and Canada; most of these rates are not more than three years old.

Twenty-six systems, or 30.6 per cent., apply a so-called room schedule, in accordance with which the price per KW.-hour is reduced after a certain initial quantity at a high price has been consumed. This quantity varies in accordance with the number of active rooms in the residence. In some instances the number of the square feet of the floor space is substituted for the number of rooms.

Twenty-four systems, or 28.3 per cent., use a two, or multi-rate, schedule. As in the preceding rates, the price per KW.-hour is reduced after a certain initial quantity at a high price, approximately light rate, has been consumed. In this case, however, this initial quantity is the same for all consumers. Some systems make only one reduction in price per KW.-hour; others make two or more, setting for each step a fixed amount of current consumption.

Eighteen systems, or 21.2 per cent., have a plain KW.-hour schedule, there being one uniform price per KW.-hour, regardless of the quantity of current consumed and the capacity (connected load) of the installation.

Twelve systems, or 14.1 per cent., charge on the basis of maximum demand, as is customary for practically all power service.

Three systems, or 3.5 per cent., apply a plain KW.-hour schedule, the same as the other 18 systems just mentioned, but in addition thereto make a fixed service charge per month.

Two systems, or 2.3 per cent., also apply a plain KW.-hour schedule, the same as the other 18 and three systems, but give a discount, which increases with the current consumption.

These figures clearly show that the room and two or multi-rate schedules are the most favoured methods of charging. In these cases the primary rate gives a high return for a small initial amount of energy, usually equal to the monthly demand for light during peak load hours, so that the remainder, representing energy consumed during off-peak load hours, can be sold at a low rate, and one meter only is used for light and power.

Sixty-one per cent. of the systems referred to allow a fixed prompt payment discount; the remainder allow none, and three of them provide a penalty if the bill is not paid in a certain time. Sixty per cent. use one common meter for all requirements.

In order to make a direct cost comparison, the unit price of 100, 200, and 500 KW.-hours purchased in one month was worked out. The lowest charge for 100 KW.-hours is between 1.5 and 2 cents per KW.-hour; the lowest charge for 200 and 500 KW.-hours is between 1 and 1.5 cents; the charge made by more than 50 per cent. of all systems lies between 3 and 6 cents per KW.-hour, and the highest charge for 100 KW.-hours is slightly in excess of 10 cents. The highest charge for 200 KW.-hours lies between 9 and 10 cents, and the highest charge for 500 KW.-hours lies between 7 and 8 cents per KW.-hour.

Of all the systems investigated, 10.6 per cent. charge less than 3 cents for a monthly purchase of 100 KW.-hours, 65.9 per cent. less than 6 cents, and only 4.7 per cent. adhere to the customary charge of 10 cents of 10 years ago.

One of the other factors affecting the electric-cooking rate is the influence of this load on the feeder system, through which the energy is delivered to the consumer. While the maximum demand for a single range seems to be between 35 and 40 per cent. of its connected load, the maximum demand for groups of ranges, as shown in the first three items of Table I, does not exceed 15 per cent. (14.6 per cent.) of the connected load. In other words, the diversity factor is about 1 to 7, permitting the installation of seven times as many ranges on a feeder system as the connected load apparently would permit. In fact, it is even considered safe (L. A. Gale) to figure on a ratio of 1 to 10, as the maximum demand of the domestic-cooking load does not occur at the time of the station peak.

Table I.—Central Station Rates.—Connected Load, Maximum Demand, and Diversity-Factor for Domestic Ranges.

Name of city or country.	No. of households.	Connected load, KW.	Maximum demand, KW.	Diversity factor.
Salt Lake City, Utah ...	24	77	11·5	15·0 %
Great Falls, Mont. ...	21	110	13·5	12·3 %
Worcester, Mass. ...	16	77	13·5	17·5 %
Anaconda, Mont. ...	22	92	—	—
Canada	1	—	2·9*	—
England	1	6·2	2·2†	36·6 %

* Maximum demand during six successive days.
† 1·75 KW. are light and heat.

Similar conditions exist for large kitchens. The two named first in Table II, and supplying regular restaurant service, furnish meals at all hours of the day to single persons or small parties at short notice, and, therefore, must have a high maximum demand as well as a high diversity factor (57.8 per cent., or 1 to 1.75). The other four kitchens, however, supply meals only at fixed hours of the day to large groups of persons at one time, and consequently have a maximum demand and diversity factor (37.7 per cent., or a 1 to 2.6) fully one-third smaller than the other two. In addition, therefore, it should be borne in mind that battleships, as well as the two enterprises named, have their own power houses, which when the help ceases to work for the purpose of eating, operate with a minimum load, and, therefore, can supply the entire cooking energy without an increase in the capacity of the plants.

Table II.—Central Station Rates.—Connected Load, Maximum Demand, and Diversity-Factor for Large Kitchens.

Place of installation.	Connected load, KW.	Average demand, KW.	Maximum demand, KW.	Diversity factor.
Engineers' Club, Boston	30·0	—	18·0	60·0 %
Quaker Cafeteria, Sacramento, Cal.	96·2	-	55·0	57·3 %
U.S. battleship *Texas*:				
Officers' galley ...	120	27·4	54·0	45·0 %
Crew's galley	240	21·2	90·0	37·5 %
Siemens-Schuckert Co., Berlin, Germany ...	93	20—40	40·0	43·0 %
North German Lloyd, Bremen, Germany ...	194	40—60	60·0	30·9 %

In the second portion of the article, Mr. Swoboda turns to the more difficult part of his subject—that of establishing cost data of actual cooking operations.

The difficulties met with are worth recording, in view of the frequency with which such data is tendered in papers and discussions.

He points out that some reports state the energy for heating food only, securing hot water and steam from another source; others include all this, and in one instance the heating of the water for washing dishes is recorded. The type of equipment is often not stated, although efficiencies vary considerably. Sometimes energy registered by the meter is used for other purposes and not indicated; also savings in food and labour, and maintenance of equipment are rarely mentioned.

It is assumed that each country has developed a standard practice of its own. In the States and Canada hot water is supplied to the kitchen from the general system of the building; steam also is often available in factories for certain cooking purposes, and the electric equipment consists of a baking and roasting range, though with a single-meter system probably other domestic uses are also included.

The author, evidently judging by the English trial data which he publishes, concludes that it is customary to heat the water by special coke boilers—which is, of course, very far from being true as regards the average English consumer, who will probably continue for some years to use the existing coal range for heating bath water when required, and use the electric boiling ring, just as he now uses the gas boiling ring, for minor requirements.

Mr. Swoboda falls into the further error (if our interpreta tion of his remarks is correct) of assuming that it is the usual English practice to give special cooking rates and install special meters for cooking, thus eliminating the use of energy for other purposes.

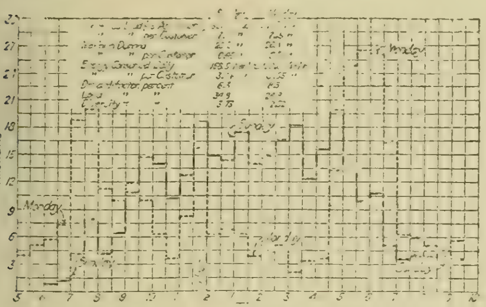
While this is certainly true as regards the two or three individual returns recorded by him of English tests, yet the fact remains that the majority of the progressive electric cooking centres in this country have adopted a domestic or 'single meter for all domestic purposes' tariff, the movement having received its impetus from the favourable results obtained by the so-called "Norwich tariff," which was put into use nearly 10 years ago, long before the Americans had made any move in this direction.

Germany, according to Mr. Swoboda, has adopted the system of individually heated cooking vessels to a considerable extent, and heats the water electrically.

Judging by the conditions, it it assumed that the German reports cover only two hot meals per day, as against three in England and America.

The data covers a period of eight years, and the author deduces that in the United States and Canada 1 KW.-hour per day, or .33 KW.-hour per meal, are required; in England 1.36 KW.-hour per day, or .44 KW.-hour per meal, and in Germany .76 KW.-hour per day, or .38 KW.-hour per meal.

The German figures include water heating, and correcting for this the cooking figure becomes .20 KW.-hour per person per meal, which low average is attributed to the use of individually heated utensils in place of large ranges.



Cooking Load Curve of American Apartment House.

Average electrical consumption means little to the purchaser of an electrical stove, who would naturally like to know the approximate monthly bill. Tabular data from American sources shows that the average bill is $3.5 per month for a 3-cent rate. In addition, it is mentioned that at Billings, Mont., with 300 ranges, the lowest bill is about $1.50, and the usual highest about $5, neglecting a few careless consumers who incurred bills up to $10. For fully one-half of the consumers the bills were not more than $3.6 per month each.

The company operating at Twin Falls, Idaho, guarantees that the bill shall not exceed $4.8 per month for any household.

The energy consumption in the case of restaurant kitchens (a la carte service) ranges from .95 to 1.21 KW.-hours per meal, and for large kitchens, feeding groups of persons at fixed hours (as the U.S. Battleship *Texas* and a large German cable works) from .33 to .43 KW.-hour per meal. The energy consumption falls off with experience of the use of the apparatus.

The author draws attention to the ease with which electric heating can be applied to individual apparatus, such as table utensils; to the possibility of using automatic temperature regulation in ovens, and introducing exact cooking methods leading to certain results, in connection with which time and temperature data has been published by Lancaster and Gunaer.

The saving in both labour and food are referred to, as well as the superior quality of the food when cooked.

Several of the tables reproduce English results which have already appeared in our pages.

We notice that the author avoids all reference to the first cost of apparatus, which is a greater obstacle in this country than the cost of energy to the general adoption of electric cooking, and judging by opinions of American central-station men set forth in the report of the Electric Range Committee of the N.E.L.A. (quoted in our issue of October 6th) is also not without influence on progress in the States.

Mr. Swoboda's paper, which contains 21 tables of electric cooking data, is an instructive summary of the present position of the art. We can only regret that more representative English data was not available, or, at any rate, not included, although from the "business getting" point of view, probably more convincing than any data to the average person is the knowledge that other people, in similar circumstances, are adopting the electrical method. This fact is, for instance, corroborated in an article by Mr. S. M. Kennedy which appeared recently in the *Electrical World*. He mentions the case of a lady who was about to construct an apartment house, and wanted independent advice regarding the advantages of electric cooking in such a case. The local power company referred her to 13 apartment houses in different parts of the States, and 10 of these replied, all stating that the electric range filled all the cooking requirements of the tenants; the rate paid averaged 3 cents per KW.-hour and monthly bills varied from 1.75 to 3.50 dollars, averaging 2.1[illegible] dollars. All advised the equipment of the new apartment house with electric ranges as being clean, safe, economical, and modern. The unanimity of the replies was a revelation to the lady who applied, and to some of the power company's employés. [We reproduce a typical load curve from a house of this type containing 45 apartments.] Mr. Kennedy also referred to a half square mile area in a rural district in Southern California, where of the 16 houses in the block, 14 are using electric ranges, despite the fact of there being natural gas mains only 1,000 ft. distant. One householder was induced to purchase a range, and it is significant that within less than four months, the other 13 residents followed suit; this is not an isolated experience on this company's system.

THE PARALLEL OPERATION OF ELECTRIC POWER STATIONS.

On December 12th the paper on this subject by Mr. J. S. Peck was discussed by the Scottish Local Section of the Institution of Electrical Engineers. An abstract of the paper appeared in our issue of December 1st, 1916.

Mr. W. W. Lackie (Glasgow), who opened the discussion, admitted that Glasgow was one of those cities guilty of having separate stations for traction and power, but these had for years been run in parallel when required. In Glasgow they had had considerable experience in linking-up. In 1898 the Corporation purchased the Kelvinside undertaking, and in 1912 the Partick and Govan stations were taken over by the Corporation and linked-up with the Glasgow system, and it was not very long before the consumers' lamps and wiring were brought into line with the Glasgow pressure, and the Partick and Govan stations were then run in parallel with the Glasgow stations when required. In the case of the Kelvinside station, it supplied its own area from 3 to 11 p.m., when the load was considerable, but during the remaining 16 hours of the day the load was drawn from the main power stations. Govan and Partick stations would have undergone similar treatment had not the war compelled the suspension of operations. For stations of less than 3,000 KW. which were to be linked up with large power stations, it would be found practicable to change consumers' lamps and apparatus to a pressure and periodicity to suit the larger power station. There were 14 local authorities and 14 supply companies in the London area supplying electricity. There was no doubt that the 12 of these of under 3,000 KW. maximum demand could and should be tackled, which would practically halve the number of generating stations in London. It appeared to him that for many years linking up would be limited to an exchange of energy at times of light load, *i.e.*, at week ends and on holidays, and in some cases for all-night loads. Consequently, when apparatus had to be installed it would not be necessary to have it of anything like the capacity of either of the stations connected. When Port Dundas, St. Andrew's Cross, and Pinkston stations were linked-up, fortunately they had the same voltage and periodicity, and little trouble was experienced. The plant at Pinkston at that time consisted of reciprocating engines, running at 75 R.P.M., coupled to alternators with 40 poles, whereas the plant at Port Dundas consisted of turbines running at 750 and 1,500 R.P.M., with 2 and 4 pole alternators. One or two adjustments had to be made before all went smoothly, but there was nothing of a serious nature. The three stations were now run in parallel at times of full load, and interconnected with cables which, between Pinkston and Port Dundas, were over one mile long, and between Pinkston and St. Andrew's Cross between two and a half and three miles long. All the stations might be said to be of different capacities, and yet there was no difficulty in arranging the load amongst them. He could not say what the speed regulation of the reciprocating engines at Pinkston was, but he thought it was very different from the speed regulation obtained from turbine-driven sets. If a rotary was to be used for interconnection both ways it must have independent field excitation if it was to be anything like stable. This arrangement was adopted in the Falkirk electricity department.

Mr. Whysall (Greenock) pointed out that it was a fact that many stations were being satisfactorily operated when linked-up to each other without any of the devices spoken of by Mr. Peck. His personal experience of linking-up was small. In Greenock they had interconnected with a small hydro-electric system at very short notice, and there had been no difficulty. In connection with the linking-up of two undertakings having a different periodicity, he favoured the synchronous motor-generator, and thought they should be prepared to accept its disadvantages.

Mr. Arch. Page (Glasgow) argued that the necessity for considering complicated phase-converters and frequency-changers was a reflection on the short-sighted policy which was followed in the early days of electricity supply. One undertaking in Scotland started out by offering its prospective consumers 3-phase, 2-phase, or direct-current supplies all at different voltages. In Glasgow they were running four stations linked up, with an aggregate capacity of 60,000 kw. The first two stations had been running together since 1905, and the electricity department and tramway systems were linked up in 1908. So long as the stations were working in tandem, or, as one might express it, in series, there was no trouble. The only limiting factor was the capacity of the interconnecting cables. They had recently closed the links forming a triangle, and the possible necessity for some type of trunk cable was looming up. He was afraid the impression conveyed by this paper to engineers who had no experience of running A.C. stations in synchronism, and who were contemplating this step, would be unfavourable, and it might even have a deterrent effect. It could not be too strongly pointed out that so long as the frequency was common, whether or not the voltage varied, the running of any number of stations linked-up was a very simple matter. In Glasgow, apart from the economies effected (and these had been considerable), the great feature of linking-up had been the factor of safety so far as continuity of supply was concerned. This might be noticeable there because the tramways department had little or no lighting load, and the margin of spare plant in Pinkston was always available to help the electricity department when sudden darkness came over the city. They had all kinds of plant, reciprocating engines and turbines, with varying regulation at the steam end, also throttle and cut-off governing. The better regulating machines did take up the fluctuations, but with the large number of plant units in commission the ammeters were fairly steady. The load distribution was easily controlled by the switches for regulating the speed, which were mounted on the main control panels. It might be well to sound a note of warning to engineers who were thinking of linking-up, to make certain that the capacity of the interconnecting cables was not only adequate to deal with the load to be transferred from one station to the others, but that there should be a margin of copper to deal with the fluctuations, which in the case of, say, a tramway or railway load would be shared by the prime movers in the second station which ordinarily was dealing with a power and lighting load. He asked the probable efficiency of the phase-converters; anyone who had had experience of the tricks of motor-generators and rotaries when there was a surge on the A.C. system knew how unreliable these frequency-changers were bound to be. As to the question of regulators in the feeders, he asked Mr. Peck where his preference lay as between the induction type and step-by-step regulation. It was their practice to have a voltage-regulator on only one station.

Mr. Seddon thought that linking up would no doubt hasten the growth of larger stations, with a corresponding reduction of plant in the smaller ones, and this change would operate to the advantage of the supply authorities. Probably only in the case of stations of about equal plant capacity would exchange of load take place. At times, transfer of load would have to be effected with low frequency and volts down on the disabled station, so that auxiliary bus-bars would be required. He believed synchronous motor generating plant was the best coupling to adopt. Where it was required to connect a single-phase station with a 3-phase supply of a similar frequency, he believed Scott-connected 3-phase to 2-phase transformers was the best method.

In his reply, Mr. Peck pointed out that those with 3,000-kw. stations and under could change to the standard frequency of the district; pressure could be cheaply changed by transformers being rewound. As regarded frequency, if the station was small and uneconomical, it was time it was scrapped. It might involve the changing of voltages, and there might be a difficulty in changing from 25 to 50 periods, or from 40 to 50, and it would be necessary to make some radical changes in the motors or couplings. It was standard practice to put in a rotary-converter for correcting speed deviations, and speed would fluctuate unless there was some exciter to make the speed stable. Small independent stations would probably be changed into sub-stations for distributing purposes, which would be to the general advantage. Let them have large stations by all means, though he did not see why the small stations should not do what they could. The small station could be run with a governor, and at waste-heat stations let them supply all the energy they could. He thought it was quite possible to transfer at unity power factor between stations without boosters if a small difference in voltage was allowed. Step-by-step regulators were considerably more efficient than induction regulators, which also took a considerable amount of current from the line, although, perhaps, not so much as to affect a large system. On the other hand, the induction regulator would give a uniform variation in voltage and also had the advantage of being motor or automatically driven. As to his illustrations, they must remember that the speed of motors was constantly being adjusted to make the stations take up the desired load, the governors being set for a certain regulation, and having the load factor over the whole range. In practical working, extreme ranges seldom or never occurred. His impression was that a frequency-converter would be somewhat cheaper than a phase-converter of the motor-generator type with a 3-phase motor and 2-phase generator, or *vice versa*. To link up a system with 30,000 kw. of plant, a frequency-changer of 38,000 kw. would be required, and a number of frequency changers were in use approximating that capacity. If they were not to scrap odd frequencies, and wished to link up large systems, it would involve large cost for frequency-changing apparatus.

WAR ITEMS.

Trading With the Enemy.—The "London Gazette" for January 5th contains further lists of persons and bodies in the following countries with whom trading is prohibited:—Argentina, Uruguay, Bolivia, Brazil, Chile, Colombia, Greece, Morocco, Netherlands, Paraguay, Spain, &c.

The Controller of the Foreign Trade Department has issued a new consolidating list containing the names of over 2,000 persons and firms with whom persons in the United Kingdom are forbidden to trade. Cases still come to the notice of the Department in which firms are corresponding with persons on the statutory list, and they not infrequently give as an excuse that they have never heard of the list. Everyone engaged in foreign trade should realise that he is under an obligation to make himself familiar with the statutory list, and to observe it. Failure to do so renders him liable to the heavy penalties provided by the Trading with the Enemy Acts, and these apply to holding any communication whatever with anybody on the statutory list, and not merely to entering into an agreement or continuing to carry on business with such persons. In exceptional cases a licence may be obtained from the Foreign Trade Department exempting from the prohibition. The statutory list is published at intervals in a consolidated form, and additions are made approximately at intervals of a fortnight. Copies of the consolidated list and of all additional lists may be obtained at a small cost from the Superintendent of Publications, His Majesty's Stationery Office.

The German Aron Meter Co.—It is stated that all the shares in the H. Aron Elektrizitats Zahler Fabrik, G.m.b.H., of Charlottenburg, have recently passed into the possession of German subjects. As a consequence, the compulsory administration introduced by the Ministry for Commerce has been abolished.

Tramways Substitution.—The Municipal Tramways Association announces that arrangements have been made with the War Office for the establishment of a substitution scheme applicable to tramway undertakings for dealing with employés of military age.—*Daily Telegraph.*

Women Workers.—The "Times" states that a woman has been placed in charge of the electric lighting station at Bradninch, near Exeter; also that women are to be employed for "gate" work on the London tube trains. They will not be so employed on the "District" at present.

Sleeping at their Posts.—At the Hull Munitions Court, three local electrical workers were charged with being asleep when they should have been at work. They were engaged on a 24-hour shift on a ship. It was stated that owing to the fact that their particular department did not work diligently the ship was delayed for three days. The Electrical Union desired a heavy penalty to be imposed for this slacking. Two of the men were fined £2, and the third, aged 17, who said that this was the first time he had done a 24-hours' shift, was fined £1.

Natal and Preference to British and Allied Manufacturers.—*The Board of Trade Journal* recently stated that the Durban Town Council had decided to submit the following resolutions to the Natal Municipal Association for consideration and adoption:—

"1. (*a*) That every Natal Municipal Council and Local Board be asked to affirm the principle that all goods and materials purchased out of the public funds should be the produce of British or Allied countries, and that such a condition shall be inserted in all specifications for the supply of goods or materials, unless it can be shown that such goods can only be purchased from neutral countries.

"(*b*) That every Natal local authority be asked to furnish to the Secretary of the Natal Municipal Association, for transmission to the Right Hon. the Prime Minister, a return of those goods which it has been customary to purchase from enemy or neutral countries, with a view to the information being forwarded to the Union High Commissioner in London, for publication for the information of British manufacturers.

"2. That the Natal Municipal Association be recommended to submit resolutions (*a*) and (*b*) to the next meeting of the United Municipal Associations of South Africa, and that that Association be urged to impress upon its constituent authorities in the Cape, Transvaal, and Orange Free State Provinces, the desirability of acting in the direction indicated in those resolutions."

Exports to China.—The "London Gazette" for January 9th contains a further list of persons and bodies in China and Siam to whom exports may be consigned.

Vacancies in the O.T.C.—Men suitable to train as officers, whose exemptions are about to expire, and young men about to reach military age, are advised that there are now vacancies in the Inns of Court Officers' Training Corps. They should call without delay for a personal interview with the Selection Board at 10, Stone Buildings, Lincoln's Inn, London, W.C., any day (except Saturdays) between the hours of 10 a.m. and 4 p.m. No appointment is necessary.

Optical and Glassware Munitions.—The Minister of Munitions has made an order requiring all persons engaged in the manufacture, purchase, sale, or other dealings in chemical and medical glass or glass tubing and rod to comply with regulations restricting the manufacture unless the glass is required for an Admiralty, War Office, or Ministry of Munitions contract, or the supply is authorised by the Director of Optical and Glassware Munitions, 117, Piccadilly, London, W. The purchase and sale outside the United Kingdom of chemical or medical glass or glass tubing or rod is also restricted. Chemical and medical glass includes carboys, thermometers, glass for miners' safety flame lamps, glass for X-ray apparatus, &c. Certificates will be granted to dealers to order reasonable quantities of chemical and medical glass and glass tubing and rod for the purposes of stock and/or export, provided that such orders are not considered by the Minister of Munitions as likely to interfere with the execution of orders required for war purposes. No further authorisation to dispose of such stocks will be required, provided that in the case of articles, the export of which is prohibited, the usual permit to export be obtained.

Exemption Applications.—At the West Riding Appeals Tribunal, at Leeds, last week, the City Tramways Committee appealed for four single men, armature winders and electrical equipment repairers. The matter had been previously adjourned for the department to try to find substitutes, but it was stated that suitable men had not been obtainable, and, much as these men would like to be released for military duties, it was found impossible to grant their request. There were at present 70 or 80 cars unfit for use owing to lack of skilled labour. With a little more time the department might be able to get the substitutes. The cases were further adjourned, the Corporation representative undertaking to report when the men were replaced.

The City of London Tribunal has given a final extension of two months to a plate-glass merchant, single, aged 30, who has been learning wireless telegraphy, and wants to sit for the Postmaster-General's examination in February.

At Bacup, the secretary and manager of the Corporation electricity department asked for the exemption of an engineer (30), whose certificate had been withdrawn from the recruiting office. The man appealed for had the oversight of 1,000 H.P. of current for power purposes, four miles of high-tension mains, a similar extent of low-tension mains, in addition to the overhead street lighting of the main roads. The Military Representative said he was bound to put on pressure, as the man was single, young, and passed for general service. The manager replied that the difficulty was to replace him. He was the only one with a knowledge of the undertaking. Exemption was granted to March 31st, but the Tribunal thought some steps should be taken to replace him.

At Southport, appeals were heard for three men in the Corporation electricity department: a storekeeper (38), passed for C2, a plumber and cable jointer, general service, and a meter tester and attendant (37), B2. The electrical engineer said that so far as the department was concerned they considered they had got to the limit. The cable jointer was given conditional exemption, and temporary exemption to March 1st was granted in the other two cases.

The Birkdale District Supply Co. appealed, at Southport, for a single man (24), general service, employer as assistant engineer and switchboard operator. The manager said they had tried to find substitutes, but with indifferent success. The case was adjourned to February 1st, and it was intimated that the company would have to try and find a substitute.

Before the Stratford-on-Avon Tribunal, on January 3rd, the Military Representative asked for the withdrawal of exemption allowed to Mr. J. G. Bomford (24), electrical engineer, partner in the firm of Messrs. Booth & Bomford, on the ground that it was no longer necessary in the national interest that he should continue in civil employment. Mr. Bomford said that he had been passed in Class C1, and he was engaged on important railway and marine engineering work. The pre-war staff of 20 had been reduced to eight. The application was not acceded to, and the exemption was confirmed.

The Margate Tribunal has given the junior partner in a local electrical engineering firm 14 days in which to obtain work of national interest in his own line of business.

At Broadstairs, on January 2nd, certificates previously granted to four members of the staff of the Isle of Thanet Traction & Lighting Co., Ltd., and to a tram driver, were renewed. The manager (Mr. Forde) said that they had to furnish the War Office with a list of the men who had joined up, and those in a low category would be exchanged for present employés passed as fit for general service.

At Nuneaton, the Military Representative applied for a review of conditional exemption granted to a stoker (35) at the Corporation electricity works. The clerk said that the man was in a certified occupation. The Chairman: A stoker in any occupation, who is married and over the age of 25, is in a certified occupation. The conditional exemption was confirmed.

At Hitchin, on January 1st, exemptions granted by the Recruiting Officer some time ago to essential men in public utility service were, under a new War Office Order, brought before the Tribunal. These included P. Wilson (19) and A. Dobbs (19), on the staff of the electric light station, and they were ordered to be medically examined and classified before the review is made.

At Letchworth, Colonel Sowerby appealed for exemption for A. Edwards (34), electrician at Lilley Manor, and four months' conditional exemption was conceded.

At a meeting of the Newcastle-under-Lyme T.C., on January 3rd, the Electricity Committee reported having considered the staff at the electricity works, and the question of the introduction of female labour, as recommended by the Military Representative. It was decided that, in the opinion of the Council, it was impossible to release any of the present members of the staff for military service; that as the work undertaken by the remaining eligible members of the staff is of a highly skilled nature it would not be practicable to employ female labour; and that the Chairman be instructed to lodge appeals on behalf of the staff when occasion required. None of the eligible members of the staff left are passed for general service.

Before the East Suffolk Appeal Court, the Electric Light Co., at Felixstowe, appealed against local decisions in respect of a Diesel oil engine driver (24), refused exemption, and a wireman, electrician, and gas engine attendant (37), granted until January 31st. It was stated that the staff was barely sufficient for the important work to be done; it was absolutely impossible to replace the men. The refusal of exemption to the younger man was confirmed, and the elder man was given conditional exemption with a view to the military seeking a revision of a conditional exemption certificate held by a single young man at the works.

At Trowbridge, the Military sought a revision of conditional exemption granted to Gilbert Rawlings, electric light attendant at the works of Messrs. J. Sainsbury & Co. The certificate was granted on the ground that Rawlings was in a certified occupation, and the Recruiting Officer contended that, in spite of that, it was no longer in the national interest that the man should be exempted. The Tribunal refused to interfere in the case.

At Newton Abbot (Devon), it was reported that Mr. D. R. A. Millman, electrician, passed in Class C1, had failed to secure work of national importance in the month allowed. Another month (final) in which to comply with the order was granted.

At Maidenhead, on January 2nd, the Tribunal confirmed the certificate of conditional exemption held by Mr. C. O. Milton, borough electrical engineer, who is to remain in the V.T.C.

BUSINESS NOTES.

Scheme of Arrangement.—Tyler Apparatus Co., Ltd. With reference to the affairs of this company, the list of creditors in which we published in our issue of December 22nd, 1916, we have received a copy of the scheme of arrangement which we understand has been passed by the creditors. Under this scheme the claims of the first debenture-holders, secured creditors, and unsecured creditors will be satisfied as follows:—

The second debenture-holder, Mr. A. M. Powell, will pay off, and take a transfer from the first debenture-holders of the whole of the first debenture for the sum of £1,450. He will also advance to the company a further sum of £1,000 for additional working capital to be secured by the issue of a further debenture for the said amount. As the only debenture-holder, Mr. Powell agrees to the present book debts as at October 13th, 1916 (amounting to £4,500 or thereabouts), being released from his debentures and assigned to three trustees in trust to pay the same over to the creditors from time to time upon the terms and conditions mentioned in a certain deed as from October 13th, 1916. At the expiration of nine months from November 1st, 1916, the company is to pay to the trustees £50 per week out of the income of the company for the benefit of the creditors until such time as the whole of the creditors have received 20s. in the £. In order to allow the company a reasonable opportunity of paying its debts in full and re-establishing itself, Mr. Powell agrees not to call in the principle sums due under the debenture for a period of not less than 18 months from the date of the trust deed, but without prejudice to any of his other rights thereunder in the event of a breach of conditions or reservations.

The receiver at present appointed on behalf of the first debenture-holders is to be discharged, and the balance of any amounts collected by him, or the book debts as at October 13th, 1916, since his appointment, will form part of the trust fund. The Board is to be reconstituted, and three new directors, who have been responsible for bringing and carrying through the above scheme, are to be appointed. All debts not exceeding £5 (the aggregate does not exceed £150) are to be paid out of the funds of the company as soon as possible.

New British Dry-Cell Industry.—After experimental work extending over two years, British Utilities, Ltd., has established a factory for the manufacture of dry cells at South Park Road, Wimbledon. We understand that the works have been in operation for some six months, turning out a high-grade cell under the trade mark of "Firefly," and that these cells are guaranteed to stand up for three months in stock. The firm is equipped for large-scale production, and is specialising in medical cells, dry cells for bells, telephones, and ignition purposes, and in refills for popular sizes of electric torches. Needless to add, there is an immense opening for reliable makes of dry cells in this country, and it is a matter of satisfaction that steps are being taken by British makers to meet this demand, despite the difficulties created by the war and the uncertainty of the position after the war. We can only hope that satisfactory assurances will be forthcoming in respect of the latter question, so that such new industries can be established with confidence.

Catalogues Wanted in Italy.—Messrs. Ing. Stauble and Rag. Salvini, of 76 Foro Bonaparte 76, Milan, who have an established organisation for the sale, &c., of all kinds of electrical material, and have carried out business for many Italian industrial, electrical and telephone concerns are anxious to establish connections with British manufacturers, and accordingly will be pleased to receive catalogues, prices, conditions, &c.

Catalogues and Lists.—LANGDON-DAVIES MOTOR CO., 110, Cannon Street, London, E.C.—20-page illustrated price list of single-phase and polyphase motors.

MESSRS. FERRANTI, LTD., Central House, Kingsway, W.C.—New pamphlet Ma56, giving very fully illustrated instructions for the use of alternating-current house service watt-hour meters (types FC and FCT).

Cable-Makers' Association.—The address of this Association is now Sardinia House, Sardinia Street, Kingsway, London, W.C.

Liquidations.—KILOWATT PUBLISHING CO., LTD.—This company is winding up voluntarily with Messrs. A. Webster, 203/206, Temple Chambers, E.C., and E. A. Burnie, 59/60, Gracechurch Street, E.C., as liquidators. A meeting of creditors is called for January 16th.

LEITNER ELECTRICAL CO., LTD., Maybury, Woking.—First dividend 3s. 4d. in the £, payable January 24th by Corfield and Cripwell, 119, Finsbury Pavement, E.C.

Calendars and Diaries.—MESSRS. ALFRED HERBERT, LTD., of Coventry, have sent us, as in previous years, one of their serviceable wall calendars, each monthly page of which has very bold block date figuring and interesting pictures of some of the firm's machine tools.

MESSRS. ALFRED GRAHAM & CO., of St. Andrew's Works, Crofton Park, London, have issued, as before, their handy-sized blue pocket book of Tide and Speed Tables for the year. It contains diary spaces and a great deal of information of a general character. Messrs. Graham have also again sent us one of their serviceable desk blotting-pads with diary at left-hand side.

THE DAVENPORT ENGINEERING CO., LTD., of Bradford, have issued a wall calendar with daily slips for 1917. Their patent water coolers are illustrated.

MESSRS. THERMIT, LTD., of 675, Commercial Road, Limehouse, London, E., have prepared the usual calendar and note-book for the current year. As before, the opening pages are devoted to illustrated descriptive matter concerning the company's process.

MESSRS. PECKHAM, DUCAMP & CO., of 90, Charing Cross Road, London, W.C., have prepared a very serviceable and well-bound desk reminder, in which ample spaces are reserved for every day of the year. A small calendar for the current month appears at the top of each weekly page.

Book Notices.—"The Electrical Engineer's Diary," for 1917, has come to hand from Messrs. S. Davis & Co. (price 5s.). As last year, it is published in two editions one with stiff covers, the other with limp covers. Besides the diary portion, which is printed on sectional paper with a week to an opening, and is provided with four sheets of blotting paper, which can be torn out, and take the place of the interleaved paper formerly used, the volume contains an encyclopaedic mass of information suitable for the use of engineers, architects, contractors, &c., and covering almost every subject connected with the generation and use of electrical energy. Official rules and regulations, including the I.E.E. wiring rules, are included *in extenso*; a list of London streets in which electricity mains are laid, and a list of electricity supply authorities in the United Kingdom, form useful features, and the technical information is well up to date, such matters as phase advancers, lighting in war time, &c., being covered. Certainly as a desk companion the engineer will find it an extremely useful work, especially if he makes himself well acquainted with its contents. One often finds that the information, in search of which one has turned the office upside down, was lying close at hand all the time in the "Engineer's Diary," as likely as not.

The "International Mercantile Diary," issued by Messrs. Syren and Shipping, Ltd., price 5s. net, is intended to facilitate the development of trade between Great Britain and foreign countries, and therefore is provided with very comprehensive foreign exchange tables, arranged on a new method, for the conversion of any sum of money at any rate from or into sterling. Tables for converting British or metric weights and measures into foreign equivalents are also given, which, it is claimed, cover *every* country, and have a far greater range than any previously published. The tables are based entirely upon the decimal system, and the publishers point out that they will, therefore, be of equal value whether the existing British currency is retained after the war or is replaced by decimal coinage with the pound as the unit of value. The book also contains a mass of useful information on matters relating to trade and commerce.

With regard to the tables, we note the usual lack of appreciation of the meaning of "significant figures," some of the equivalents being given to as many as six figures and others to only three; also, in English, centimetre, &c. carry no accent. As a rule, it is sufficient to give the equivalent values to four significant figures. There is no "grain troy," the "grain," unlike the pound and ounce, being fortunate enough to have only one value. The boiling point of water is given as 202° F., and the conversion factor from Centigrade to Réaumur is incorrectly stated. The kilometre on page 21 is given as 2,000 metres. Conversion tables are given on an ingenious system, which economises space and facilitates reference; but here again the mistake has been made of giving too many figures, as many as *nine* significant figures being given in some cases. The prefix "myria" is not used in practice. A table appears on page 30, representing the geometrical progression 1, 2, 4, 8, &c., to the 56th term, which is given to 17 significant figures! It would be interesting to know of what practical use such a table can be. Time and space prevent us from commenting further on this remarkable collection of conversion tables, except to say that, in some respects, the author has shown more zeal than judgment. The diary portion is admirably arranged.

"Scientific Papers of the Bureau of Standards." No. 295, "Determination of the Degree of Uniformity of Bars for Magnetic Standards." Washington: Government Printing Office.

"A Laboratory Course of Practical Electricity." By M. J. Archbold. London: Macmillan & Co., Ltd. Price 5s. net.

"Science Abstracts." Sections A and B. Vol. XIX, Part 12, December 27th, 1916. London: E. & F. N. Spon, Ltd. Price 1s. 6d. each.

Industries of the Empire.—The following is a copy of a statement issued last week by the Trade and Industry Committee of the Royal Colonial Institute:—

"For some time past the Trade and Industry Committee of the Royal Colonial Institute has been engaged upon the work of encouraging the establishment of new industries in the British Empire, with a view to giving a measure of confidence and security to capital to be embarked therein, as well as assisting the expansion of existing industries. As a result of a resolution, the Committee has been in communication with the Governments and Chambers of Commerce of the Dominions and Colonies with a view to urging the necessity of making it obligatory on all Government and municipal bodies to purchase Empire-made goods, and to place all contracts as far as possible with British firms. Such action, in the opinion of the Committee, would prove a strong factor in stimulating the establishment of new, and the growth of existing, industries, as well as consolidating inter-Empire trade.

"In response to the communication sent by the Trade and Industry Committee on the subject, replies have been received from 28 Governments and 21 Chambers of Commerce and Boards of Trade, which go to prove that the Empire is united in the desire to assist and encourage Empire trade, and to take such action as may be deemed appropriate and feasible. There is naturally divergence of views as to the methods to be adopted for attaining the object in view, mainly on account of the various systems of government which exist in the British Empire, but it is satisfactory to find that the Crown Colonies and Colonies not possessing responsible government are unanimous in their desire to co-operate in carrying out the principle embodied in the communication of the Committee. As regards the self-governing Dominions, there is a general desire to comply with the terms of the resolution, and to take such steps as will ensure unity of action in the future.

"The Chamber of Commerce of Sydney affirms the principle that all Government Departments, Municipalities, and other public bodies spending public money, should purchase Empire-made goods and place all contracts with British firms where possible. The Chamber of Commerce of Melbourne states that the principle embodied in the resolution is already largely in force in the Commonwealth, and that the Chambers of Commerce throughout Australia have already taken steps to carry out the principle embodied therein. As regards South Africa, the resolution was adopted at a meeting of the Association of Chambers of Commerce of South Africa in Cape Town on September 12th last. The Chambers of Commerce in India have taken active steps in connection with trade after the war, and have formulated a series of suggestions for the Empire as a whole. They strongly advocate the extension of the system, by which Government Departments and local authorities give preference to British goods, and that local authorities should only use other than British goods if actually forced to do so by considerable advantage in favour of such foreign goods. The replies are, on the whole, of a very satisfactory character, and may be seen in the Trade and Industry Department of the Royal Colonial Institute, Northumberland Avenue, W.C."

Trade Announcements.—The offices of the PHILLIPS COMMUTATOR GRINDER CO., LTD., have been removed from the City to 122, Walworth Road, London, S.E.

THE LONDON ELECTRIC FIRM has removed to Brighton Road, Croydon. Telephone No. "68 Purley."

For Sale.—The Wolverhampton B.C. Electricity Department has for disposal two mild-steel steam separators. For particulars see our advertisement pages to-day.

LIGHTING AND POWER NOTES.

Australia.—Electric power from the Public Works Department power house at Port Kembla will be used in the construction of the great dam on the Cordeaux for the Sydney water supply: a survey for a cable is being made over the distance of about seven miles, which is on the way towards the southern line towns to which the Works Department has offered a supply of power. Mittagong, one of these towns, has decided upon a municipal installation, and is about to ask the ratepayers' consent to the raising a loan. North Illawrra Council, which has for some considerable time been contemplating an installation, has recently received offers for the supply of power from the South Bulli and the Corrimal Collieries, but has been unable to come to any decision up to the present.—*Australian Mining Standard.*

Bedford.—Extension Scheme.—As mentioned in a previous issue, a special meeting of the T.C. was called to consider the extension scheme at the electricity works, which had been recommended by the Electricity Committee, at an estimated cost of £33,980, of which sum a prospective consumer outside the borough was to advance £5,080. A great diversity of opinion was shown in the discussion, Mr. W. E. Sowter voicing the case of the Committee at considerable length, and (judging by the Press report) giving excellent reasons why the new work should proceed. However, on a vote it was decided to rescind the resolution of the Committee to carry out the extensions, by 12 votes to 11. A motion was then carried appointing a sub-committee to seek better terms from the contracting parties, and during these proceedings Mr. Sowter handed in his resignation, as he took the vote to indicate a lack of confidence in the Committee. The discussion revealed the usual lack of understanding of matters electrical; and although an array of aldermen foregathered to squash the proposed extension, none of them apparently offered a suggestion for meeting the immediate new demands of 720 KW., for which, according to Mr. Sowter, no generating plant is available.

Belfast.—Extension Scheme.—The monthly meeting of the Corporation was marked by a rather acrimonious discussion in connection with the proposed new power station. Sir John Snell wrote that he had had a conference with the chairman of the Electrical Committee, Councillor Duff, and the Electrical Engineer, and as a result he asked for further information, after which he would be able to present a report. Sir John further suggested another conference in London, which was approved. Councillor Alexander again drew attention to the unsatisfactory state of the electrical supply, and said that surely a local man could be got to keep the station in order. Our correspondent says the margin of power over the demand is very small at the present time, and it is quite evident that something must be done at an early date to supplement the supply.

Bradford.—War Wages.—Having before it a considerable number of applications from workers, and recommendations from Corporation committees, the special Corporation Committee to deal with war wages and bonuses agreed last week upon an equitable flat-rate addition to pre-war rates of pay as the best way of dealing with the whole matter, and adopted for recommendation to the City Council the following scheme:—Advances and bonuses given since the commencement of the war, either in accordance with Trade Union rates or otherwise, shall, in the case of men, be made up to a total of 8s. per week on the rates or scales in operation on August 4th, 1914. In the case of women and youths, the bonus will be increased from the present 2s. to 4s. per week. In the few cases in which increases during the war have exceeded 8s. per week, there will be no reduction, and if during the continuance of the scheme the standard rate of wages in regard to any trade should be increased to cause the aggregate increases to exceed 8s., the new standard will be paid. The revised bonus allowance will be added to the normal remuneration of the married employés serving with the Forces in arriving at the allowances payable to their wives. The new bonuses are to be regarded as war wages, and recognised as due to the existence of the present abnormal conditions, and will be applied proportionately to the actual wages earned, whether more or less than the wages of a normal full week. This scheme, if approved by the City Council, will apply to all Corporation employés except a dozen or less.

Burnley.—The Electricity Committee will be prepared, on the conclusion of hostilities, to consider the question of supplying electricity to the Rose Grove district.

Chippenham.—Workhouse Lighting.—The B. of G. has appointed a Committee to consider the question of having the electric light installed at the workhouse. The Electricity Co. has offered to install a plant with 136 lights and 126 switches, at a cost of £175, and to allow £50 for the present gas fittings. If the Guardians take the light for five years the payments could be spread over that period, and the maximum cost of lighting would be £55 per annum. The House Committee had recommended the acceptance of the offer as being a reasonable one.

Continental.—Portugal.—The *Times* correspondent at Lisbon says that by a decree just published there, the consumption of gas and electricity is reduced in the case of public lighting by 50 per cent. and of private by 30 per cent.; the closing hours of shops is fixed at 7, and that of theatres and cafés at 11.

Darlington.—The Corporation electricity undertaking has a capital of £128,936, and a revenue of £27,177 resulted from last year's working, equal to 9·42 per cent. on the capital employed. The last year is the only one in the last eight that the department has not transferred any of its surplus profit in aid of the rates. The depreciation fund amounts to £7,318, while £5,515 has been spent out of profits on capital works.

Dewsbury.—War Wages.—The Electricity Committee has resolved to grant the application of the Amalgamated Society of Engineers for an advance of 3s. per week in the wages of men employed in the electricity works from October 1st last, subject to it being recognised that the advance is a war wage and dependent on the existence of the abnormal conditions. It was resolved to grant an additional 2s. per week war bonus to all the staff at the electricity works, except one man already dealt with.

Doncaster.—Street Lighting.—At a recent meeting the Mayor said, with regard to the recently adopted limited system of lighting the town by electricity, that the electric lamps had served their purpose so well that he would like to see them replace the gas lighting all over the town.

Dublin.—Loan Sanction.—The re-borrowing by the Corporation of £46,816 in respect of the electric lighting undertaking and refuse disposal works has been sanctioned, and steps have been taken for the creation of stock for that amount.

The Special Investigation. In a letter to the Dublin Corporation as to his position in connection with the City Electricity Undertaking and the reports of Mr. D'Alton and the Special Committce of Inquiry, Mr. L. J. Kettle, Deputy City Electrical Engineer, declares his readiness to put his opinion on the matter to a test by running the works or the undertaking against Mr. D'Alton for a week, a month, or a year under similar conditions, and guaranteeing to show at least equally good results. "I will wager my salary," he says, "for the time being against his on the result, and if I am proved incompetent, you will not be under the necessity of getting rid of me, for I shall not wait for that. If I win, I am confident you will show appreciation." Mr. Kettle mentions that he has time and again asked to be paid on results, for he would be very pleased to have not only a professional, but a financial interest in getting the best results possible. He adds that the guarantees to effect economies which he gave the Council he has made more than good. The books and records show that it was not he who, as alleged, put false statements before the Council. The undertaking is not, he asserts, the hopeless thing one would imagine from the reports. He attaches to his letter an appendix, in which he deals, in technical detail, with the points stated in Mr. D'Alton's report.

Eccles.—Bulk Supply.—The Corporation has decided to inquire from the Salford Corporation and the Lancashire Electric Power Co. as to their terms for supplying electrical energy in bulk.

India.—According to *Indian Engineering*, the Government Resolution on the Report submitted by the Committee appointed in June last to advise Government on the question of the charges at present levied by the Calcutta Electric Supply Corporation, Ltd., will be received with general satisfaction. With rebates for prompt payment the present cash rates for current are 5 annas for lighting and 3 annas for fans, with further reductions in the case of large consumers, while the meter rent was reduced from Re. 1 to 8 annas in 1915. The Committee, after considering the case in all its bearings, recorded the following opinion:—"We cannot but come to the conclusion that there is a sufficient margin to admit of a further reduction in the cash price per unit for lighting. There has been a reduction of 1 anna since the agitation for lower rates commenced in 1914. This reduction was, we think, unduly delayed, and it would have been more fitting if the additional profits had been utilised in working out the loss on the old plant rather than increasing the dividend of the shareholders." With this expression of opinion the Government Resolution fully concurs.

Keighley.—Street Lighting.—A proposal to spend £300 on the further lighting of the streets by electricity, has been referred back by the T.C.

Leigh.—Linking-up.—The T.C. has confirmed a proposal by the Electricity Committee to link-up its undertaking with that of the South Lancashire Tramways Co., for the purpose of a mutual stand-by, and also for the laying down of plant at a local works, which schemes will involve the expenditure of £2,100 and £1,440 respectively.

Lewes.—Street Lighting.—The T.C. has decided to have certain public thoroughfares temporarily wired for public lighting by electricity, at an estimated cost of £45.

London.—Marylebone.—The Electricity Committee, on the report of the general manager, recommends the reconstruction of the ash conveyor (which has been in use 11 years), at a cost of £1,590, plus £100 for labour. He has also reported on the fires which frequently occur in the overhead bunkers, and has decided that some means must be provided for quickly removing the coal which is on fire. He recommends that a conveyor should be erected under the coal bunkers in the boiler house, at a total cost of £1,700.

The general manager reports that he finds the cost which would be entailed to gasify coke in producers, extract the ammonia and turn it into sulphate, and fire the boilers with gas, would far exceed any saving that could be made.

As the next best step he recommends that two of the boilers should be fitted with the Underfeed Co.'s travelling grate, at a total cost of £2,100; the boilers are designed to evaporate normally 18,000 lb. of water per hour, and this can be increased to 25,000 lb.

A technical report on the low-temperature distillation of coal has been submitted to the Committee.

The working of the electricity department for the September quarter shows that 2,745,481 units were sold, a net increase of 3·79 per cent. over September, 1915. The revenue from consumers, including meter rentals, amounted to £28,312, an increase of £812 on the corresponding quarter. The total expenditure for the quarter amounted to £17,413, an increase of £1,841. The result of the quarter's working is a drop of £133, as compared with 1915, but, on the half-year, it is £1,939 better than last year.

It is estimated that the lighting units have decreased by about 12½ per cent., as the result of daylight saving, further lighting restrictions, and consumers' economies since last year. The analysis discloses an increase of no less than 20 per cent. in sales for uses other than lighting, which it is expected to retain after the war.

Woolwich.—The General Purposes Committee has agreed to support the Hackney B.C. in defending the pending action in respect to alleged preferential charging, but urges that official action should be taken to defer the proceedings till after the war.

Battersea. The Electricity Committee recommends the Council to grant an advance of 3s. per week as war wages to fitters in the employ of the Electricity Department.

With reference to the electricity supply in the Nine Elms district, the Committee is arranging for a 300-k.v.a. transformer, to be supplied by the British Electric Transformer Co., at a cost of £368.

Southwark. The Electricity Committee has prepared a list of revised charges, which will be equivalent to a total increase in prices since the war started of 30 per cent. on lighting and 50 per cent on power. It is pointed out that, as revised, the charges are only equivalent to those of the competing company in the area. It is suggested that in the future an increase in price of 1 per cent. may be made for each 6d. by which the price of coal exceeds 20s. per ton.

Manchester.—Proposed Loan.—The Electricity Committee proposes to apply to the L.G.B. for sanction to borrow £30,000 to cover the cost of additional plant at consumers' and Corporation sub-stations.

Mr. S. L. Pearce, the chief engineer, anticipates, in view of the increased demand, that it will be necessary to review the position with regard to the generating plant in the course of the next few months.

Portuguese East Africa.—According to the *British South African Export Gazette*, the English company holding the contract for the supply of power to the Government railway and docks at Lourenco Marques, has installed a 400-kw. generating set and two new boilers, at a total cost of £6,500, on the advice of Messrs. Mordey & Dawbarn, the consulting engineers.

St. Annes-on-Sea.—Electric Heating.—Mr. J. H. Clothier, the electrical engineer to the District Council, reports that during the past month there has been quite a run on electric radiators, householders turning to this form of heating in preference to the now costly coal fire. The result has been that the load has been particularly heavy, constituting a record.

Sheffield.—Loan Sanction.—The Treasury has approved of the borrowing of £8,280 for rotary converters and sub-station buildings, including cost of purchase of a site for the sub-station.

New Power Station.—A public meeting of ratepayers has approved the proposed new power-station scheme ; it was pointed out that the electric furnaces in use or ordered represented an output of 100,000 tons of steel per annum.

Southport.—The Corporation Electricity Committe has instructed the Town Clerk, Borough Treasurer, and Electrical Engineer to draw up new regulations with reference to electricity supply.

Swansea.—Hire-Purchase Scheme.—The Corporation has approved of a recommendation of the Electric Lighting and Tramways Committee, as the best means of encouraging the supply of electricity to houses and premises where the occupiers are unable, or unwilling, to bear the initial cost of installation, to supply the electrical apparatus, do the wiring, &c., on the hire-purchase system. The scheme is applicable to electrical apparatus of all descriptions obtainable at the Committee's showrooms, upon a cash payment of 20 per cent., the balance to be paid by means of quarterly instalments spread over three, five or seven years. The cost of installing a house varies from £3 12s. 6d. for one of five rooms, to £6 12s 6d. for one of ten rooms, and the payment of the cost of the installation and fittings is to be charged to a suspense account, which will be reduced year by year as the instalments are repaid.

Walsall.—The maximum load recorded at the old Wolverhampton Street station on December 13th last was 2,006 kw., the effective plant capacity being 1,870 kw. The original war wages of the electricity and tramways departments have been increased from £411 and £1,300 to £822 and £2,075 respectively.

Owing to the delay in getting the new generating station into full use, the Electricity Committee has decided to increase the price of current by 20 per cent., as from the meter readings for the December quarter.

Wimbledon.—Loan Refused.—The B. of T. has refused to sanction a loan of £3,183 for house mains, services, meters, and a sub-station transformer. The Council has decided to inform applicants for connections of this fact.

Winchester.—Price Increase.—The T.C. has increased the price of current as from the Christmas quarter for lighting, power, heating, and cooking by another 10 per cent., making 25 per cent. since the war broke out.

TRAMWAY and RAILWAY NOTES.

Astley.—A correspondent states that the proposed new tramway through the Astley district—where extensive new coalfields are being opened out—which would connect with the South Lancashire Co.'s system at Leigh and Boothstown, has been shelved until after the war.

Bradford.—The tramway authorities are inviting employers of the city to change the meal times of their staffs in such a way that the meal hours will be spread over a wider period than at present, in view of the increased demand on the cars consequent on the railway restrictions, and also of the limit on the number of cars available owing to the action of certain workmen in refusing to work overtime.

The traffic receipts up to the present time—quite apart from the increased use of the cars by reason of the railway restrictions—amount to £10,000 more than for the corresponding period of last year, and last year was unusually high. About 600 men have been released from the staff of car operators for the Army or war work, to attempt to replace whom the department has secured 300 women as conductors. The sheds have been combed and re-combed for men fit to be trained as drivers, and the repair department has lost 84 men to the Army or war work. The men left have not, unfortunately, been able to appreciate their responsibility to quite the extent which is desirable under present circumstances, and the decision of the local Munitions Court having gone against them in a recent dispute on rates of pay, they are refusing to work overtime. The renewals and building department of the undertaking, owing to war effects, has practically ceased to exist, and the number of cars which can be put on the road is greatly reduced, to cope with greatly increased traffic. The normal week-day number of cars is 176, but the number possible is now about 156, and whereas the Saturday service is normally 196, it is now reduced to 164.

Accident.—On Monday morning a car, from which the driver had alighted, ran away down a steep hill, colliding with another car and wrecking it ; 21 passengers were more or less seriously injured.

Darlington.—The tramways have now completed their 11th year, and in the annual abstract of accounts it is stated that the gross profit for the past year was 6·5 per cent. on the capital outlay of £77,929, compared with 5·8, 5·3, 4·4, and 4·4 per cent. for the previous four years. After providing for interest and depreciation, there was a net loss of £1,088. The working costs per mile were almost the same as in the previous year. The passengers carried numbered 4,439,278, an increase of 204,495 on the previous year, and the traffic receipts showed an increase of £963.

Doncaster.—Welded Joints.—The Tramways Committee has appointed the Tudor Accumulator Co., Ltd., to carry out the work of welding and building not less than 250 rail joints on the Corporation's permanent way. The track has given considerable anxiety for some time, and £5,000 has been spent on it during the past financial year.

Referring to war-time difficulties last week, Councillor Balmforth said that they had had to resort to women drivers and conductors, who had done so well that he did not know whether the men would not be in the second place at the finish of the war ; 36 Saturday drivers had been trained, and something like 85 women, 28 of whom had left at various times. The department required more cars, but could not get them, and the number they had were running full time, and could not be laid by for overhauling. There was difficulty in getting repair parts, and some cars had had to be pulled to pieces to effect repairs on others. In regard to an application for cheap workmen's fares, he said that in the near future fares might have to be increased.

Dudley.—Accident.—On Thursday morning, last week, a serious tramway accident occurred on the Tipton Road route, resulting in the death of one person and injuries to 25 or 30 others. The accident was almost a repetition of one which occurred in the same place a year ago. The driver left the car for a few moments at a terminus, while the conductress turned the trolley pole and mounted the rear platform, when the brakes were apparently released, and the car ran away uncontrolled down an incline, being derailed at some points and overturned. Of the passengers 25 were taken to the hospital, while one—an extra conductress who was learning—was caught under the car and died shortly after rescue.

Huddersfield.—Mr. E. H. Sellars, the Chairman of the Tramways Committee, has made a public appeal for patience and forbearance during the present stress and difficulty in the tramway service. The department has lost 180 men to the Army or to war work, and the whole of the works staff has been combed to find suitable men to train as motormen. The number of stopping places on the routes is to be materially reduced, and the public are asked not to require parcel carrying after 5 p.m. Ladies are asked to use the cars for shopping at times other than workers' meal times.

Keighley.—Women Drivers.—The Corporation has decided to abandon its experiment of employing women drivers on the electric cars. One or two minor accidents have occurred, and it is said the women have not the necessary muscular power effectively to apply the brakes.

The question is to be considered as to whether it is feasible for the tramway system to be linked up to that of Bradford through Bingley and Crossflats by petrol omnibuses.

Lancashire Tramway Wages.—As a result of an arbitration conducted by Sir George Askwith, a war bonus of 6s. 6d. per week has been granted to the male tramway employes of 14 Lancashire towns, that amount to include any increases granted since the outbreak of the war. Youths under 18 are to receive a war bonus of 3s. 3d. The award makes no change in the wages or war bonus paid to female employés. Among the areas affected are Birkenhead, Salford, Wigan, Stockport, Oldham, Preston, Bolton, Accrington, and Ashton-under-Lyne.

Sheffield.—Application is to be made to the Ministry of Munitions for a permit to have 400 tons of tramway rails rolled.

South Lancashire.—A new system of tickets with the stages numbered was introduced at the beginning of this week by the South Lancashire Tramways Co.

Miners wishing to enter the South Lancashire Co.'s cars in the afternoon, at Walkden, now form queues.

THE CONDENSATION PUMP.

In the *General Electric Review* for December, Dr. Irving Langmuir, of the Research Laboratory of the General Electric Co., Schenectady, N.Y., describes a new form of mercury vapour vacuum pump, characterised by its extreme speed and the high degree of vacuum attainable.

The original type of pump is shown diagrammatically in fig. 1.

In this device a blast of mercury vapour passes upward from the heated flask A through the tubes B and C into the condenser D. Surrounding B is an annular space E connecting through F and the trap G with the vessel to be exhausted. The tube C is enlarged into a bulb H just above the upper end of the tube B. This enlargement is surrounded by a water condenser J, from which the water is removed at any desired height by means of the tube K, which is connected to an aspirator. The mercury condensing in D and H returns to the flask A by means of the tubes L and M. The tube N connects to the "rough" or "backing" pump, which should maintain a pressure considerably lower than the vapour pressure of the mercury in A.

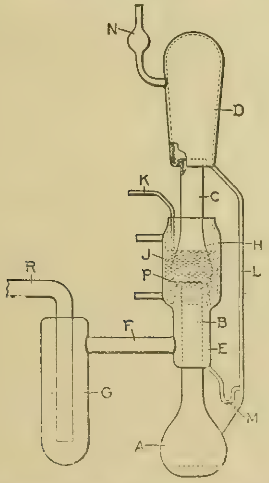


Fig. 1.—First Form of Condensation Pump.

This pump operated extremely satisfactorily, but was rather difficult to make. Trouble was frequently experienced by some liquid mercury collecting at the bottom of the annular space E. This mercury by being in contact with the hot tube B, gave off vapour which produced a blast passing upwards into the annular space E. Some of this mercury vapour flowed out along the tube F and interfered with the free passage of gas from F into the pump.

To avoid this difficulty the design shown in fig. 2 was adopted. In this pump mercury vapour from the flask A is carried through the thermally insulated tube B to the nozzle L. The vessel to be exhausted is connected to R. The gas from this vessel passes through the trap G and the tube F into the annular space E. At P this gas comes into contact with the mercury vapour blast issuing from the nozzle L, and is thus forced outward and downward against the walls of the tube C, and is finally driven down into the space D, from which it escapes into the rough pump connection N. The mercury which condenses on the sides of the water-cooled tube C passes back through the tube M into the boiler A.

By this construction none of the mercury which condenses passes into the annular space E, and thus the troublesome blast of mercury into the tube F is wholly avoided.

In the pump shown in fig. 1, a part of the mercury vapour condensed on the walls of the enlargement H, but the larger part passed up into the air-cooled condenser D. In the newer pump (fig. 2) the enlargement of the tube C and the second condensing chamber are eliminated entirely. This greatly simplifies the construction without materially affecting the operation of the pump. It is true that the speed of operation appears to be somewhat higher in the type containing the enlargement, but the speed of these pumps is usually so excessive, even without the enlargement, that a further increase in speed serves no useful purpose.

In order that the pump may functionate properly it is essential that the end of the nozzle L (fig. 2) shall be located below the level at which the water stands in the condenser J. In other words, the overflow tube K must be placed at a somewhat higher level than the lower end of the nozzle, as is indicated in the figure. The other dimensions of the pump are of relative unimportance. The distance between L and D must be sufficiently great, so that no perceptible quantity of gas can diffuse back against the blast of mercury vapour, and so that a large enough condensing area is furnished.

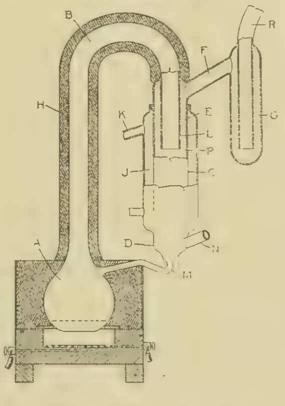


Fig. 2.—Improved Form of Condensation Pump.

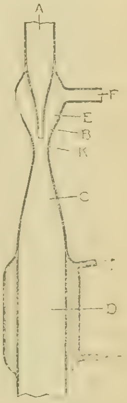


Fig. 3.—Diagram Illustrating the Action of an Ejector.

The pump may be made in any suitable size. Some have been constructed in which the tube B and the nozzle L were 1¼ in. in diameter, while in other pumps this tube was only ¼ in. in diameter, and the length of the whole pump was only about 4 in. The larger the pump the greater the speed of exhaustion that may be obtained.

In the operation of the pump the mercury boiler A is heated by either gas or electric heating, so that the mercury evaporates at a moderate rate. A thermometer placed in contact with the tube B, under the heat insulation, usually reads between 100° and 120° C. when the pump is operating satisfactorily. Under these conditions the mercury in the boiler A evaporates quietly from its surface. No bubbles are formed, so there is never any tendency to bumping.

Unlike Gaede's diffusion pump, there is nothing critical about the adjustment of the temperature. With an electrically-heated pump in which the nozzle L was ¼ in. in diameter, the pump began to operate satisfactorily when the heating unit delivered 220 watts. The speed of exhaustion remains practically unchanged when the heating current is increased even to a point where about 550 watts is applied.

The back pressure against which the pump will operate depends, however, upon the amount and velocity of the mercury vapour escaping from the nozzle. Thus, in the case above cited, with 220 watts, the pump would not operate with a back pressure exceeding about 50 bars,* whereas with 550 watts, back pressures as high as 800 bars did not affect the operation of the pump.

The "speed" of a pump is determined by the time taken to reduce the pressure in a chamber of given capacity by a known fraction, and is measured in cm.^{3} per second; in the case of a piston pump this is approximately equivalent to the piston displacement per second. Mechanical high-vacuum pumps have speeds not greater than 100 to 200 cm.^{3} per second, though Gaede's molecular pump gives a maximum speed of about 1,300 cm.^{3} per second. Leakage back through the pump renders the degree of vacuum attainable dependent, to some extent, upon the exhaust pressure into which the pump discharges; in the case of Gaede's molecular pump, the ratio between the exhaust pressure and the lowest attainable intake pressure is about 50,000 : 1. The rate of flow of gases through tubes at pressures so low that the collisions of the gas molecules with each other are of relatively rare occurrence compared with the collisions between the gas molecules and the walls of the tubes ("molecular flow") depends directly upon the diameter of the tubes, which offer a relatively enormous resistance to the flow at very low pressures; hence large tubes must be used. The attainment of very low pressures is limited by the speed of the pump and the size of the tubing between the pump and the vessel that is being exhausted, and also by leakage either in the pump or in the vessel; in the latter case, the gas leaking in does not, in general, pass through the walls of the vessel, but is given off from its walls or from bodies within it. Even after heating glass for half an hour or more to 360 C., the evolution of water vapour from the glass surface at room temperature is not entirely stopped. It is this phenomenon that puts a limit to the pressure actually attainable with mercury vapour pumps.

For a number of years Dr. Langmuir has been convinced that the collisions between gas molecules and a solid or liquid body against which they may strike, are, in general, almost wholly inelastic. Each molecule which strikes a surface thus condenses on the surface instead of rebounding, although it may subsequently re-evaporate. This condensation takes place just as well at high temperatures as at low, but at high temperatures the re-evaporation may occur so soon that it is difficult to detect the condensation. In this case, the condensed molecules constitute an adsorbed film. The condensed particles, before they re-evaporate, are held to the surface by the same kind of forces as those which hold solid bodies together. This leads to a theory of adsorption which is in excellent agreement with experimental facts. It was by a direct application of these ideas that he was led to construct a high-speed mercury-vapour pump.

An ejector such as is shown in fig. 3 could not be used to produce a high vacuum. Suppose, for instance, that a blast of mercury vapour passes through the tube A and escapes from B into the exhausted chamber C, and condenses at D. A large fraction of the atoms of mercury vapour escaping from B will have transverse velocity components, so that they will strike the walls of the outer tube at K. These will condense, but the heat liberated will cause the walls to assume a temperature comparable with that of the mercury vapour blast. The condensed mercury will, therefore, evaporate approximately as fast as it condenses. The atoms which evaporate are just as likely to leave the surface in a direction towards E as towards C. Therefore a large fraction of the mercury vapour which strikes the wall K will pass into the tube E and out through F, so that it will completely prevent the entrance into E of a gas at low pressures. Experiments have subsequently proved that this is exactly what happens when it is attempted to operate an ejector at very low pressure. Not only does the device fail to pump, but it is often impossible to get any gas to pass through the device, even when there is a pressure of 100 bars or more at F and the pressure at D is held at one bar or less.

If it had been assumed that the mercury atoms striking K were reflected into E, then there would be no obvious means of preventing this reflection. Dr. Langmuir was convinced that reflection did not occur, and, therefore, that to avoid this blast of mercury vapour into E, it would only be necessary to cool the walls of the outer tube at the point K. In this way, the blast of gas into E is made to disappear, and the gas from F therefore passes into E and towards K. Beyond the nozzle B the molecules of this gas are struck by the atoms of mercury escaping from B, and are forced outward (not drawn inwards) against the walls of the outer tube at K. The gas molecules are then subjected to a continual bombardment from mercury atoms, which have velocity components in the direction towards C. If the walls of the tube C are also water-cooled, the gas which enters at F is thus pushed along the walls of C, and is finally driven into the condenser D.

This was the reasoning which led to the construction of the type of pump shown in fig. 1. The very first pump constructed operated perfectly satisfactorily, and gave a speed of about 1,800 cm.^{3} per second.

The action of the pump is based on radically different principles from that of the ejector. The most essential element in the operation seems to be the condensation of the mercury vapour at K and the maintenance of a temperature in this region so low that the condensed mercury does not re-evaporate. It is, therefore, suggested that pumps based on this principle should be called condensation pumps.

The condensation pump lends itself admirably to construction in metal. One type of pump which has proved relatively simple in construction and efficient in operation is shown diagrammatically in fig. 4. A metal cylinder A is provided with two openings, B and C, of which B is connected to the backing pump and C is connected to the vessel to be exhausted. Inside of the cylinder is a funnel-shaped tube F, which rests on the bottom of the cylinder A. Suspended from the top of the cylinder is a cup E, inverted over the upper end of F. A water jacket J surrounds the walls of the cylinder A from the level of B to a point somewhat above the lower edge of the cup E.

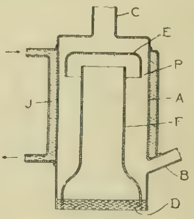


Fig. 4.—Condensation Pump in Metal.

Mercury is placed in the cylinder, as indicated at D. By applying heat to the bottom of the cylinder the mercury is caused to evaporate. The vapour passes up through F and is deflected by E, and is thus directed downward and outward against the water-cooled walls of A. The gas entering at C passes down between A and E, and at P meets the mercury vapour blast, and is thus forced down along the walls of A and out of the tube B. The mercury which condenses on the walls of A falls down along the lower part of the funnel F, and returns again to D through small openings provided, where the funnel rests upon the bottom of the cylinder.

Pumps of this type have been made in several different sizes. A pump in which the funnel F is 3 cm. in diameter, and the cylinder A is 7 cm. in diameter, gives a speed of exhaustion for air of about 3,000 cm.^{3} per second, and will operate against an exhaust pressure of 200- 00 bars, depending on the amount of heat supplied to the mercury. The power consumption ranges from 100 to 500 watts.

Very small pumps have also been constructed in which the tube F is only 0·6 cm. and the cylinder A is only 2 cm. in diameter. This type of pump gives a speed of about 200 cm.^{3} per second.

The bar is the C.G.S. unit of pressure: one dyne per sq. cm. One bar is equal to a pressure of ·00075 mm. of mercury, or about one-millionth of an atmosphere.

It must be realised that the condensation pump, like any mercury pump, does not remove mercury vapour from the system to be exhausted. The vapour pressure of mercury at room temperature is in the neighbourhood of two bars. By inserting a trap such as that indicated at G (in fig. 2), between the pump and the exhausted vessel, this vapour pressure may be lowered.

For a very large number of experiments, the presence of mercury vapour is not injurious. By the use of solid CO_2 or liquid air the mercury vapour may be entirely eliminated.

By means of a new type of vacuum gauge devised by Dr. A. W. Hull, pressures as low as 10^{-5} bar, obtained by the condensation pump, have been measured. There is little doubt but that pressures very much lower than this can be, and have been, obtained by cooling the bulb to be exhausted in liquid air, so as to decrease the rate at which gases escape from the walls.

THE POSITION OF THE SHIFT ENGINEER AFTER THE WAR.

By JOHN MARKS.

Since war broke out, the shift engineer has been declared to be indispensable, badged, and sternly prevented from following his one-time wandering propensities in search of better jobs (off shift).

Previous to the war, complaints were rife from the whole body of shift engineers that they were grossly underpaid, and in many cases treated worse than the workmen ; in far too many cases this was true, and many remedies were suggested for the very undesirable state of things then existing.

The writer, who did many years' shift duty in important plants, has always taken a keen interest in the welfare of the station man, and particularly of the men on shift ; on many occasions prior to the war, he maintained, against his colleagues, that the best policy was not to try to mend matters, but to end them by leaving station work altogether. Though the reasons for this view were simple, and founded on facts which could not be disputed, yet the writer found the majority of station men against him when he declared that the only way to better things was to get out of the line.

It should be obvious to any man who will study the financial returns of the large power companies for an hour or two, that to expect comfortable berths, having adequate salaries attached to them, from the central-station line, is to expect the impossible. The money earned is not sufficient to pay a return to the shareholders, let alone be generous to the officials ; and until the companies concerned do pay substantial dividends for a series of years, there will be nothing but low pay and overwork for every engineer connected with the central-station industry, from the top to the bottom, in both municipal and company work.

This fact presses especially hard on the shift engineer, whose work by its nature is inconvenient socially, and often debars a man from intercourse with members of his own and kindred professions.

This would be but a slight disadvantage if the remuneration and prospects were reasonable ; but good pay cannot come where profits are lean or non-existent, and prospects cannot be lively when there are literally many hundred well-qualified men holding positions inferior to their abilities ; whilst, at the same time, the tendency is for the number of officials and men required in the industry to diminish consequent on the increased size of individual generating sets, and the present fashion for very large stations supplying wide areas.

The shift engineer must maintain the supply, often with plant badly overloaded and in need of repair, and must also be prepared to turn out the unit on his particular shift for the least possible expenditure.

On top of these advantages, he enjoys the privilege of night and week-end duty, and is also permitted to be blamed for any little untoward happening, which may be discussed whilst he is not present. The above list of drawbacks is by no means exaggerated, and yet it is possible to find many shift men who delude themselves with the idea that a good berth will come their way if they only wait long enough.

Now, though the shift man's duties are responsible, yet they are mostly of a very routine nature, requiring steady day-by-day application to many small details, rather than original thought or brilliant ingenuity ; in fact, in some ways a clever man would be a nuisance as a shift engineer. He was all right in the days when things were new and little understood, and when a really good technical education was necessary in order to permit him to visualise rapidly what was developing when things went wrong, and so to check or remedy the same as soon as possible ; but that day has passed. Consequently, we have a second good reason why the shift engineer cannot expect his remuneration to mount very high, and shift men will be wise to recognise that men of quite mediocre talents and training can, and do, run shifts successfully, year in year out, in quite large plants.

Then, again, the station man is unorganised, and experience teaches that unorganised occupations are never paid well, or even treated considerately, unless they are occupations for which few men can compete.

The writer does not consider that organisation will do much for the shift man, for two reasons. The first is that, to the type of man now in mind—namely, the man brought up and sent into engineering as a profession, £250 to £300 a year is a pittance, and not a living. Now neither in company nor in municipal work will the shift man's salary ever go above the higher limit, and in the great majority of cases it will not reach the lower figure. The writer constantly comes across men on the verge of, or just over, 40 years of age, who will not see that with men only a year or two their seniors, or in some cases not their seniors at all, in the superior jobs, there will be no possible chance of these jobs falling to them until they are too old to be considered, or to enjoy them if they should achieve them. Such men cannot deny the position when it is pointed out to them, but merely content themselves with getting cross over the matter, and seeking to delude themselves as to the facts.

The second reason is that amongst station men there is far too much snobbery, as to their being above belonging to a protective association ; as if they were better than doctors or lawyers, and as if there can be any dignity in belonging to a profession in which underpay and overwork is the rule! There is practically no spirit of loyalty between man and man ; in fact, often the reverse. And the contrivings to get the superintendent or chief to lunch at their homes, or spend the evening there, would be laughable if they were not so contemptible.

Then, again, the doctors or lawyers can enforce their demands by making matters unpleasant for those who quarrel with them, and they have done so. With the shift man, however, the case is different ; his job can be kept going, if need be, by the older officials working the station until strike-breakers can be obtained. These chaps would be available in 10 days on the offer of a salary of 50s. a week. Thus, whilst the work does not lend itself to high salaries or pleasant conditions, its present economic state makes it impossible for its members to enforce their demands.

Hence, once again, the policy is to get out of station work into some sphere in which one's abilities will render one too valuable to be readily dispensed with ; in such cases both money and power can be obtained. They can never be obtained, however, in any routine type of berth, and shift engineering is undoubtedly routine to a great extent.

At the present time, chiefs are wanting shift engineers, and one of them recently pleaded at a Tribunal Court that shift engineers were being advertised for in *thousands*. As a matter of fact, there were considerably less than 100 such advertisements in the columns of the Review that week. Still, the men are wanted at present.

In such a case one would expect to find a greater salary than was offered before the war, or than will be normal after the war, when so many more men will be available. What do we find? That the very large majority of such places offer less than 50s. a week salary; that many of those offering that pittance (with war bonus) state that the appointment is for the war only, whilst the appointments at or above the level of £200 a year are so rare as to be cause for wonder and comment.

If this is what is offered now in a time of want, what will be the case when shift men are once more as plentiful as dead leaves in October? Another feature which must be considered is the fact that long before the war, chiefs up and down the country were offering shift jobs to men of a very different class to that drawn upon, say, 10 years ago. Twelve months before war broke out the writer knew young fellows who had never done anything more than act as engine-room lads, to obtain shift jobs, and, what is more, hold them. These cases were carefully noted, and it was also found that they were by no means isolated. The jobs tackled, to the writer's knowledge, included both three-wire D.C. and three-phase work; in at least one case the man who tried for, and pulled off, the job, certainly stretched the truth in order to secure the berth; whilst in another case that the writer knew of, the man made a full statement to the chief that he knew but little of the electrical side of the work.

The important point is that such men have not only obtained, but have held, such appointments, and have gone from one station to another and held their jobs amongst strangers.

It should be borne in mind that lads such as these have been brought up on incomes of, as a rule, less than £2 per week; consequently, when they work up into a position carrying, say, 45s. or 50s. a week, in peace time, they have satisfied their ambition as regards obtaining what they describe as a good job, especially when they have been accustomed to losing their wages if they were off sick; whilst the privilege of 10 or 14 days' holiday with pay also enhances the attractiveness of the post.

Consequently, the chief employing them is pleased by obtaining a man who will settle on a low wage compared with what the usual type of engineer expects to earn; he is also relieved from the bother caused by his shift engineers always being on the move, in search of appointments carrying salaries on which they can live. The engine-driver type of lad who has got himself into a shift job *can* live on the screws usual to the business.

It is possible that when a good many of these men are employed up and down the country they will join up with, say, an engine-drivers' Trade Union; and from this point of view there may be interesting developments in store for the chiefs who have encouraged such men. In many places with which the writer is in touch, the shift engineer mixes socially with the drivers: the writer does not refer to the works' football team meetings as social meetings, but to the fact that in many cases they actually live in the same districts, even the same streets, and knock about together for the greater part of their spare time.

This may be quite all right, or it may not, according to the view a man takes of his position. Every man must settle this matter for himself; but, when this sort of thing can be found in a good many towns, the sensible shift engineer who has come into engineering as a profession will recognise that a job of this type is no job for him. In fact, the writer believes that before many years are run, the shift-engineer position will be that of a foreman, and not an official. Consequently, the wise policy is to go into the work for the sake of the experience to be gained, and to get out of it at any cost after three years.

The writer expects criticism, but would ask his critics to remember that all the above statements are statements of fact, and the direct outcome of first-hand experience by the writer.

Academy of Sciences.—The Académie des Sciences has awarded the following prizes for electrical progress:—Plumey Prize to Prof. Louis Barbillion, of Grenoble; Kastner-Boursault Prize to Prof. Eric Gérard, of Liège (posthumous award); Hébert Prize to M. J. Lemoine; Hughes Prize to M. L. Chaumont (killed in battle); Henri de Parville Prize to M. E. Montoriol. Many of the other prizes were awarded to men who have fallen in the war.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—Feb. 19th. Municipal Council. Meters, maximum-demand indicators, feeder regulators. Specification from E.L. Department, Town Hall.

Melbourne.—January 31st. Department of the Navy. Dynamos, switchboard, motors, balancers, and control gear, for Flinders Naval Base. Specifications from the Director of Naval Contracts, Melbourne.*

March 5th. Council. One 7,500-k.v.a. turbo-alternator. See "Official Notices" January 5th.

Bambridge.—February 3rd. Urban Council. Public lighting of the district with gas or electricity.

Middlesbrough.—February 1st. Corporation. Twelve months' supply of electric lamps. Mr. S. E. Burgess, Borough Engineer.

New Malden.—January 31st. Malden and Coombe U.D.C. Installation of fire-alarm system. Particulars from the Council's Engineer.

New Zealand.—Tauranga.—February 12th. Borough Council. Supply of six three-phase transformers, 11,000-400 volts. Messrs. H. W. Clime & Sons, Consulting Engineers, Raetihi.—*N.Z. Shipping and Commerce.*

South Africa.—Durban.—February 12th. Six four-ton electric travelling portable jib-cranes for the harbour.*

Spain.—January 29th. Municipal authorities of Monterrubio de la Serena (Province of Badajoz). Concession for the electric lighting of the town during a period of 16 years.

The municipal authorities of Fuente del Arco (Province of Badajoz) have lately invited tenders for the concession for the electric lighting of the town during a period of two years.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Colchester. T.C. Tramcar brake blocks; Messrs. Pasley and Co.

Glasgow.—The Electricity Committee recently received tenders for one 6,000-kw. turbo-alternator set, with relative condensing plant, to be put down at the Port-Dundas station, for the winter of 1917-18. The offer by the British Westinghouse Co., at £20,500, for the turbo-alternator, with condensing plant to be manufactured by the Mirrlees Watson Co. at £8,045, has been accepted, this offer being the lowest.

Horsham.—U.D.C. Pritchett & Gold and E. P. S. Co., maintenance of new station battery for 10 years, at £45 per annum.

Leigh.—The tender of Messrs. Bruce Peebles & Co., Ltd., for a 250-kw. "La Cour" motor-converter for £1,225, has been accepted by the T.C.

London.—Marylebone.—The B.C. is recommended to accept the following tenders:

Reconstruction of ash conveyor, £1,690. Messrs. Babcock & Wilcox, Ltd.
Coal conveyor under bunkers, £1,190. Messrs. Babcock & Wilcox, Ltd.
Cast-iron parts, £265.- Messrs. Jas. Oakes & Co.
Underfeed grates to two boilers, £1,781.—Underfeed Stoker Co., Ltd.

Manchester.—The Electricity Committee. Accepted tenders:

Erith-Riley stoker.—Erith's Engineering Co., Ltd.
Steelwork.—Redpath, Brown & Co., Ltd.
Transformers.—Ferranti, Ltd.
Cables.—British Insulated & Helsby Cables, Ltd.; Pirelli General Cable Works, Ltd.

Sheffield.—Tramways and Motors Committee. Accepted tender: British Thomson-Houston Co., Ltd., for 50 tramcar motors.

The Electric Supply Committee has accepted the following quotations:

R. White & Sons. Extending ashes roadway at Neepsend power house, £1,096.
A. Reyrolle & Co., Ltd. Eight sets of panels of sub-station switchgear, £4,041; six panels of 3,300-volt, three-phase sub-station switchgear, £750.
Vickers, Ltd.—Two 750 kw. rotary converters for augmenting the supply of electricity for tramway purposes, £2,444, plus 5 per cent. for contingencies.

The Health Committee has placed an order with Edison Accumulators, Ltd., for five additional electrical vehicles for refuse collection, at the following prices: One at £1,264, four at £1,066 each.

The Water Committee has purchased a second-hand motor-generator, with starter, from Mr. C. L. Turner, for £77.

Sunderland.—The Council, on Wednesday, accepted the following tenders:—

Armstrong, Addison & Co.—Wood troughing.
Wooliscroft & Son.—Earthenware cable supports.
J. W. Thompson.—Cast-iron joints, troughs.
B.I. & Helsby Cables, Ltd.—Copper rod.
R. H. Longbotham & Co., Ltd.—Purchase of second-hand plant.

Twickenham.—The U.D.C. has accepted the tender of Messrs. Stuart & Moore to install five call-bells for £48 11s. 3d.

FORTHCOMING EVENTS.

Birmingham and District Electric Club.—Saturday, January 13th. At 7 p.m. At the Swan Hotel, New Street, Birmingham. Annual meeting.

Chief Technical Assistants' Association.—Saturday, January 13th. At 3 p.m. At the Tavistock Hotel, Covent Garden, W.C. Discussion on "The First Principles in connection with the Design and Lay-out of Plant for Central Stations," to be opened by Mr. Heaviside.

Association of Supervising Electricians.—Tuesday, January 16th. At 7.45 p.m. At St. Bride's Institute, Bride Lane, E.C. Half-yearly meeting and informal discussions.

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, January 16th. At 7.30 p.m. At the Engineers' Club. Paper on "The Principles Involved in Computing the Depreciation of Plant," by Mr. F. Gill and Mr. W. W. Cook.

(Birmingham Local Section).—Wednesday, January 17th. At 7 p.m. At the University, Edmund Street. Paper on "Principles Involved in Computing the Depreciation of Plant," by Mr. F. Gill and Mr. W. W. Cook.

Illuminating Engineering Society.—Tuesday, January 16th. At 5 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Discussion on "The Lumen as a Measure of Illuminating Power," to be opened by Prof. J. T. Morris.

Chemical Society.—Thursday, January 18th. At 8 p.m. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

Belfast Association of Engineers.—Thursday, January 18th. At 7.45 p.m. At the Municipal Technical Institute, College Square. Paper on "Electric Lifts for Land and Shipboard," by Mr. C. G. Major.

Greenock Electrical Society.—Thursday, January 18th. Visit to the Brewers' Sugar Co., Ltd. (Cereals Works), Westburn Square. (Meet at 7.30 p.m.)

Royal Institution of Great Britain.—Friday, January 19th. At 5.30 p.m. At Albemarle Street, Piccadilly. Lecture on "Soap Bubbles of Long Duration," by Prof. Sir James Dewar, F.R.S.

Institution of Mechanical Engineers.—Friday, January 19th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. General meeting.

Association of Mining Electrical Engineers (West of Scotland Branch).—Saturday, January 20th. At 4.30 p.m. At the Royal Technical College, Glasgow. Paper on "Modern Switch and Fuse Gear: Its Defects and some Suggested Remedies," by Mr. A. McPhail.

NOTES.

Mr. F. L. Rawson.—The issues of the *Daily Mail* of the 6th, 8th, 9th, 10th and 11th inst. contain articles "from Harold Ashton" describing the most recent activities of Mr. Frederick L. Rawson, who "does an enormous business in Divine healing on the astonishing system of prayer on a sliding scale of payment." It is an old theme, to the tune of those "with plenty of money and no brains" having been produced for the benefit of those "with plenty of brains and no money"; but the up-to-date application of the "astonishing system" is an interesting variation on the old theme. It recognises that prevention is better than cure, and provides for immunity from shot and shell. Brief reference is made to Mr. Rawson's earlier activities in "science and speculation," including the Elmore Companies. Should Mr. Ashton desire to prosecute his inquiries further into those matters, he will find the files of the ELECTRICAL REVIEW for 1890, and subsequently, quite useful sources of information. It is to be hoped that Mr. Ashton's articles may lead to further investigation and such protection as may be necessary for weak-minded members of the community.

Electric Light Switching.—The results of the Second Batch Exam. were published on page 16 of our last issue.

Foreign Trade.—THE DECEMBER FIGURES.—The official returns of imports and exports during last month contain the following electrical and machinery figures :—

	Dec., 1916.	*Inc. or dec.*	*Twelve months,* 1916 *Inc. or dec.*
IMPORTS :—			
Electrical goods, &c.	£192,756	+ £80,753	+ £556,540
Machinery	520,671	− 180,137	− 855,373
EXPORTS :—			
Electrical goods, &c.	237,795	− 20,997	+ 938,590
Machinery	1,655,029	+ 180,773	+ 1 066,837

Linking-up Electricity Works: North-East Coast.—A meeting of the North-East Coast interests was held in the Town Hall, Sunderland, on the 20th ult., Mr. A. S. Blackman, borough electrical engineer and general manager, Sunderland, presiding. The chairman, in explaining the object of the meeting, referred to the Board of Trade circular letter of May 25th, 1916, with regard to the interconnection of electricity supply stations, and also to the memorandum of the National Electric Power Supply Joint Committee, urging consideration of the question of linking-up, from the national point of view, in the interest of fuel economy. It was decided to form a Committee to go fully into the matter, and the secretary was instructed to obtain information with regard to linking-up already accomplished in other parts of the country. The Committee was appointed as follows :—Messrs. A. S. Blackman (Sunderland), chairman; H. A. Couves (County of Durham E.S. Co.); H. Ellis (South Shields); A. B. Gridley (Cleveland and Durham E.P. Co.); J. R. P. Lunn (Darlington); R. A. Scotson (Middlesbrough); R. P. Sloan (Newcastle-on-Tyne E.S. Co.); J. J. Smith (Stockton); J. W. Spark (West Hartlepool); C. Turnbull (Tynemouth), together with Mr. S. R. Windle (Sunderland), who was elected honorary secretary.

The Price of an Outrage.—The Defence of the Realm Losses Commission has been engaged in hearing a claim by the Rev. J. Dixon, of The Vicarage, Willesden, for the repayment of professional charges incurred with reference to negotiations with the North Metropolitan Electric Supply Co. and the Ministry of Munitions, in connection with the laying of an electric cable through consecrated ground, which he considered an outrage against religious feeling as long as the cable remained. The Vicar pointed out to the company that there were two alternative routes. The President (Sir James Woodhouse), according to the *Daily Telegraph* report, said that the company required, for military purposes, to lay an electric cable in the most direct way, under the pathway of the churchyard, and they so informed the Vicar. The Vicar objected. They consulted the engineers of the local authority, and there were objections to the alternative routes, which they pointed out. Ultimately they were informed that this outrage, which would take place by the use of the churchyard, could be arranged by a payment of £200 to the church fund and thirty guineas for legal expenses for a Faculty. They described it as blackmail, and refused to pay it, and the result was that the military authorities exercised the powers under the Defence of the Realm Act, and laid the cable through the churchyard. The refusal of the Vicar to consent to their doing that occasioned these costs. The whole question was how much should be paid. The outraging of religious feelings would disappear if he got enough money.

The President said he thought the less they said about patriotism in the matter the better. It was a question of money. That was clear from the correspondence. He thought the Commission took a strong view about the application. They would communicate their decision

Reconstruction Policy.—In our leading article on "Government Assistance for our Foreign Trade" (ELEC. REV., December 29th, 1916), we referred to the effect of the changes in the Cabinet on the work of the Reconstruction Committee appointed by Mr. Asquith. The following comment on the position appeared in the *Times* of yesterday :—"The Reconstruction Committee, which was appointed by Mr. Asquith last March to advise upon problems that will arise on the conclusion of the war, was placed in a difficult position by the resignation of the late Government. It was a Committee of Mr. Asquith's Cabinet, and several of its members no longer had any authority to continue their work. Mr. Vaughan Nash, however, has kept his staff together, and the routine office work of collecting material has been kept going in Dean's Yard. It is hoped that the position will be regularised in a few days' time, and it is understood that a scheme for continuing the valuable research work undertaken by the Reconstruction Committee is now before the Prime Minister. Among the important problems which the Committee referred to sub-committees, were those associated with demobilisation, industry and trade, relations between labour and capital, and education. These sub-committees, which are composed largely of experts, will presumably receive a new mandate from Mr. Lloyd George. One of the most important, Lord Balfour's Committee on After-War Trade Policy, has been summoned to meet again in a few days' time, after a long interval."

Trade after the War.—We have received a copy of the third report of the Special Committee of the London Chamber of Commerce on "Trade During and After the War." We hope to refer to the matter in a later issue.

The Use of Magnesite.—As from January 9th, the Minister of Munitions has prohibited the use of magnesite and magnesite products for, or in connection with, (1) The construction or repair of any building (other than a furnace), or any flooring or deck; or (2) the manufacture of any insulating or non-conducting material, except under and in accordance with the terms of a permit granted by the Minister of Munitions. All applications in reference to this Order should be addressed to:—Director of Steel Production (W.J.J. 342), Armament Buildings, Whitehall Place, S.W.

Appointments Vacant.—Charge engineers, electricians and engine drivers used to high-speed petrol engines for the North of Ireland Camp E.L. plants. See our advertisement pages to-day.

The Government and Overseas Trade.—At a meeting of the Advisory Committee to the Board of Trade on Commercial Intelligence, on Wednesday, Sir Albert Stanley, President of the Board, emphasised the importance of the Committee's work. Amongst the matters considered by the Committee were proposals for a large extension of the Trade Commissioner Service in the British Dominions, proposals for commercial missions, and other matters relating to the organisation of British overseas trade, and questions arising out of the work of the Department of Commercial Intelligence.

Electric Lamps for Policemen.—The Chief Constable has asked the Hull Corporation for the police to be made an allowance for the provision and maintenance of flash lamps of 1s. per man per month in lieu of the existing oil lamps. The Watch Committee has agreed to do so during the war.

Long-Life Tungsten Lamps.—It is well known that when a tungsten filament is operated in an evacuated bulb under ordinary conditions, the resistance of the filament gradually increases, thus lowering its temperature, and the bulb is progressively darkened by a black deposit of vaporised tungsten. Both these effects contribute to lower the efficiency and candle-power of the lamp. Heretofore, in order to increase the life of a lamp at a given efficiency, various solid halogenous compounds of low vapour tension, such as potassium iodide, have been placed in the lamp in such a position that when the filament is at normal incandescence and the bulb is well evacuated there is evolved an atmosphere which is chemically active to the metal of the filament, and which is of substantially the pressure of a first-class vacuum.

Roy Winne, of Schenectady, N.Y., has discovered that the useful life of a lamp may be further increased by placing in the bulb with a regenerative compound of the above nature, a very small amount of gas, preferably nitrogen. Ordinarily, the pressure of the gaseous atmosphere should be less than 100 microns, and usually within the range of about 10 to 50 microns, or 0·010 to 0·050 mm. of mercury.

To illustrate the effect of the novel filling combination on the life of the lamp: a 125-volt 100-watt lamp, having a drawn tungsten filament was provided with a small amount of potassium thallium chloride placed in the same way as in a vacuum lamp. The bulb was evacuated, and then enough dry nitrogen was admitted to produce an atmosphere of about 25 microns (0·025 mm. of mercury) pressure. The lamp was then sealed off and operated at a specific consumption of 0·95 watt per candle. After 1900 hours the candle-power had fallen only to 96 per cent. of its original value. During the operation of the lamp the resistance of the filament repeatedly increased several per cent., and then came back to normal. In the absence of the nitrogen the initial efficiency of a lamp of this type containing potassium thallium chloride would have fallen to about 80 per cent. in about 1,000-1,200 hours.—*Electrical World.*

The Care of Accumulators.—A South African correspondent sends us the following astonishing item from a local paper, which quotes it as a letter addressed to *The Motor*. H. M. writes: "I have an 8-volt lighting battery, which has been standing a long time, and does not give any current, and will not charge up. I have been advised to empty it, and fill it up with spirits of salts and carbonate of soda, and then put the cells in boiling water for three hours. This, it is stated, releases the charge in the plates, and produces condensed oxygen gas. I should like your opinion on this, as a practical man told me he got the recipe from a newspaper." Exactly what the cell would look like after this strenuous course of treatment we can only try to imagine: much would depend on whether the soda was put in before the spirits of salts, or whether the mixture was made beforehand. The recipe, which reminds us of the genius who washed his watch with soap and water, and the Mad Hatter who used butter for a similar purpose, must have been invented by some cynic who had had a bitter experience with storage cells, and owed them a grudge.

New Steel Tubing Plant.—The working of a new and ingenious machine for making steel tubes automatically has been demonstrated at the works of Mephan Ferguson Proprietary, Ltd., Footscray, by Messrs. H. C. Tucker and H. M. Baker, who have purchased the sole rights for the Commonwealth from the Automatic Welding Co., of Menominee, Michigan, U.S.A. It is claimed that the invention will revolutionise the consumption of light gauge steel tubing in Australia. Plants have recently been established in America, Canada, and Japan, and the manufacturers are at present negotiating with concerns in Great Britain for the English rights.

The machine so operates that a strip of steel inserted into one end is converted at the other into a welded tube ready for the market, and cut to any predetermined length. The machine is capable of turning out 1,000,000 ft. in a year, in any size from ¼ in. to 2 in. diameter, and in any reasonable shape, including circular, octagonal, square, oblong, &c. As far as is known, no steel tubing has up to the present been manufactured in Australia. The steel strip used by the machine is imported. Over £1,000,000 is spent annually by Australia in importing all classes of tubing.—*Melbourne Age.*

Educational.—Melbourne.—With a view to raising the standard of efficiency in the technical branch of the City Council's Electric Supply Department's service, the Electric Supply Committee has had under consideration a proposal to establish (*a*) a system of apprenticeship with provision for technical training; (*b*) a system of scholarships whereby the most promising of the junior engineering staff may be able to gain experience in the workshops of the best British electrical manufacturers. One member will be sent each year to Great Britain for two years' experience. It is recommended that the Council provide the successful officer with £50 for his return fare, and an allowance of £1 per week during his absence. Those chosen will be required to give a guarantee that they will return to Melbourne at the end of the term of two years. The cost of the scheme is estimated at £150 per annum.—*The Age.*

Bars for Magnetic Standards.—In a recent paper (Sc. Paper No. 295) the U.S. Bureau of Standards draws attention to the lack of uniformity met with in steel and iron standard bars used for the calibration of permeameters, and for magnetic testing generally. By means of a pair of test coils slipped over the bar, at a fixed distance apart, the departure from uniformity has been mapped out for many such bars, and in many cases large deviations from uniformity have been observed, of which no indication is apparent to the eye. Few bars show a deviation from uniformity as low as 10 per cent., which would enable an accuracy of 1 per cent. to be obtained with the apparatus used at the Bureau. It is pointed out that this method of testing for uniformity is capable of being applied to the detection of mechanical inhomogeneities and flaws, and for other purposes.

Volunteer Notes.—First London Engineer Volunteers. Headquarters, Chester House, Eccleston Place. Orders for the week, by Lieut.-Col. C. B. Clay, V.D., Commanding:

Monday, January 15th. Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.25—8.

Tuesday, January 16th. School of Arms, 6—7. Lecture, 7.15, "Company Drill," by Company Commander Fleming.

Wednesday, January 17th. Instructional Class, 6.15. Platoon Drill, Platoon No. 1.

Thursday, January 18th.—Platoon Drill, Platoon No. 7. Ambulance Class by M.O., 6.30.

Friday, January 19th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.23—8.25.

Saturday, January 20th.—Commanding Officer's Parade, 2.45. Uniforms, for Drill in Battersea Park.

Sunday, January 21st.—Entrenching at Otford. Parade Victoria (S.E. & C. Railway Booking Office), 8.45 a.m.

(By order), Macleod Yearsley, *Adjutant.*

Electrolytic Zinc Dust.—The sudden increase in the price of zinc dust after the beginning of the European War, owing to the cutting-off of the German and Belgian supply, led to the conducting of some experiments on the possibility of its production on a commercial scale from solutions of zinc, and the substitution of zinc made in this manner for the zinc dust ordinarily used in the precipitation of gold and silver in the cyanide process. The production of electrolytic zinc sponge seemed the most feasible method of accomplishing this object, the sponge to be of such a nature that it would crumble to dust when dried. Sodium zincate solutions allow of the deposition of zinc sponge under a widely varying range of electrical and thermal conditions. Stirring of the electrolyte must be avoided. Current efficiencies of about 60 per cent. and zinc dust precipitating efficiencies of 70 to 75 per cent. are possible. There seems to be no difficulty in getting 1 lb. of zinc dust from a solution of zinc with 3 kw.-hours of energy. Sodium zincate solution recommends itself because of its ease of preparation from caustic soda and zinc oxide, both of which are articles of commerce.—*Journal of the Franklin Institute.*

Cost of American Rural Transmission Lines.—Some data recently presented by the Committee on Overhead Lines at the N.E.L.A. Convention, is interesting as showing that many minor distribution lines in sparsely-settled districts in the States bring in little if any return on the investment they represent. More figures were not given for Eastern territories because few lines serving low-density loads are installed there, the practice being not to install lines unless a profitable load is in sight. The loss in working was not indicated with a view to discouraging supply to thinly populated districts, but to show that legislation necessitating more costly lines would be deterrent to such extensions. Ten groups of lines were analysed having a length of service of only 1·6 years, and therefore the average deficit of 8·7 per cent. on the investment, or 50 per cent. of the gross revenue, does not represent the result of the lines in full working. The total cost per mile recorded includes right-of-way, physical cost exclusive of conductors, conductors, services, street lighting equipment, &c., and overhead costs, and averages for 630 miles of line, $1,610 per mile, varying from $860 to $2,750 per mile in individual States. The annual revenue per mile of line averaged $262; individual groups of lines show averages of between $133 and $385 revenue, and of between 1,800 and 8,000 kw.-hours supplied annually per mile of line. The data, however, shows that the gross revenue return per mile of line was almost always over 10 per cent. on the cost of the line, and in three cases was over 20 per cent., and the final deficit was arrived at by assuming interest at 7 per cent.; depreciation at 8 per cent. on lines exclusive of conductors, which was taken at 2 per cent., and at 8 per cent. on services, transformers, and street lighting equipment. Operation and maintenance was reckoned at 1·5 per cent., exclusive of taxes, and the power cost in most cases was between 3 and 4 per cent. Several lines yielding a less revenue than $200 per mile show a smaller deficit (on the assumed basis) than the average on account of lower construction cost. In such cases light construction and long spans reduced the cost to, roughly, $1,000 a mile of line.

Using Power Supply for Lighting.—At the Wolverhampton Police Court, last week, John Cullwick Turtour was summoned at the instance of the Wolverhampton Corporation for having improperly used electricity.

Mr. Howell (Deputy Town Clerk), who supported the summons, said the defendant in August last applied for a supply of electricity for power purposes. Recently an inspector passing defendant's premises noticed wires about the place, and he found that the current supplied for power was being appropriated for lighting purposes. The charges for lighting were at a higher rate.

Mr. R. Dallow (solicitor), who defended, said it was a fact that the current supplied for power purposes was used for lighting. He explained that prior to November 5th the premises were lighted from a dynamo run off shafting. On November 5th a mishap occurred to the dynamo, and defendant, who was working on munitions, could not stop, and so arranged the wires to get light from the power supply. The same day, or shortly after, a man from the electricity works called, was shown the light, and was asked to supply a second meter, which the Corporation ultimately supplied. Under the circumstances, defendant did not think he was doing any harm, and there was certainly no intention to defraud, as everything was done openly. Neither was there any idea of saving money, as a considerable sum was spent in lamps. The sole idea was to get on with the work.

After evidence had been given by Mr. Ernest Stubbs (assistant electrical engineer to the Corporation), the Stipendiary said no doubt electric current was applied wrongly, but there did not appear to have been any considerable use of it in the wrong way. However, there had certainly been a mistake, to put it in the mildest way, and defendant would be fined 40s.

Institution and Lecture Notes. — Institution of Municipal Engineers.- "Some Notes on the Uses of Electricity in Municipal Engineering" were read at the annual meeting of the Institution, on Saturday last, by Mr. Horace Boot, for the edification of municipal engineers and surveyors, the author remarking that he had been struck with the lack of general knowledge shown on several occasions. The paper indicated the various uses to which electricity could be put, but it was not suggested that the borough engineer and surveyor should be thoroughly competent in every branch; generally, the advice of Mr. Boot was to call in an expert where the municipality did not already possess one as a permanent official. In the course of a short discussion, the two or three speakers who took part concentrated upon the question of sewage pumping, and drew attention to the better results obtained by the use of small automatic electric pumping plants than by compressed air. Attention was called to the fact that a small electrically-driven centrifugal pump could be worked as efficiently as a large one, and at the same time did away with the labour difficulty, which was causing a good deal of trouble with small schemes. Mr. Reginald Brown also mentioned the Act recently obtained by the Post Office, giving compulsory powers to erect poles on private property, and complained of the injustice of allowing the Post Office to do this before arranging what compensation should be paid the owner. He also supported Mr. Boot in the belief that the telephone system of the country would be better in the hands of the local authorities.

London School of Economics and Political Science.—On Thursday, January 18th, at 5 p.m., Mr. E. J. P. Benn will lecture on "The Organisation of Trades."

Institution of Electrical Engineers.—At the meeting of the SCOTTISH LOCAL SECTION, in Edinburgh, on Tuesday evening last, a paper was read on "Principles Involved in Computing the Depreciation of Plant," by Messrs. F. Gill and W. W. Cook. The same paper was to be read in London last night.

Fatalities.—An inquest was held at Lancaster, on Friday, respecting the death of William Thomas Goodchild (50), an electrician, of Wandsworth. The evidence showed he was engaged fixing conduits in a factory near travelling cranes. In avoiding one crane he was caught by another, and crushed to death between the side of the crane and a standard. The Coroner commented on the fact that it was the third death within a short period; he said that warnings should be given to men engaged in such dangerous occupations, and if another fatality occurred he would probably recommend a criminal prosecution. The charge-hand of the electricians, John Maudsley, said Goodchild was carrying out his orders, and had been repeatedly warned about the cranes, but witness admitted that in future it would be wiser to stop the cranes when such work was being carried out. The jury agreed to a verdict of "Accidental death," and added a rider that the electrical cranes should be stopped while work of this character was in progress.

A Bradford Corporation tramway inspector, Mr. Enoch Bower, who was crushed between two cars on December 23rd, died on Saturday, aged 57.

David Davies, an electrician, whilst repairing an electric trolley at the Glamorgan Colliery, Llwynypia, received an electric shock, and, falling from the scaffolding about 18 ft. to the ground, was killed.

An inquest was held at Huddersfied, on Monday, in the case of James Chadwick (35), lead-burner, of Rochdale, who was killed whilst engaged on repairs at a Huddersfield works. The evidence was to the effect that he had arranged to attach a lamp to a flexible lead. The installation was worn, and consequently, faulty, and the deceased received a shock at the lighting voltage. The lead-burners, it was said, had three or four flexible leads, which appeared to have been made up of odd parts. In returning a verdict of "Accidental death," the jury recommended that the leads should be used only after being obtained from the electric stores.

Electrical Supplies to South Africa.—The *South African Mining Journal* for November 18th, just to hand, says:—

"On the whole, there are plenty of electrical materials in town. The British are keeping up very fair supplies, which are very necessary on account of the many standardised goods, as arranged in the various plants in the pre-war days. We are getting plenty of lamps from America, but much of their electrical material is not suited, because of the different sizes, for our general trade, and they are not laying themselves out to supply material outside their own particular sizes. This is altogether in contrast to the method adopted by the Japanese, who are doing everything they can to copy any models sent from here, in every detail and accuracy. Their efforts so far in supplying the South African market with electrical goods have been quite a success, and as travellers, and in a lesser degree speculators, are constantly travelling between here and Japan, the prospects in many directions of trade with them seems promising for great expansion."

The issue of the same journal for the previous week comments as follows on the copper position:—

"In reviewing the copper cable position, owing to the prohibition of export by the British Government, it has been gathered that the mines have fortunately provided themselves with large stocks of cables where copper wire is part and parcel of their composition. In this respect, also, the mines have ample copper wire and other copper goods to last many months as the managers have anticipated that something was likely to happen in this direction. The prominent representatives here of the Cable Makers Association have also anticipated the position by accumulating large stocks of cables, containing copper, in Johannesburg, as well as other copper goods. Hence the prohibition will not be felt here for a considerable time, but obviously the tendency will be to harden values for all copper material, particularly in electrical goods where copper wire is the medium for conveying the electric power and light. In commercial circles, apart from the mines and municipalties, there are ample stocks on hand to carry on with for a very long while and substitutes are so easily procurable."

South American Telegraphs.—By a decision of the Brazilian Supreme Court, adverse to the Western Telegraph Co., the Central and South American Telegraph Co. will be enabled to lay cables from Buenos Ayres, in Argentina, to Brazil, along the Atlantic coast.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—At Barrow T.C. meeting, on Monday, there was a long discussion upon a proposal by the Electricity Committee that the salary of the borough engineer, Mr. H. R. BURNETT, should be increased from £550 to £600 per annum, to date from January 1st, 1916. It was shown how the output of the Corporation works had grown from between three and four million units to 13.8 million units last year, and would probably be 15 million units this year. Mr. Burnett had supervised most important extensions of the works, and saved the Corporation the costs of a consulting engineer. The Mayor pointed out that in a list of nine towns, with an average output of four million units, there was not a case where the engineer's salary was below £600. In one town, with an output of seven and a half million units, the salary was £700. The Council decided to increase the salary to £600, but rejected the recommendation to make it date from January 1st, 1916.

The Doncaster Corporation last week approved the appointment of Chief Inspector BAKER as superintendent traffic manager, in succession to Superintendent Strachan, who has left. Inspector FULLER was promoted to be chief inspector. There was strong opposition on the ground that, though no word could be said against the two officials concerned, the whole system of traffic management required reconstruction.

The Bradford Corporation has agreed to lend the services of Mr. C. J. SPENCER, the tramway manager, to the Government for important special work. Mr. Spencer will commence his new duties very shortly.

Increases of remuneration recommended to the Wakefield City Council include those of Mr. G. VAREY, temporary chief assistant electrical engineer (period of war), from £175 to £208; Mr. T. C. BENNETT, assistant station superintendent, £120 to £130; and Mr. C. P. SECKHAM, assistant superintendent, £109 to £117.

The Newcastle-under-Lyme T.C. has increased the salary of the electrical engineer by £25 a year.

The salary of Mr. A. W. CLEGG, acting engineer at Accrington, is to be increased from £350 to £400 per annum. He is also to be granted a special fee of £50 for loss of holidays, prolonged hours of duty, and special work in connection with the installation of the new plant. He receives a further grant of £140 from the chief electrical engineer (Mr. Gray) during his absence in the Army.

The Establishment Committee of Woolwich B.C. reported at the last meeting of the Council having had under consideration a memorandum, from the Electricity Committee, recommending an increase in the salary of the borough electrical engineer. The Electricity Committee submitted statistics showing the working of the undertaking, and the salaries paid to the electrical engineers of other London boroughs. The Establishment Committee was in agreement with the views of the Electricity Committee, and recommended that the salary of the borough electrical engineer, Mr. G. W. KEATS, be increased from £400 to £500 per annum as from April 1st, 1916. This recommendation has been adopted.

General.—The marriage took place recently at Cootehill, County Cavan, of Mr. J. J. WOODS (resident engineer and manager of the Clones Electric Light & Power Co., Ltd.) to Kathleen McCutcheon, of Market Street, Cootehill.

Lieutenant ALFRED WALKER EMPSON, A.M.I.E.E., Royal Flying Corps, is in a London hospital recovering from an operation. After war broke out he gave up his position as chief engineer to the Merida Electric Light Corporation, Yuchatan, Mexico, and returned to England to join the Machine Section as a private. His brother was killed in action on New Year's Day.

Mr. W. Ratcliffe-Small asks us to state that for the present his address is 159, Westminster Bridge Road, S.E. Telephone No.: "Hop. 4703."

Mr. H. W. Bosworth, who has for a number of years been on the staff of the Lancashire Dynamo & Motor Co., Ltd., has been appointed manager of their London office. His address will remain as at present, 28, Victoria Street, Westminster.

Mr. G. R. Drummond, M.I.E.E., M.I.M.E., has resigned his post as electrical and mechanical engineer to the Government of Jodhpore, and rejoined the Lahore Electric Supply Co., Ltd., as general manager. The Jodhpore electric power scheme has been completed with the exception of the low-tension distribution from sub-stations, for which a good deal of copper is required, which at present is not available. Upon receipt of this copper Mr. Drummond has agreed to return to complete, test, and hand over the scheme. The total cost of the power scheme, including fairly large workshops, ice factory with large cold storage, will be 10 lacs of rupees, and when in full operation is expected to bring a return of 9 per cent. to 14 per cent. to the Jodhpore Durban.

Mr. G. L. F. Philips, technical director of the Philips' Glowlampworks, Ltd., Eindhoven, has been nominated Doctor *honoris causa* by the Senate of the Technical University at Delft (Holland).

Roll of Honour.—Lieutenant H. Y. V. Jackson, M.I.E.E., Royal Engineers, who was prior to the war on the South Wales staff of the British Westinghouse Co., Ltd., has been awarded the Military Cross for distinguished service in the field.

Sergeant Wilkes, Royal Flying Corps, who was at the electric power station of Messrs. Pilkington Bros., Ltd., St. Helens, has been killed in an aeroplane accident, aged 27 years.

Private W. Forrester, North Staffs. Regiment, reported to be missing, enlisted from the staff of Messrs. Bullers, Ltd., of Hanley.

Corporal J. Arnold, West Lancashire Divisional Engineers, who has fallen in action, was engaged for 15 years at the electric light station at Rainhill Asylum, near St. Helens.

The D.C.M. for conspicuous bravery under fire has been awarded to Private George Needham, of Croydon Corporation tramway staff.

Captain C. F. D. Suggate, Inspector of Ordnance Machinery, has been awarded the Military Cross. Captain Suggate obtained his commission in 1914, and has been on active service for some considerable time. Previous to entering the Service, he held an appointment in the electrical engineer's department of the Great Eastern Railway Co.

Private Fred Palmer, of the Loyal North Lancashire Regiment, has died from pneumonia whilst on service. He was employed at the Manchester Corporation Stuart Street electricity works.

At the Barrow Town Council, the Mayor recorded congratulations to R. Williams, a jointer in the mains department of the electricity undertaking, on being awarded the Military Cross.

Private Edward Owen, R.E., aged 23, an electrical engineer, has been killed in action.

Private Stephenson, formerly in the Hull Corporation electricity department, has been missing since November, when he was in action.

The *Times* reports that Second-Lieutenant W. M. Noble, R.E., who was the only son of Mr. W. Noble, of Herne Hill, and who was with the General Electric Co., has died of wounds, aged 26.

Private F. T. Woods, London Regiment, formerly in the employ of the India-Rubber Co., Silvertown, has been awarded the Military Medal for gallantry in assisting an officer to capture some of the enemy's field guns, and in carrying messages under heavy fire.

"I must say I feel very proud to-day; my son has been mentioned in dispatches," said Colonel Alex. Sinclair, when taking the chair at the last meeting of the Swansea Corporation Electric Lighting Committee. Ald. Daniel Jones said that not only the chairman, but the department could be congratulated, because the Colonel's son, before joining the Army, was employed at the Corporation electricity station. He moved that congratulations be recorded on the minutes. The resolution was carried unanimously.

Will.—The late Sir Wm. Ramsay, F.R.S., left £17,896 personal estate.

NEW COMPANIES REGISTERED.

Bury Electrical Plant Co., Ltd. (145,680).—Private company. This company was registered on January 2nd, with a capital of £3,000 in £1 shares, to carry on the business of electrical engineers and contractors, suppliers of electricity, manufacturers of and dealers in railway, tramway, electric, magnetic, galvanic, and other apparatus, &c., and to enter into an agreement with O. Ashworth, G. K. Haworth, and W. A. Bale. The subscribers (each with one share) are: O. Ashworth, "Ona," Holcombe Road, Green Mount, near Bury, merchant; G. K. Haworth, "Strathmore," Bury New Road, Ramsbottom, merchant; W. A. Bale, 607, Rochdale Old Road, Bury, incorporated accountant. The first directors (to number not less than two or more than three) are: O. Ashworth and G. K. Haworth. Qualification, 50 shares. Solicitor: G. Clough, 8, Garden Street, Bury. Registered office: Castle Grounds, Bury, Lancs.

Ercole Marelli & Co., Ltd. (145,688).—Private company. This company was registered on January 3rd, with a capital of £20,000 in £1 shares (preferred), to carry on the business of makers and importers of and dealers in electric and ventilating fans of all kinds, electric dynamos and alternators, direct and alternating-current motors, and dynamos for galvoplastic industries, &c., and to enter into an agreement with E. Marelli. The subscribers (each with one share) are: A. M. Baroni, 19-20, Garlick Hill, E.C., electrical engineer; F. J. Manning, St. Michael's House, Basinghall Street, E.C., solicitor. The first directors (to number not less than two or more than five) are: E. Marelli, A. S. Benni, and A. M. Baroni. Qualification, £5. Remuneration, as fixed by the company. Solicitors: Jones, Hall & Manning, St. Michael's House, Basinghall Street, E.C. Registered office: 19-20, Garlick Hill, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Coatbridge & Airdrie Electricity Supply Co., Ltd.—Further charge on the company's undertaking and property, present and future, including uncalled capital and Coatbridge and Airdrie undertakings, and benefit of certain agreements, contracts, &c., dated December 21st, 1916, supplemental to charge dated October 17th, 1906, to secure £3,000. Holders: County of London Electric Supply Co., Ltd., Moorgate Court, Moorgate Place, E.C.

Tyne Electric Steel Foundries, Ltd. — Particulars of £30,000 debentures created December 8th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £15,300. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Telephone Co. of Egypt, Ltd.—A memorandum of satisfaction to the extent of £500 on December 20th, 1916, of debenture stock covered by trust deed dated July 27th, 1904, and three supplemental deeds of acknowledgment dated February 21st, 1906, March 4th, 1908, and October 27th, 1907, securing £200,000, has been filed.

Henry White & Co., Ltd.—A memorandum of satisfaction to the extent of £900 on June 3rd, 1915, £1,100 on August 31st, and £8,000 on December 4th, 1916, of debentures dated December 11th, 1903, securing £10,000, has been filed.

City of Oxford Electric Tramways, Ltd.—A memorandum of satisfaction to the extent of £1,100 on December 15th, 1916, of charge dated 1st, 1916. All shares taken up; 15s. per share called up on 8,500 "B"—

Brown, Boveri & Co., Ltd. (89,167).—Capital, £50,000 in 1,500 "A" and 8,500 "B" shares of £10 each. Return dated December 1st, 1916. All shares taken up; 15s. per share called up on 8,500 "B"; £6,375 paid; £7,500 considered as paid on 1,500 "A." Mortgages and charges: Nil.

Pirelli, Ltd. (103,068).—Capital, £8,000 in £5 shares. Return dated October 26th, 1916. All shares taken up. £8,000 paid. Mortgages and charges: Nil.

CITY NOTES.

Dublin United (Electric) Tramways, Ltd. The directors recommend a dividend of 6 per cent. per annum (less tax) on the preference, and final dividend of 5 per cent. (less tax) on the ordinary shares, both for the half-year ended on December 31st, 1916, being the same rate as at the same period in 1915. Towards rail renewal £20,000 is set aside, and towards reserve and renewal fund £7,000, and the carry-forward amounts to £13,359. At the corresponding period in 1916 the respective amounts were: £18,000, £5,000, and £18,045. During 1916 the passengers carried were 60,448,121, and the receipts were £319,612, as compared with 60,165,648 passengers carried, and receipts £317,762, in 1915, an increase of 282,473 passengers and of £1,850 in receipts. Ald. Cotton, M.P., has resigned his directorship owing to infirm health; the board have co-opted Mr. W. Hewat.

Isle of Thanet Electric Tramways & Lighting Co., Ltd. Mr. A. R. Monks, presiding at the annual meeting recently, moved the adoption of the report, which showed for the year ended September 30th last a profit of £9,742, compared with £10,050 for the previous year. The Isle of Thanet had passed through another year of severe depression. Since the end of the financial year the tramway receipts had shown some increase, but substantial improvement could not be expected until the termination of the war. Mr. Monks said that this was, perhaps, the worst year they had ever had. In addition to the common causes operating in war-time against tramways on the East Coast, they had had Bank Holidays, aircraft raids, and sunless times. They had had difficulty in maintaining their staff; their women conductors had been quite satisfactory. The revenue account showed a decrease in traction of £2,976. and in sale of electricity £924, although from October, 1915, they had charged an extra 10 per cent. on electricity sales. They took advantage of the high price of scrap copper and rails to realise those stores. The total revenue was £28,835, a decrease of £2,752. In the pre-war year of 1913 the figures were £19,670 better than those of 1916. The increased power station costs (£797) this year arose from the price of coal and coke. Coke had risen very seriously (£450), so that they had had to use more coal than if they could have had ample supplies of coke. They were using Kent coal in combination with Welsh coal, and although at first it was not quite satisfactory, during the last few weeks it had been so. They had entered into no contract for coal for the current year, but they had no anxiety about it, as they had fair stocks and a fair amount coming from running contracts. The total operating expenses were £19,092, a saving of £2,445 for the year. Really, the position was better than appeared on the face of the accounts, having regard to the increase in wages and the increased cost of material. Until the war was over they must go on marking time and preserving the concern as well as they could.

German Electrical Companies.

The Karbidwerk Lechbruck, A.G., after making provision for depreciation, reports net profits of £2,200 for 1915-16, as in the preceding year. A dividend of 4 per cent is in contemplation on a share capital of £55,000, being the same rate as in 1914-15.

The E. H. Geist Elektrizitats, A.G., of Cologne-Zollstock, which went into voluntary liquidation a few years ago owing to the pressure of competition on the part of the large firms, has closed the year 1915-16 with an unchanged deficit of £21,000, which prevailed at the beginning of the winding up proceedings.

The directors of the *C. J. Vogel (Telephon-Drahtfabrik), A.G., of Berlin-Adlerhof*, report net profits amounting to £57,000 for 1915-16, as compared with £48,000 in the previous year. It is intended to pay a dividend at the rate of 16 per cent. on the old share capital of £175,000, as compared with 15 per cent. in 1914-15, and 8 per cent. on the new shares.

The report of *Siemens Elektrische Betriebe, A.G., of Berlin*, which refers to the year ended on September 30th, 1916, states that the value of the connections of the electricity works owned by the company, and of those in which it is otherwise interested, increased by 25 per cent., the production in KW.-hours was 30 per cent. higher, and the receipts 20 per cent. greater, but the final results showed no improvement, owing to the enhanced cost of materials and labour. After placing £28,000 to depreciation, as in 1914-15, the accounts indicate net profits of £83,900, as compared with £83,200 in the previous year. It is proposed to pay a dividend of 5 per cent. on the ordinary share capital of £1,500,000, as against 5 per cent. in 1914-15, and 6½ per cent. in 1913-14. The loan capital amounts to £1,626,000, and recourse has been had to the banks for additional credit, which has increased from £146,000 in 1914-15 to £470,000 now, for the purpose of extending existing supply works.

The Elektrizitats A.G. vorm. Schuckert & Co., of Nuremberg, is one of the two proprietors of the Siemens-Schuckert Works, and the company's financial results for the year ended on July 31st, 1916, were given in a recent issue. According to the directors' report, the proceeds derived from the inland investments were not considerably less than those in the preceding year, but the foreign holdings experienced material changes. For instance, the whole of the shares in the Aktieselskabet Hafslund, of Vinderen, near Christiania, were sold to a Norwegian group, a special incentive being given by the high position of the Norwegian rate of exchange. It was also possible for the company favourably to dispose of all its Italian investments, and thus become relieved of the considerable risk incidental to holdings in hostile countries, and the large amount of money thereby realised equipped the company for new business. In the case of the remainder of the investments in hostile countries and in the war zone, adequate provision had been made for depreciation, which would exclude any loss in future years.

The directors of *Siemens & Halske, A.G., of Berlin*, report that most of the company's departments were preponderatingly occupied on war work in 1915-16, further displacements having taken place in the direction of increased transformation of working, new plant, restrictions, and extensions. In particular, a great demand was made on the branches for signalling and control, conductors, wireless telegraphy, telephony, internal-combustion engines, and carbon electrodes for various purposes. Much technical work had to be overcome in consequence of the numerous new requirements put forward, and considerable progress and success were achieved; and great activity was also exercised for the needs of the Army and Navy outside of the company's regular departments. The total production was not less than in 1914-15, the financial results, despite the displacements in some departments, approximating to those in the preceding year. As previously reported, the dividend is at the rate of 12 per cent., as in 1914-15. The "permanent investments" are valued at £4,168,000, as against £4,426,000, and include interests in the Siemens-Schuckert Works, the Austrian Siemens-Schuckert Works, Siemens Bros. & Co., Ltd., the Russian Siemens and Halske Co., and the Russian Siemens-Schuckert Co.

The Siemens-Schuckert Werke, G.m.b.H., of Berlin, whose dividend of 10 per cent. for 1915-16 was recently announced, reports that the company's output of peace manufactures was influenced by Government measures and the further withdrawal of workmen for the Army. A considerable share was taken in the manufacture of substitutes, particularly for conductors and their insulation, which had met the requirements, although much time had been needed to gain the confidence of consumers in the use of the substitutes. It was, however, impossible fully to cope with the growing demand. The export trade to trans-marine countries and to Spain entirely ceased, but a market existed in other countries. As a result of the great requirements of the home chemical industry, and the iron and steel and engineering industries, the company received large orders for generating plant in the form of units up to 60,000 KW., for generators and transformers in connection with transmission pressures up to 100,000 volts. The report adds that the transfer from war to peace manufactures would make a large demand on the liquid funds, which showed a further increase as compared with 1914-15. The subscriptions made by the company and its officials to the five German war loans, together with the contributions of the two proprietary companies, are reported to have reached £2,800,000.

Fellows Magneto Co., Ltd.—The "Financial Times" states that the subscription list has been closed, preferred shares to the value of over £46,000 out of the 50,000 8 per cent. cumulative preferred and participating shares offered having been subscribed for, and allotted.

Northampton Electric Light & Power Co., Ltd.—An issue of 50,000 "B" shares of £1 each is offered for subscription at par, preference in allotment being given to the existing share and debenture holders. The issue will be made as ordinary shares unless the applicant elects to take 5 per cent. cumulative preference shares, the two classes ranking *pari passu* with the existing shares of the corresponding classes.—*Financial Times.*

Anglo-American Telegraph Co., Ltd.—Balance dividend of £1 10s. per cent. upon the ordinary consolidated stock for the year 1916, less income-tax at 4s. 9d. in the £; balance dividend of £1 10s. per cent. upon the preferred stock for the year 1916, less income-tax at 5s. in the £; first and final dividend of £1 10s. per cent. upon the deferred stock for the year 1916, less income-tax at 4s. 6d. in the £. The above dividends, together with those already paid, will amount to £3 15s. per cent. on the ordinary consolidated stock, £6 per cent. on the preferred stock, and £1 10s. per cent. on the deferred stock for the year.

India.—The Poona Electric Supply Co., Ltd., has been incorporated under the Indian Companies Act with a capital of Rs. 10,00,000, divided into 6,000 ordinary shares of Rs. 100 each and 4,000 preference shares of Rs. 100 each.

Messrs. Cromptons, Bombay, Ltd., have applied to the Government of Bombay for a licence for the electrification of portions of the Poona City, Poona Cantonment, Kirkee, the Poona Suburban Area, &c., and an agreement has been entered into between them and Messrs. H. M. Mehta and H. M. Watson on behalf of this company for the purchase of the licence. The company will generate, develop, and accumulate electrical power, and, in general, carry on the business of electricians in all its branches. The managing agents are Messrs. H. M. Watson & Co., of Apollo Street, Bombay.—*Indian Textile Journal.*

Stock Exchange Notice.—Application has been made to the Committee to allow the following to be quoted in the Official List:—

Southern Brazil Electric Co., Ltd.—£507,000 6 per cent. mortgage debentures, Nos. A1 to 850 (£500), B1 to 1,000 (£100), C1 to 500 (£50), and D1 to 1,000 (£20).

Kaministiquia Power Co.—Dividend of \$1¾ per share, or at the rate of 7 per cent. per annum, for the quarter ending January 31st.

Direct United States Cable Co., Ltd.—Interim dividend of 2s. per share, less income-tax at 5s. in the £, being at the rate of 4 per cent. per annum for the quarter ended December 31st.

Calcutta Electric Supply Corporation, Ltd.—The number of units sold to consumers during the five weeks ended December 1st, 1916, amounted to 2,366,060, compared with 2,093,887 units in the corresponding five weeks of 1915.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange business has been contracted in most directions in consequence of the coming this week of the War Loan prospectus. It is officially announced that the loan will be out on Thursday night, and that prospectuses will be available for distribution by nine o'clock on Friday morning. So far, there has not been much selling of existing securities, and that there is an eager welcome awaiting the new loan is beyond a doubt.

No surprise would be expressed had there been some sort of a rush to sell stocks and shares, with a view to providing money for investing in the new issue, but probably it is better appreciated now than it was at the time that the 4½ per cent. War Loan appeared that for sellers to be able to realise, there must also be buyers, and that these latter may themselves be potential applicants for the new loan if they are not called upon to take the older securities

So far as electric lighting shares are concerned, prices are much the same as they were a week ago. As we were then saying, a little interest attaches to the forthcoming dividend announcements, which are expected to be about the same as those of last year in companies serving the City; while, as regards the West End undertakings, it is possible that in some cases we may see a decline.

The Board of Referees sitting to hear excess profits tax appeals have given their decision as stated on page 8 of the last issue of the REVIEW, which is that in the case of the London suburban and provincial companies the statutory percentage should be increased from 6 per cent. to 7½ per cent., and that in the case of the London companies the percentage should be raised from 6 to 7 per cent.

The Home Railway market has shown a fair degree of buoyancy, considering the fact that business has once more fallen away to something like a minimum. Strength is noticeable mostly in stocks of the lower-priced order. Districts are something of a favourite at 17½, a rise of 1½. London Electric ordinary shares rose 7s. 6d. to 2⅝, and Underground Electric "A" shares gained a few pence at 6s. 9d.; the £10 shares hardened to 2¼, while the company's income bonds, after touching 94¼, reacted to 93¾. Metropolitan and Metropolitan Surplus Land stocks are firm at 25 and 48 respectively. North London ordinary stock fell 3 points to 70, apparently on pressure to sell on behalf of a deceased account. The Central London group is steady.

The market is strongly convinced that the raising of fares on the lines other than the Tube railways will have a marked effect upon the traffic of the latter, and already we have heard not a little as to the money which is to be saved by going on certain routes by omnibus instead of by train, though at the expense, it may be, of a certain amount of time. The pre-ordinary stocks are holding their prices firmly, and once more it is more difficult to buy than it is to sell in not a few instances.

The declaration of a dividend of 30s. per cent. for the year on the deferred stock of the Anglo-American Telegraph Co. goes against 33s. 6d. paid a year ago. The market, however, was prepared for this, because the extra 3s. 6d. last year was in the nature of an interest payment upon interest, and was not considered likely to be repeated. There was a little activity in advance of the declaration—sufficient to wing memory with recollection of the days when Anglo "A" used to be one of the chief gambling stocks in the markets, its annual dividend being awaited by thousands of keenly-interested speculators To-day it has descended—or ascended— to the level of a sober speculative investment, in which a movement of 10s. per cent. causes as much surprise as in the old days four times that amount would have done.

The Eastern group generally is firm; and there has been a little buying of Western Telegraph shares, probably on behalf of those who are selling their West Coast of America shares to the Western Co. on the terms indicated here last week. Marconis are stagnant, and therefore inclined to be dullish. Some of the Irish holders have recently turned sellers, and the price has drooped to 55s. Americans are what the market calls sticky about 16s. Canadians remain unchanged at 9s. 3d.

Affairs in Brazil are considered to wear a much more promising aspect than they did two or three weeks ago. Active buying of the country's bonds and railroad shares has aroused renewed attention in the industrials. Curiously enough, however, Brazilian Tractions, after reaching 52, gave way to 50½, it being said in this case that the holding of a well-known proprietor, recently deceased, may have to be marketed, though, on the face of it, this seems to be improbable.

Mexican matters also are declared to be on the mend, although, as the news comes from Washington and New York, too much importance need not perhaps be attached to it. However that may be, the prices of Mexican Railway issues are certainly better; and should the optimism continue, no doubt it will soon find its way to the Mexican industrials, which are, at present, more depressed than ever. Mexico Tramways bonds are particularly flat.

Anglo-Argentine Tramways lean to the duller side. British Columbia Electric stocks have pursued their improvement, the preferred and the deferred both attracting purchasers, from which the inference is drawn that the unfortunate result of the company's last year's working may be regarded, as we suggested at the time, as the low ebb to which its fortunes are likely to decline. Two or three of the debenture stocks in this group are rather better. Amongst Latin-Canadians the tendency is steady, without noticeable features developing.

British Aluminium ordinary continue heavy at 28s. 6d., and Electric Constructions went back to 20s. India-Rubber are ¼ down at 12½. Castner-Kellners weakened to 3 5 16. Taken all round, the industrial market is unusually quiet, for which, naturally, the imminence of the War Loan is declared to be the principal cause. Another consideration, not quite so prominent, is the uncertainty felt in regard not only to present excess profits duty, but to the possibility of the existing rate being increased.

This factor bulks largely in the quietude prevailing amongst rubber shares, which is in striking contrast to the buoyancy displayed twelve months back, when something like a boomlet was in progress. It manifests itself also in the iron, coal, and steel group, where the recent peace talk has had the effect of causing people to ask what is likely to happen in this particular industry after the war is over, and war profits are replaced by more normal earnings. The whole of the Stock Exchange, however, waits upon the coming of the War Loan, the influence of which is likely to be felt for the greater part of the time during which the subscription lists are open.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1914.	Dividend 1915.	Price Jan. 9, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary ..	5	5	8½	—	7 8 2
do. do. do. 4½ Pref..	4½	4½	8 7/16	—	6 11 0
Chelsea	5	4	3	—	6 18 4
City of London	9	8	11¼	— ⅛	7 2 8
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10½	—	6 18 3
do. 6 per cent. Pref.	6	6	9⅞	—	6 1 6
Kensington Ordinary	9	7	5⅝	—	6 4 5
London Electric	4	8	1⅜	—	6 10 5
do. do. 6 per cent. Pref.	6	6	4 7/16	—	6 15 4
Metropolitan	8½	8	2¼	—	6 13 4
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 4 0
St. James' and Pall Mall ..	10	8	6	—	6 13 4
South London	5	5	2⅞	—	6 19 0
South Metropolitan Pref. ..	7	7	1 3/32	—	6 7 8
Westminster Ordinary	9	7	5⅝	—	6 4 5

Telegraphs and Telephones.

	Dividend 1914.	Dividend 1915.	Price Jan. 9, 1917.	Rise or fall this week.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	95	—1	6 6 4
do. Def.	30/-	33/6	23¾	—	6 6 4
Chile Telephone	8	8	7⅛	—	5 12 8
Cuba Sub. Ord.	5	5	8½	—	6 8 6
Eastern Extension	7	8	14	—	*5 14 4
Eastern Tel. Ord.	7	8	140½	—	*5 14 0
Globe Tel. and T. Ord.	6	7	12½	—	*5 12 0
do. Pref. ..	6	6	10	—	5 18 5
Great Northern Tel.	22	22	37	+1	5 19 0
Indo-European	13	13	49½	—	6 11 4
Marconi	10	10	2¾	— ⅛	8 12 9
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord. ..	10	10	2¼	— 1/16	4 9 0
United R. Plate Tel.	8	8	6 11/16	—	*5 19 8
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13⅞	—	*5 15 4

Home Rails.

	Dividend 1914.	Dividend 1915.	Price Jan. 9, 1917.	Rise or fall this week.	Yield p.c.
Central London, Ord. Assented	4	4	65½	—	6 2 2
Metropolitan	1½	1	25	—	4 0
do. District	Nil	Nil	17	+1½	Nil
Underground Electric Ordinary	Nil	Nil	2¼	+ ⅛	Nil
do. do. "A" ..	Nil	Nil	6/9	+8d.	Nil
do. do. Income	6	6	93¾	+ ¾	*6 8

Foreign Trams, &c.

	Dividend 1914.	Dividend 1915.	Price Jan. 9, 1917.	Rise or fall this week.	Yield p.c.
Adelaide Sup. 6 per cent. Pref.	6	6	4 15/16	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	8	—	9 3 4
do. 2nd Pref. ..	5½	5½	2¾	—	—
do. 5 Deb. ..	5	5	64½	+2	7 15 0
Brazil Tractions	4	4	50½	—1½	7 18 5
Bombay Electric Pref.	6	6	10¼	—	5 17 8
British Columbia Elec. Rly. Pfce.	5	5	6⅜	+1	7 17 6
do. do. Preferred	—	Nil	42½	+2	Nil
do. do. Deferred	—	Nil	40½	+3	Nil
do. do. Deb.	4½	4½	62½	+ ½	6 16 0
Mexico Trams 5 per cent. Bonds	—	Nil	30	—2½	Nil
do. 6 per cent. Bonds	—	Nil	22½	—5	Nil
Mexican Light Common ..	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	15½	—	Nil
do. 1st Bonds ..	Nil	Nil	27½	—	—

Manufacturing Companies.

	Dividend 1914.	Dividend 1915.	Price Jan. 9, 1917.	Rise or fall this week.	Yield p.c.
Babcock & Wilcox	14	15	2 13/16	—	5 6 9
British Aluminium Ord. ..	5	7	28/6	—	5 12 3
British Insulated Ord.	15	17½	11¾	—	7 5 10
British Westinghouse Pref. ..	7½	7½	2⅜	—	6 6 4
Callenders	15	20	13	—	7 8 10
do. 5 Pref.	5	5	4½	—	5 1 8
Castner-Kellner	20	22	8 5/16	— 3/16	6 12 7
Edison & Swan, £3 paid ..	Nil	—	1/16	—	Nil
do. do. fully paid ..	Nil	—	⅛	—	Nil
do. do. 4 per cent. Deb.	5	5	61½	—	8 2 8
Electric Construction	6	7½	1	— 1/16	7 10 0
Gen. Elec. Pref.	6	6	9¾	—	6 3 1
do. Ord.	10	10	13¾	—	7 5 6
Henley	20	25	16	—	7 18 10
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12½	— ¼	*8 0 0
Telegraph Con.	20	20	33	—	*6 5 0

* Dividends paid free of income-tax.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month.		No. of weeks.	Total to date.		Route miles open.	
		£	£		£	£		Inc.
Bristol (Trams) ..	Dec. 29	17,977	—4,130	52	258,596	+ 5,247	30·5	..
Cork	" 31	2,118	+ 167	52	26,685	+ 660	9·89	..
Dublin	" 22	24,615	+ 603	51	311,281	+ 2,197	54·55	..
Hastings	" 31	8,959	+ 647	52	64,070	+ 4,007	19·3	..
Lancashire United	" 27	6,620	+ 268	52	94,776	+ 5,468	42	..
Llandudno-Col. Bay	" 29	822	+ 55	4½	822	+ 55	6·5	..
Tyneside	..	..		..		..	..	..
Anglo-Argentine ..	" 31	217,974	+6,487	52	2,672,405	+ 4,677	..	..
Auckland	" 15	21,682	- 122	28	126,697	+ 854	26·59	..
Calcutta	" 29	19,370	+1,490	..	..	+13,358	..	..
Kalgoorlie, W.A. ..	October	2,716	..	48	25,983	..	20.5	..
Madras	Dec. 31	4,491	+ 705	52	51,858	+ 3,926	..	..
Montevideo ..	Dec.	31,364	+ 69	9	59,718	+ 56	..	..
Dublin-Lucan Rly.	Dec. 31	551	+ 71	26	4,251	+ 383	7	..

COLONIAL TELEGRAPHS AND TELEPHONES.

By R. W. WEIGHTMAN, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

(*Continued from page* 27.)

Line Wire.

In the Crown Colonies and South Africa galvanised iron wire is not so much used now, although for minor telegraph circuits 200-lb. and 400-lb. wires are still employed considerably; 200-lb. wire is also used to some extent for unimportant telephone circuits.

For long-distance telegraph lines 150-lb. and 200-lb. copper wires are used. Practically all telephone circuits are of copper. In South Africa 70-lb., 100-lb., 150-lb., 200-lb., 300-lb., and 400-lb. gauges are used according to the grade of service required.

The 70-lb. wire is used for local distribution on telephone exchange systems, and for this service it is, in the author's opinion, a useful and adequate wire.

Bronze wire, usually 150 lb. per mile, is employed in some Colonies for long spans, but not largely, and copper-clad steel wire has also been used to a slight extent. In two Colonies where this latter wire has been tried it has quickly broken down owing to moisture penetrating the copper, probably through defects caused in the handling, and causing corrosion of the steel core. Where it is erected near the sea the thin coating of copper is soon eaten away, and the life of the wire is very short indeed.

In situations where the insulation of open wires may be lowered from any cause, hard-drawn copper and bronze wire, with a special insulation to a Post Office specification, is sometimes used. This insulation consists of impregnated paper, cotton lapped and braided, the braiding being impregnated with a weatherproof composition, the basis of which is red lead. This compound is impervious to moisture, and its waterproof properties appear to improve with exposure to the air.

The Britannia joint is commonly used for jointing both iron and copper wires, but here and there McIntyre sleeves of both oval and twin-tube type have been introduced. The author has all along favoured the wire joint, as with native workmen there is less risk with it. In inexpert hands the sleeve is liable to be badly twisted and the wire damaged. On the other hand, with the sleeve the soldering iron is dispensed with, and this is certainly a great advantage in a country where the work is in skilled hands.

The practice as to terminating line wires varies. That favoured by the author was to terminate, on both sides of a road or railway crossing, at acute angle poles; also every half-mile on heavy routes, and every mile on light routes, all terminating points being securely stayed.

Earth plates of both galvanised iron and copper are used. The former costs about half the latter, and serves the purpose equally well. Care should be taken to have plates of the same material at both ends of the wire. In Canada galvanised iron rods, which are driven well into the ground, are largely used.

Canada.—Copper and iron wire are both used largely on both telegraph and telephone systems. The open telephone circuits in Canada are transposed. Phantom telephone circuits superimposed on physical circuits are largely used, and special transpositions are arranged in these cases. McIntyre sleeves are employed generally for making joints.

As a rule the line wires are bound to the insulators by a length of wire of the same gauge as the line wire. It is taken round the neck of the cup, one end is passed over and the other under the line wire, and each end is given five complete long tight wraps around the line wire.

There are a few farmers' lines on fences in Canada. The fences generally consist of three separate strands of barbed wire on wood posts, the top strand being 15 to 20 in. from the next. The top wire is used for the line, and it is not usually insulated in any way, but merely stapled to the posts. The earth is used for the return. In dry weather no great amount of leakage takes place, owing to the extreme dryness of the atmosphere, and fairly satisfactory talking is possible over short distances; but in wet weather the speech-transmission value of such lines is very poor. In a few instances the line wire is insulated on porcelain knobs. At creeks and road crossings the line wire is raised on poles. These lines are not permitted to be joined up to public exchanges.

Australia.—For main trunk telephone circuits copper wire 300 and 400 lb. per mile, and for minor trunk circuits which connect with the main trunk system, 100 and 200 lb. per mile, is used. For other minor trunk lines, and also for telegraph circuits, other than those on which fast-speed Wheatstone is employed, 200 and 400-lb. galvanised iron wire is used. For the high-speed circuits copper wire is provided. Galvanised iron wire suffers very little from corrosion, except when erected on the sea coast.

Telegraph Systems.

In the Crown Colonies, Post Office standard apparatus is in general use, and the circuits are to Post Office diagrams. The Cardew vibrator is used a good deal, in some cases superimposed on Morse lines, and also in place of the Morse on lines that suffer chronically from low insulation.

The Vyle polarised sounder is replacing the sounder and relay, and as also being adopted with condensers on central-battery omnibus circuits. The standard practice on these circuits is to use a voltage of 80 with a feed resistance, non inductive, of 1,000 ohms between the battery and the line. The sounders are wound to 2,000 ohms, and the condenser is of 4 mfd. capacity. On a line of 150-lb. copper, 120 miles in length, the author found working was improved by introducing sufficient non-inductive resistance into the line tapping at each station to make the resistances of the tappings at all stations uniform. Where primary cells are used, the practice is to use a 2,000-ohms feed resistance.

At Colombo, Ceylon, the Baudot system has been installed on a circuit 800 miles in length, connecting with Madras. There is usually one repeater in the circuit, but direct working is often carried on satisfactorily. The apparatus is similar to that used by the Indian Government, and differs essentially from Post Office practice in that the distributors as well as receivers are motor-driven. Some difficulty was experienced at the start owing to the storage batteries, which were already in use for other telegraph purposes, being of very low capacity, viz., 18 ampere-hours. The trouble was overcome by the motor circuits being tapped off different sections of the battery, so that only one motor was run off the one lot of cells. With this arrangement there was no further trouble.

The system was introduced to fit in with standard practice in India. The native Morse operators quickly picked up the new alphabet, and became expert in manipulating the instruments. The double set installed in the first place was soon afterwards duplexed satisfactorily. This experience should be of value to other administrations whose traffic is on the increase. The Morse is undoubtedly better suited to native operators than the more delicately constructed type-printing apparatus, and it will continue to hold its own on ordinary lines, and even on lines on which the traffic is sufficient to require a Morse duplex to carry it. But for heavier traffic one or other of the type-printing multiplex systems, of which there are several now on the market, will be found to give better results than either the Morse quadruplex or the Wheatstone.

The question at what stage secondary cells should be installed for telegraph working should not be decided by the mere financial saving that may result. The equipment is not costly, the constancy of the voltages makes for good working, and there are no complaints of weak signals, unavoidably common with primary cells; these are advantages which cannot be measured in *£. s. d.* Where the number of primary cells in use is over 200, and a local supply of current is available for charging, the adoption of this system is worth considering.

Leclanché porous-pot form cells are much used on ordinary line and local circuits. The Leclanché is still erroneously regarded by many as suitable only for light intermittent work, and the prejudice against it for heavy work dies hard.

In South Africa, Post Office standard apparatus is also in general use. Single needles with tapper keys are used on omnibus circuits connecting with railway stations in the Natal Province. For this class of circuit they are probably more suitable than any other type of instrument. They require no adjustment, and respond to signals of varying strength within wide limits. In the larger offices the double-plate sounder takes the place of the single needle. The Vyle polarised sounder is replacing the relay and sounder, and it is also being adopted on central-battery omnibus circuits, and on concentrator systems. The author regards this system as one of the greatest developments in telegraphy in recent years. It has the centralised battery feature of the closed circuit system without the waste of current that takes place with the latter, while under the charge and discharge process of operation it has the positive action of a double-current system. There should be a large field for the application of this system on the many unimportant omnibus circuits that run out from centres in the Dominions and Colonies.

One of the longest quadruplex lines is that between Durban and Johannesburg, about 350 miles by line, and this works quite satisfactory without a repeater.

The Wheatstone automatic has been in use between the main centres for many years, and the Creed apparatus has been introduced more recently. The Creed circuits are worked duplex, and high-speed duplex repeaters are employed on them where necessary. One of the longest of these circuits is that between Cape Town and Johannesburg, about 1,000 miles, and this has two repeaters on it. The latest type of sounder silencer, that recently brought out by the Automatic Telephone Co., on the principle suggested by Major A. C. Booth, of the British Post Office, is being installed. Motor-driven transmitters have been introduced. Both Gell and Kotyra keyboard perforators as well as ordinary mechanical perforators are in use.

At the principal offices the working current is got from secondary cells with charging and distribution equipment of Post Office standard design. At other stations primary cells of both bichromate and Leclanché types are used. The principle of using Leclanché cells for all purposes up to the point where storage cells can be installed, adopted by the British Post Office after the searching investigations of Mr. Lucas, is being applied as circumstances permit. These investigations proved the great suitability for heavy work of the porous-pot type of cell when charged with a finely granulated form of depolarising mixture; it is, besides, the cleanest and easiest cell to handle, and there is no waste of material when the cell is in disuse. The "sack" form of Leclanché cell is even more suitable than the porous-pot form where heavy currents are required, owing to its lower internal resistance. Its initial cost as compared with the porous pot is, however, against it. Dry cells are only used on telegraph work where portability is desired.

In Canadian practice minor circuits are worked single current on the closed-circuit system. The apparatus generally is of American make, and the circuits of American design.

On many of the longer telegraph circuits, repeaters are employed. The longest line is on the Canadian Pacific system, from Montreal to Vancouver (2,900 miles), duplex, with two repeaters.

Where power is available from two different supply stations, the Canadian Pacific Co. employs motor-generators directly on the line and local circuits. Two separate machines are provided for each voltage, one with the positive and the other with the negative earthed, and in each case a stand-by machine is installed, to replace either of the two machines in the event of breakdown. This means for main-line current a separate set of three machines for, say, 125 volts, another set for 200 volts, and for the longest circuits another set for 400 volts. For local circuits machines giving 25 volts are used, and resistance is inserted where necessary to make all local circuits uniform. Where power is available from one supply station only, secondary cells are used. Both negative and positive batteries are installed, and stand-by batteries of 50 per cent. the value of the batteries in use are provided. The voltages employed are notably high compared with British practice. Enamelled-coil windings are largely used, with satisfactory results so far.

In Australia telephones are now frequently used where formerly Morse apparatus would have been installed. The introduction of either the Murray or Western Electric multiplex or the Baudot system is under consideration. Creed apparatus was introduced between the Eastern and Western States in 1913, and has been in regular use for the past two years.

A reorganisation of the circulation of traffic from small offices has recently been made. Where formerly a number of small offices situated at great distances from the chief office of a State, worked direct with the chief office on one wire, they are now sub-divided and connected on short lines with distributing centres which have fast direct communication with the chief office. This involves an extra transmission, but the experience is that the traffic is handled more rapidly and congestion is reduced to a minimum.

In New Zealand the Murray multiplex is being introduced with two quadruple sets at Wellington, which will connect with a similar set at Auckland, and another at Christchurch. It is considered that this system will solve the traffic problems of the Dominion better than any of the other type-printing systems.

The longest telegraph circuit is that between Wellington and Dunedin, about 530 miles, including a section of submarine cable 40 miles in length. The telephone is largely used for the transmission of telegrams, and by its use the most remote places are brought into touch with the general system of the country.

Telephone Systems.

Throughout the Crown Colonies, and also in South Africa, the natives, who form the large majority of the inhabitants, are not sufficiently educated, or concerned in commercial pursuits, either to appreciate the value of the telephone or to use it.

At Suva, Fiji, a multiple magneto board on the "ring through" system is about to be installed. This will have an ultimate capacity of 1,200.

The author is aware that there are objections to the adoption of this system in a large exchange, but he is of opinion that for exchanges in countries where the commercial conditions are not so pressing as in large centres, the "ring through" has its advantages. A subscriber does not perhaps provide a special attendant for his telephone, and if he is busy when his bell rings he may not be able to answer immediately. With the "ring through" system, the calling subscriber does the ringing, and if prompt attention is not given, a second, and further rings can be given without disturbing the operator, and the calling subscriber knows that his inability to get through is not due to any remissness of the operator, but to inattention at the called subscriber's end. When the conversation is finished, both subscribers depress their "ring off" buttons. This method of clearing is also criticised, but from years of experience of "ring through" exchanges, the author can say that while one subscriber may forget to "ring off," it very rarely indeed happens that both forget, and the pressing of either button operates the clearing signal.

There are no automatic exchanges in any of the Crown Colonies. Not only are insulation difficulties felt to be a bar to their introduction in the damp climates of these countries, but the need for the employment of highly skilled mechanicians to look after the plant is regarded as another obstacle.

The distribution at the larger of these exchanges is generally by means of cables from the exchange led to pole lines through distribution and protector boxes fixed to the poles; 10-lb. and 20-lb. conductors are employed.

The underground cable distribution is sometimes arranged by means of cast-iron boxes of Post Office types in the manholes, but the method most generally employed now is that of lead branching joints.

Where the distribution is by means of armoured cable the lead-sleeve joints are usually in cast-iron boxes for protection and to preserve the continuity of the armouring. Where aerial lead-covered dry-core cable is used it is supported in the usual way on steel suspender wires. A cable suspender best suited for a tropical climate is made with a loop of three-ply tarred marline, which is attached to the suspender wire by a suitable galvanised steel hook. Raw-hide suspenders quickly deteriorate in a hot, damp climate, and zinc suspenders are too rigid for the lead sheathing of the cable; they are apt to grip the cable too tightly and set up crystallisation and fracture of the lead. A free means of suspension is essential.

For small exchanges the author prefers the underground armoured cable. It can be used with complete safety. The upkeep is practically nil; all the work of erecting suspender wires and the heavy stresses they bring upon the poles are obviated.

The termination of cables in a building usually follows Post Office practice, the cables being connected to distribution cases by means of a link of enamel and cotton-covered lead-sheathed cable made airtight with beeswax. This class of cable is also used between the underground cables and the main frames in exchanges. Similar cable, but without the beeswax seal, of single or multiple pairs is used between the distribution cases and instruments. This cable is most useful in any position in which a short cable lead is wanted, as in running wires into a small office or testing station. Its insulation can be relied upon, and the careful sealing necessary with dry-core cable is obviated.

Aerial rubber cable has been tried in some of the tropical Colonies, but it is liable to break down owing to the heat and rain to which it is exposed.

Where underground cables are connected to pole lines it is usual to take out not more than 25 pairs at any distribution point. This permits of comparatively light and inexpensive pole-line construction.

Special measures are taken in the manufacture of all apparatus for use in the hot humid climate of the tropical Colonies to keep up the insulation of all electrical parts. Teak-wood is always used, and screws are of non-corrodible material. Iron and steel mounts are zinc plated, and precautions are taken as far as possible to prevent insects getting inside instruments. For coil windings of large gauge, plain enamelled wire is the rule, but it is sometimes given a single lapping of silk which is impregnated with beeswax. The silk in this case is certainly a mechanical protection for the enamel, and is of value in this respect. Owing to the difficulty of properly enamelling wire of gauges smaller than about 30 S.W.G., small-gauge coil windings are given a single silk covering, and the coil is impregnated with a high-quality insulating varnish in a vacuum chamber. This impregnating process makes the coil quite moisture-proof.

All switchboard wiring and cabling is done with enamel and silk and cotton-covered wire.

In South Africa the number of telephones per 100 of the population, not including natives, is about three. The telephone services throughout the country are under the Government with the exception of the Durban exchange, which is owned and worked by the municipality. Every town and village of any importance has its exchange, and a large trunk system has been developed. At present the longest connections in regular use are about 500 miles in length. A speech efficiency equal to 30 miles of standard cable is aimed at, and intercommunication is given to all stations that come within this limit. Loading coils have not yet been introduced, but they will be employed when the time arrives to consider the longer trunk lines between the Cape and Transvaal main centres.

At the principal Government exchanges central-battery manual boards are in use, the largest being that at Johannesburg, with an ultimate capacity of 9,000 lines. At other towns magneto boards on the "ring through" system are employed; in others drop shutters are used, and, again, in other exchanges indicator-jack boards are in use with mechanically restoring clearing drops.

Magneto boards with automatic clearing are in use at certain exchanges. The hand micro-telephone is used throughout on subscribers' instruments.

Telegraph circuits are superimposed on telephone wires where it is advantageous to do so, and phantom telephone circuits are obtained wherever possible. The telephone is much used for public telegrams between outlying stations and central transmitting offices. On lines of this character it is not unusual for several offices to be in bridge on the same pair of wires, the calling being done by a code system of ringing. Magneto telephones are used, and silence cabinets of standard types are provided.

Both wet and dry cells are used on magneto telephones. The author always used wet cells in Natal, as he found them more reliable and economical than dry cells. A dry cell is no longer efficient when it becomes really dry, and in a hot, dry climate the moisture which keeps the cell active is liable to evaporate quickly and leave the cell useless long before the elements are used up.

The underground cables and distribution methods vary in the different Provinces in accordance with the practice in vogue prior to the union, but the work of co-ordinating the methods to one standard has now made great headway. In present-day practice underground cables having 10-lb. conductors are in use. Heavier conductors are employed where required, also composite cables having large conductors for long-distance circuits. Lead branching joints in manholes are in general use on underground distribution. The joints are made solid with compound which is forced in under pressure.

Distribution is carried out both by underground direct cable, and on the block system from high poles by means of both dry-core cable and open wires. In both cases the internal distribution is through lead-covered cables to distribution frames or cases, and thence to the subscribers' sets.

(To be continued.)

REVIEWS.

The Electrical Contractor. By Louis W. Moxey. London: Hill Publishing Co. Price 6s. 3d. net.

This book is written for the instruction of American electrical contractors, who, apparently, are as ignorant as those of England are reputed to be on the subject of conducting the business whereby they earn their living. On this side we are used to the statement that electrical contractors know nothing either of business methods or technical details. It is necessary for the enthusiastic supporter of municipal trading to find some justification for his views, and this is most easily done by proclaiming the incompetence of the contractor. It is, however, less easy to explain why American contractors should be so incapable as to make it necessary to write an elementary treatise such as Mr. Moxey has provided for their benefit.

The book is arranged in the reverse order to what one would naturally expect. It begins with profit recording and book-keeping; passes on to costing and estimating, and thence to mains calculations, finishing up with a chapter on illumination calculations and some rather elementary tables of "General Data." Most contractors would work out illumination details first, then calculate the cable sizes, work out the estimated cost, carry out the job—if they obtained the order—charge up the cost details, and after making up the books, return thanks for any profit left over.

Considering the book in what seems to be this more natural order, surely it cannot be necessary to write, for electrical contractors, separate chapters on simple illumination calculations, and on the calculation of voltage drop in A.C. and D.C. circuits, and to explain at length how to decide what size of conductor should be used.

If the book is written for electrical contractors such chapters should be unnecessary. If necessary to the reader, then that reader is not justified in claiming to be an electrical contractor; he should be reading an elementary text-book on physics at school.

Mr. Moxey's other chapters are more valuable, but, like many Americans, he seems inclined to let his system dominate his business. Probably in practice this is not the case, but his book reads as if all work has to conform to the system. The ordinary contractor naturally has a system, but he realises that many jobs will not fit into the system at all comfortably.

For example, Mr. Moxey gives a large number of tables covering the cost of various items of work, ranging from putting in engine foundations to fixing wire or tube. His cost tables are of some interest, but it is doubtful whether such tables would in practice be sufficiently useful to justify the labour in preparing them and keeping them up to date. Of course, a certain number of basic prices are essential to estimating, but conditions differ so widely between one job and another that the allowances necessary on this account almost destroy the value of the original figures. Mr. Moxey in effect recognises this. For example, in Table XXVII (Cost of Pole Line Construction) his figures for digging holes for 25-ft. poles range from 60 cents to 3 dollars, *i.e.*, in the ratio of 1 to 5. One may just as well estimate the cost from first principles (*i.e.*, common-sense and experience) as take such a tabulated result and decide whether the conditions correspond to the highest or the lowest figure.

Similar remarks might be made with regard to the system of costing by card records. They are of value, but in practice so many allowances and adjustments must be made that it is very difficult to reduce costs to exact basic rates. It must be done wherever possible, but to read Mr. Moxey's book gives one the impression that it is a very simple procedure, and this is far from being the case.

The book, of course, needs translation for English readers. Prices are all in dollars and cents; systems of wiring are in American (few English readers would understand exactly what is meant by "knob and tube work," for example), and labour costs are based on American rates, which are apparently about double those normally paid in London. There are also a few misprints and one or two errors, as, for example, the statement that the neutral conductor of a three-wire D.C. system should be *double* the size of the outers. Such items will doubtless be corrected in a later edition, and if this were then reduced to the basis of English rates and prices it would doubtless be of value to many contractors. At present it is to be feared that this would not be the case on this side of the Atlantic.

Electrical Engineering. First Course. By E. J. Berg and W. L. Upson. London: Hill Publishing Co. Price 17s. net.

This book, emanating from two of the professors at Union College, Schenectady, is a somewhat difficult work to deal with. The authors, according to their preface, appear to have an objection to text-books as a general thing, but, for reasons set forth, they have decided to issue this one. The book is difficult to classify, inasmuch as it consists of such a heterogeneous collection of information. Some of the chapters are of the most elementary character, while others involve advanced mathematics, and would be far beyond any ordinary "first course" student.

The first three chapters discuss, on quite ordinary lines, units, form of work, and magnetism respectively. In Chapter IV, the integral calculus is freely used to establish the magnetic intensity at any point along the axis of a coil. Chapter V deals with the design of a cast-iron electromagnet to lift a weight of 1,000 lb. The subject and treatment appear to be altogether out of place at this stage. Chapters VI and VII treat of the generation of E.M.F. and inductance respectively. They are quite good, but a knowledge of the integral calculus and differential equations is requisite. Also, the section dealing with the generation of E.M.F.'s in non-uniform fields is so brief as to be scarcely clear. After this we have a very short but clear chapter on the properties of alternating currents. The characteristics and principles of direct-current generators are then dealt with.

Following is a very good chapter on the various constants used in the design of a continuous-current generator. The method adopted is to take the dimensions of an actual machine, and to analyse them exhaustively. A machine fitted with commutating poles then receives similar treatment. Next we have two chapters on D.C. generators in parallel and in series, and on electric motors. The treatment is quite elementary, and in no way remarkable.

Chapter XIV deals with the theory of the ballistic galvanometer. This chapter would be more in place in a text-book of physics than in the present treatise.

The next two chapters in this queerly-arranged book are very good, and deal with the vector representation of alternating waves and their application. The symbolic method of alternating-current calculation is very clearly described and illustrated.

Chapter XVII—which is continued in Chapter XXI—discusses constant-pressure and constant-current transformation. Taken together, the two chapters deal fairly thoroughly with the subject.

The three intervening chapters are quite short, and treat of capacity reactance, parallel circuits, distorted waves, and resonance effects. The theory and use of the wattmeter next receive attention, but, possibly, in too brief a fashion. Two excellent chapters follow on problems in electrostatics and on distributed inductance and capacity. The treatment is thorough, and necessarily of an advanced character.

Throughout the book, as the reviewer has tried to show, the authors have not scrupled to use mathematical analysis of all kinds where necessary, and yet we find in Chapter XXV a few notes on the mathematics of complex quantities. The reviewer is of the opinion that if this is the student's first introduction to this powerful method of calculation, it will not be of much use.

Transformers, hysteresis and eddy-current losses, and wave distortion in transformers are then dealt with in a satisfactory manner. Chapter XXX is devoted to mechanical stresses in transformers. The treatment is fairly good, but should have been illustrated by a few numerical examples to be really effective. We next find 16 pages discussing the general principles of transformer design. So far as it goes the chapter is fairly satisfactory, but surely it is out of place in a first-year course of electrical engineering, as is also the following chapter on polyphase transformer systems.

Chapter XXXIII deals in quite an elementary way with alternators. It should preferably have been placed much earlier in the book, or omitted altogether. Alternator armature reaction and the characteristics of alternators are next discussed with the aid of complex quantities.

A distinctly useful chapter on the leakage reactance of an alternator follows—useful, that is to say, to an advanced student, but not to a beginner.

The familiar, and often very troublesome, phenomenon of hunting in synchronous machinery is dealt with in Chapter XXXVIII. As the subject goes, the treatment is elementary, though one would not have been surprised to see cumulative oscillations necessitating the use of elliptic functions dealt with. Each chapter in this book is more or less of a surprise.

Chapter XXXIX deals with the design of constants of an alternator. A 100-kw. engine-driven alternator is taken as an example. The method of design is not at all modern or good. Short-circuit currents in alternators are then discussed. The treatment is good and rigorous. This chapter is perhaps one of the most useful in the book.

Chapter XLI develops the equations of the synchronous motor, and these are well and clearly discussed by means of tabulated calculations and curves; while Chapter XLII deals with induction motors in a similar way.

The design of induction motors is next outlined. The reviewer does not consider the authors' method at all satisfactory. Indeed, in a footnote the authors point out that the work is not a book on electrical design. Their method is exemplified by the design of a 10-h.p. motor.

Rotary converters are then dealt with. The usual stereotyped equations are developed, and a clear account is given of the question of voltage control. The concluding chapter of the book deals in rather a neat and concise way with single-phase commutator motors.

From the above it will be seen that the book is scarcely suitable for the average first-year student. It is more a mine of wealth for the lecturer to third-year men.

The book is well printed, but bound in a cover which is very easily marked or stained.

From a number of the authors' footnotes, it is evidently intended to issue a companion volume giving an advanced course. Considering the character of the present "first course" work, the reviewer is filled with interest to know the style and contents of the "advanced course."—H. G. S.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

The Remy Thermostatic Control.

A problem that has existed since electric generators began to be installed for lighting and engine-starting purposes on petrol motor vehicles, has recently been attacked by the Remy Electric Co., of Detroit, U.S.A., the outcome of the experiment being a thermostatic device for automatically increasing the current output of the dynamo in winter, when the demand for current is heavy, and decreasing it in summer when the consumption is more moderate. Temperature, which is chief among the causes of fluctuation in current consumption, is the agent relied upon for the operation of the new control, which is illustrated diagrammatically in the accompanying illustration.

Briefly stated, the idea is to use an automatic thermostatic switch in circuit with the field coils of the generator. Under normal conditions the switch is closed and the fields are at full strength. When, however, the temperature rises to a predetermined point, the thermostat opens and introduces a resistance into the field circuit; thus the field is weakened and the current output reduced. The reduction depends on the amount of resistance, and this, together with the temperature at which the device operates, is permanently adjusted at the factory before the generator is sent out.

The active element of the thermostat is a blade made up of a strip of nickel steel and one of spring brass, the two being welded together. One end of the blade is riveted to a stamped steel bracket and the other end, which is free, is fitted with a silver contact button. A similar contact button is carried by the end of the bracket, and is adjustable by means of a small nut. The composite blade is insulated from its bracket by means of an insulating bushing where the rivets pass through. The resistance consists of a short length of wire insulated by a layer of mica. The connections are shown in fig. 1.

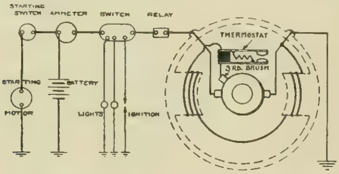


Fig. 1.—Diagram of Connections of Remy Controller.

The thermostat is so set that at normal temperatures the silver contacts are pressed together firmly, and the field current is at full strength. When the temperature rises to 150° F., the contact points are separated and the field is weakened.

The thermostatic switch is located close to the commutator where the temperature is highest and where changes of temperature are first apparent. When the temperature of the atmosphere is high, as in summer, the generator naturally heats up more rapidly than in winter. Starting out with full field strength, the dynamo delivers its full output of about 21 amperes to the battery, and continues to do so for about the length of time required to put back into the battery the amount of current taken out during the operation of starting the car engine. After that, the resistance being put in circuit, the output falls to 14 or 15 amperes, and the battery gets the remainder of its charge at a low rate. When the temperature is low, as in winter, the generator heats up more slowly, and the full current is delivered to the battery for a longer time, giving the extra charging required to compensate for cold-weather engine-starting and for the extra car illumination required in winter-time.

Device for Giving an Image of the Searchlight Arc in Full Size.

In a short article in the *Journal of the U.S. Artillery*, by Capt. Adelno Gibson, Coast Artillery Corps, particulars are given of the above device, the essential parts of which are: (1) a pin hole through the side of the searchlight drum, opposite the arc; (2) a small mirror (about 2 in. × 2 in.) held in position on the side of the drum near the pin hole so as to catch the image and reflect it downward; (3) a holder attached to the tie rod, on which a piece of sectional paper is placed to catch the reflected image. Fig. 2 is a drawing of the apparatus, giving in detail all its essential features. The image projected on the sectional paper is an excellent reproduction of the actual arc, and shows how the arc is burning without necessitating looking at it through the coloured glass window in the searchlight drum.

On the most recently improved searchlights, as the Beck light and the Sperry light, lenses are inserted in the drum so as to give a reduced image of the arc on a piece of ground glass. On the lights now installed in the U.S. service, there is no device for giving an image of the arc. The purpose of this apparatus is to provide a cheap, easily made and efficient means for projecting a full sized image of the searchlight arc outside the drum and in such a position that the operator can readily observe the condition of the carbons, the length of the arc, and whether the arc is in focus. By making two marks on the sectional paper, showing the normal length of the arc and the correct position of the carbons when properly focused, the maintaining of a proper length of arc and keeping the light focused become very easy even to an unskilled operator.

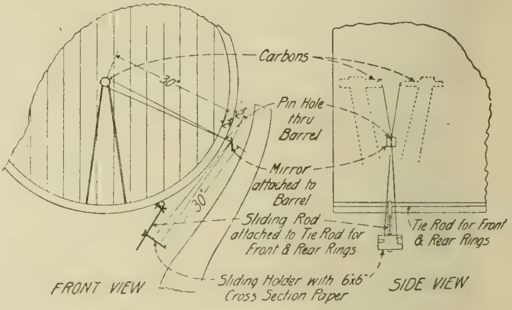

Carbons
30°
Pin Hole thru Barrel
Mirror attached to Barrel
30°
Sliding Rod attached to Tie Rod for Front & Rear Rings
Tie Rod for Front & Rear Rings
Sliding Holder with 6x6" Cross Section Paper
FRONT VIEW
SIDE VIEW

Fig. 2.—Device for Obtaining Image of Searchlight Arc.

The special merit of the device is that it provides a clear, full-sized image of the arc without the use of lenses, and yet in spite of a 32-in. focus, keeps the image in a convenient position near the searchlight drum.

The device as shown has been installed on one of the 60-in. searchlights at Fort Monroe, and has been found so satisfactory that the Coast Defence Artillery Engineer desires to have each light of the U.S. Coast Defence equipped with a similar apparatus. The materials for constructing the apparatus may be found among the scrap material at any post. The quality or shape of the mirror is of no consequence—any scrap of broken mirror will answer. The rod for holding the mirror passes through a small hole in the drum and is clamped in position by tightening two nuts, one inside and one outside the drum. The sheet metal holder of the sectional paper may be bent so as to enable the operator to see the image from any particular position desired. If so desired, the image on the sectional paper may be made clearer by surrounding the paper with a hood of sheet metal or of dark paper or cloth. This tends to exclude all light except that forming the image of the arc.

The small expense and ease of construction of the apparatus make it practicable, if so desired, to install the device on both sides of the searchlight.

Condensite-Cellulac.

A new form of electrical insulation is being placed on the market by the Diamond State Fibre Co., of Bridgeport, Pennsylvania, called "Condensite-Cellulac." This material, it is stated, is entirely different in physical and chemical characteristics from any other form of fibre, hard rubber, mica, or synthetic insulation now available; it is homogeneous throughout, and combines the properties of "Condensite," which is employed in its manufacture, with the good qualities of the best grade of vulcanised fibre.

Condensite-cellulac is permanently anhydrous and non-hygroscopic, and is impervious to the action of oil or ordinary acids or solvents. It is infusible, and is not affected by the action of heat within the range of temperature ordinarily encountered; it is very tough, and will stand considerable vibration or shock.

It may be used advantageously in apparatus which is to operate under unfavourable conditions of moisture, or subject to splashing with oil, or where exhaust steam is used in industrial processes.

Condensite-Cellulac is furnished to the trade in sheets, rods, tubes, &c., and is readily machined. It may be formed into very sheets (·015 in. or less) with remarkable accuracy to gauge, thereby furnishing an excellent diaphragm material. It is also supplied shaped to customers' specifications. The work, as thus supplied, is ready for use, having been hardened and made insoluble and infusible by the application of heat. It can also be supplied in the soft uncured state, permitting of its being hardened in the place where it is to be used, and thereby formed to fit in spaces or locations with an accuracy not otherwise possible. Thus, for instance, gaskets for hot lines, steam, hot water, compressed air, &c., may be accurately fitted to rough flanges, and cured in place by the heat of the line.

Heater for Motor-Cars.

Messrs. Drake & Gorham, Ltd., of 66, Victoria Street, S.W., have brought to our notice a neat heater for preventing motor-car radiators from freezing, or for taking off the chill from cold cylinders when starting up. It consists, as shown in fig. 3, of a perforated metal cylinder with nickel-plated ends, containing a heating element of wire wound on a strip of mica, which is attached to porcelain plates; a flexible cord about 12 ft. long with a plug enables the heater to be connected to an ordinary lampholder, and a metal loop provides for hanging it on any convenient projection on the engine. The resistance is suitable for usual lamp-circuit voltages, and the wire never glows red, so that there is no fear of ignition of petrol vapour. It is a handy and useful device, and may find other applications besides that outlined above.

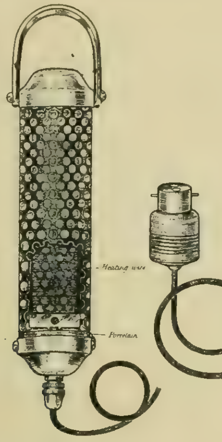


Fig. 3. Motor-Car Heater.

The "Kingsway" Signalling System.

Taking account of the new conditions to be complied with in signalling in mines, the General Electric Co., Ltd., of London, has developed a new line of apparatus for this purpose, under the above title, which, while making full use of the advantages of electricity, provides such safeguards that no danger of explosion is to be feared; the safety of the apparatus has been confirmed by exhaustive tests, and it complies with all requirements of colliery work and with the Home Office regulations.

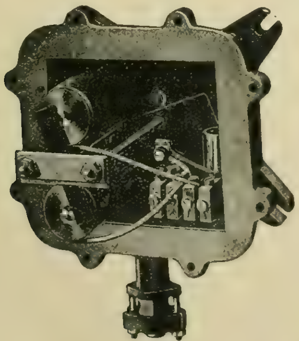


Fig. 4.—Interior of the Davies-Railing Relay.

For signalling along haulage roads the bare-wire system has been retained, but instead of a bell directly connected to the wires, the Davies-Railing patent relay is employed, which makes and breaks the local bell circuit in an explosion-proof box. Current for the line is derived from a three-volt battery, and a patent shielding winding is placed round the relay coils to damp out the inductive rise of voltage, so that danger from sparking on the wires is absolutely obviated. The relay closes the bell circuit in a mercury cup; fig. 4 shows the interior of the cast-iron box containing the relay, the box cover having long machined joints. No change is made in the method of signalling, the only difference being the insertion of the relay at a point near the bell. The relay is extremely sensitive, and operates with a current of "telephonic" strength.

This, however, is only one item in the "Kingsway" system, which includes also electrical shaft-signalling apparatus comprising indicators for the engine room, a bell for the banksman, a bell for the onsetter, and the necessary pushes, batteries, and wires. The engine-room indications are both audible and visible, and the mechanism is so contrived that the indicating finger remains standing at the last signal until a fresh signal is given, when the finger immediately flies back to zero and registers step by step the number of rings. Mining telephones and flame-proof bells, relays, and tappers also form part of the apparatus made by the company.

THE ELECTRICAL PRECIPITATION OF SMOKE AND FUMES.

From a paper read before the Canadian Mining Institute by Mr. Walter A. Schmidt, we learn that the latest Cottrell plant is that which has been installed at the copper and lead smelting works of the Consol Mining & Smelting Co., at Trail, in the Rossland district of British Columbia. The apparatus is known as a "multiple-pipe treater," which distinguishes it from the earlier "plate-treater" system installed in other plants, which has now been practically superseded by the multiple-pipe form. The treater consists of a number of 12½-in. pipes, up each of which a central wire runs. This wire varies in size according to the conductivity of the gases, but in all cases its surface area is relatively very small as compared with the dust-collecting surface of the iron pipe. The wire may be made of any conducting material, but is commonly made of nichrome. The wire forms the discharging electrode, and the inner wall of the iron pipe is the collecting electrode. The wire is charged with electric current taken from a synchronous contact-maker, which produces an intermittent direct current at 60,000 volts from an alternating current supplied to the machine. There is, of course, a high difference of potential between the wire and the periphery of the iron pipe, with a resulting glow discharge between these at all points. The smoke—that is, furnace and roaster gases charged with suspended particles of matter and fume—is passed through these iron pipes upwards in a constant stream. Each little particle of suspended matter, somewhere in the course of its passage through a pipe, is struck by one or more ions, and becomes charged with static electricity. As the electrical sign of these charges is the same as that on the iron wire, and opposed to that of the pipe, the particles become attracted to, and settle on, the iron pipe.

The gases which the Cottrell dust-collecting plant treats at the works at Trail are drawn off from the furnaces and roasters in flues which lead them to the treaters. After passing through the latter, and being relieved of their burden of dust and fume, the gases continue in flues to the main chimney. The treaters are thus part of the flue system; they are built of steel throughout, set in concrete in the flues, and are erected in sections, each containing 32 pipes. The dust collecting on the pipes is shaken down and into a hopper at the bottom by an operator coming round and tapping the pipes with a hammer at certain stated intervals. In some cases, however, automatic tapping devices are fitted to the pipes.

The first installation at Trail consisted of 384 pipes, 15 ft. in length, in 12 sections; this treated the gases from three lead stacks, and was somewhat overloaded. Approximately 100,000 cu. ft. of gas was treated daily; during the course of last year, however, the installation was doubled in size, and a second plant has also now been installed; this consists of nine sections, and is intended to deal with the gases from the various lead-roasting furnaces. As a result of the success achieved, a third plant, consisting of eight sections, is being installed to treat the gases from the copper-converters. An interesting use of the plant is to be made in connection with the latter; in the lead-stacks a lead matte is made, which, after roasting, is returned to the furnaces. In time the lead matte becomes charged with so much copper that it is more valuable for the copper than the lead. Until now the practice has been to take this copper-lead matte and charge it into the copper furnace; in this way the copper is obtained as copper matte, but the lead is lost in the slag; the gold and silver contents are, of course, saved. It is now intended that the copper-lead-matte shall be blown in the copper converters along with copper-matte from the copper furnaces. The copper will all be obtained as blister-copper, and the lead will be blown off as lead oxide and lead fume, and precipitated in the No. 3 Cottrell plant.

The dust collected in the plant which treats the gases from the lead-stack is mainly sulphide of lead, containing from 65 to 70 per cent. lead. The dust collected from the roaster plant gases contains from 50 to 60 per cent. lead, and consists, roughly, of 60 per cent. lead sulphate, 20 per cent. lead oxide, and 20 per cent. lead sulphide. Lead losses in the stack have always been very high at the works at Trail, as but little provision for settling the dust by long flues or bag-houses had been made. Since, however, the Cottrell electrical process was adopted these losses have been reduced to a minimum. The erection of a fourth plant to treat the roaster gases from the new zinc plant is also under consideration, and, while little labour is necessary to keep them running, it is estimated that the power required to run all four plants will not exceed 200 H.P. Further experimental work in the direction of treating the gases from the lead-refining furnaces with the view of saving antimony and arsenic is also in progress

THE RÖNTGEN SOCIETY.

AT the meeting of the Röntgen Society on January 2nd a paper was read by Mr. C. A. SCHUNCK, F.C.S., containing an account of his spectroscopic investigations into some sources of ultra-violet radiation. The researches, which were undertaken with a quartz spectrograph, had for their purpose the discovery of the relative efficiencies of various sources from the point of view of treatment by the ultra-violet rays. Mr. Schunck found that the tungsten arc was the most intense and efficient source of radiation at present available for this purpose.

Major W. J. TURRELL, with whom Mr. Schunck has collaborated, stated that the great practical difficulty at the present time was in getting a supply of tungsten at a figure not absolutely prohibitive. There was a very large quantity of tungsten available, enough to supply all the needs of the medical profession, but, although for military purposes the metallic tungsten was purchasable for 6s. or 6s. 3d. a lb., this supply was not available for general use, and all he could get for the civil hospitals was a pure tungsten costing about £4 4s. a lb. He made representations on the subject to the Ministry of Munitions, but no concession was granted. He suggested that the medical societies should move in the matter, as until the supply of tungsten was assured one could not expect instrument makers to go to the trouble of designing and manufacturing lamps for the supply of ultra-violet radiation. He thought that two kinds of lamps were required for therapeutic purposes, one the ordinary arc lamp, unenclosed, used with a director or condenser, and taking 10 or 12 amperes, and the other an enclosed lamp with a small opening in which one could fit a condenser or not as required, and taking 4 or 5 amperes. The latter type, he believed, would come to have a great value in the wards of the ordinary hospital and for the treatment of superficial wounds.

Major ROBERT WILSON, of the Canadian Medical Service, who exhibited last year a lamp consisting of a positive of tungsten and a negative of cored carbon, pointed out the value of ultra-violet radiation, more particularly in suppurating wounds, and said that a lamp of the type he had designed did not cost more than £10 to make, took about 4½ amperes, and furnished all the ultra-violet rays required. He did not think there was anything to be gained by saturating the carbons instead of coring them.

Mr. J. H. GARDINER suggested that there was no need to be discouraged about the difficulty in getting a supply of tungsten, for iron went a long way, and impregnation with uranium, too, would give a valuable concentration of intensity.

Mr. SCHUNCK, in replying on the discussion, said that spectroscopically one got as good an effect with one tungsten and one carbon as with two tungsten electrodes. He thought that the spark spectra might be used for treating very small areas with a condensing lens. The best source of light for this purpose was carbons impregnated with uranium nitrate and ammonium molybdate.

Car Lighting and Engine Starting for Motor-Cars.—From an interesting article in the *Horseless Age*, of New York, on the subject of the tendencies of design in petrol motor-car construction, we learn that the tendency of the times as regards the car-lighting and engine-starting equipment is to make the dynamo of the former and the electric motor of the latter as separate units, this plan having been adopted on 84 per cent. of the 1917 models of cars which have, so far, been announced, as against 61·7 per cent. a year ago. The voltage now in favour is 6 volts, this being adopted on 89·5 per cent. of the cars, leaving only 10·5 per cent. fitted with 12-volt sets. As regards the wiring, the single-wire system with earthed return has slightly increased in popularity amongst motor engineers from 82 to 83 per cent.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Published expressly for this journal by Messrs. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

18,462, 18,463. "Sparking plugs for internal-combustion engines." C. F. L. KING. December 27th.

18,464. "Electrodes of sparking plugs for internal-combustion engines." C. F. L. KING. December 27th.

18,466. "Electric starters for internal-combustion engines." C. F. L. KING. December 27th.

18,503. "Electric signalling lamps." H. LUCAS & C. L. BREEDEN. December 27th.

18,504. "Electric starters for internal-combustion engines." A. H. MIDGLEY AND C. A. VANDERVELL & CO. December 27th.

18,506, 18,507. "Electric incandescent arc devices." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). December 27th.

18,509. "Electrical transformers." A. G. ELLIS & J. L. THOMPSON. December 27th.

18,510. "Insulators for leading-in electrical conductors." J. C. H. VAN DUYL. December 27th.

18,511. "Dynamo-electric machines." E. W. DOREY. December 27th.

18,541. "Electrical apparatus for permanently waving natural hair on the head." E. F. SUTEN. December 28th.

18,552. "Apparatus for advancing the spark in internal-combustion motors. SOC. ANON. POUR L'ECLAIRAGE ELECTRIQUES DES VEHICULES. December 28th. (France, September 9th.)

18,553. "Electrolytic production of non-metallic substances." G. F. JAUBERT. December 28th. (France, December 29th, 1915.)

18,584. "Electric hand-lamps, &c." J. F. BUCKINGHAM. December 29th.

18,591. "Absorber adjustment for X-ray machine to absorb nitrous and nitric compounds generated from the air by electric discharge." H. SOMERFIELD. December 29th.

18,600. "Electric warming apparatus." H. T. PINNOCK. December 29th.

18,611. "Accumulators, and particularly electrodes or plates for accumulators and electrochemical apparatus." I. CHKLIAR. December 29th. (France December 29th, 1915.)

18,624. "Trolley heads for electric tramcars, &c." J. N. WAITE. December 29th.

18,649. "Electro-mechanical make-and-break movement." F. DE CANNART D'HAMALE. December 30th.

18,658. "Dies for pressing or moulding porcelain or earthenware articles." P. COOPER. December 30th.

18,661. "Control gear for controlling alternating-current motors." R. J. GOTTERSON & J. A. STEVEN. December 30th.

18,672. "Apparatus for transforming, and especially for rectifying, alternating or polyphase currents." J. F. G. P. HARTMANN. December 30th (U.S.A., December 30th, 1915.)

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1915.

14,423. TRANSFORMERS FOR INCREASING THE FREQUENCY OF ALTERNATING ELECTRIC CURRENTS. Marconi's Wireless Telegraph Co. & I. Shoenberg. October 12th.

17,092. X-RAY PHOTOGRAPHY. T. T. Baker. December 4th.

17,191. MAGNETO ELECTRIC IGNITION DEVICES FOR INTERNAL-COMBUSTION ENGINES. O. Heins. December 7th. (January 22nd, 1915.)

17,321. TELEGRAPHIC AND LIKE RECEIVING DEVICES. A. J. Roberts. December 9th. (Cognate application, 5,090/16.)

17,325. THERMAL ELECTRICAL SWITCHING AND/OR ACTUATING APPARATUS FOR THE AUTOMATIC CONTROL OF TEMPERATURE. E. C. St. John. December 10th.

17,497. ELECTRIC AND PNEUMATIC CONTROL MECHANISM, PARTICULARLY FOR USE IN DENTAL SURGERY. O. H. Pieper & A. F. Pieper. December 14th. (October 15th, 1915.)

1916.

The numbers in brackets are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

723. ELECTRICALLY-OPERATED PORTABLE VACUUM CLEANERS. H. Scholey. January 17th, 1916. [102,521].

948. ELECTRIC SWITCHES. F. J. Testor & F. Testor's Fabriks Aktiebolag. January 20th, 1916. [102,523.]

972. COIN-FREED TELEPHONIC APPARATUS. F. M. Balding, J. E. Scantlebury and G. S. P. Scantlebury. January 20th, 1916. [102,396.]

1,502. TESTING ARRANGEMENT FOR MACHINE TELEPHONE SWITCHING SYSTEMS. Western Electric Co. (Western Electric Co., U.S.A.). February 1st, 1916 [102,531.]

1,897. SPARKING PLUGS. J. L. Evans. February 9th, 1916. [102,402.]

2,044. WALL BOXES FOR CONTAINING ELECTRICAL SWITCHES, PLUGS, AND THE LIKE. A. E. Read, J. E. Franks & M. Brooks. February 11th, 1916 [102,404.]

3,599. CIRCUIT ARRANGEMENTS FOR TELEPHONE OR OTHER INSTALLATIONS PROVIDED WITH SELECTING DEVICES. Siemens Bros. & Co. and T. Pettigrew. March 10th, 1916. (Addition to 7,128/13.) [102,419.]

4,625. ELECTRIC TORCHES. A. A. King. March 29th, 1916. [102,426.]

5,596. INTER-COMMUNICATION TELEPHONE SYSTEMS. J. W. Dungey & C. B. Kersting. April 17th, 1916. [102,565.]

6,589. STARTING AND STOPPING DEVICES FOR ELECTRIC MOTORS. J. G. Henderson. May 8th, 1916. [102,434.]

7,252. ELECTRIC DEVICES FOR AUTOMATICALLY TURNING LIGHTS ON OR OFF. F. Steiger. May 22nd, 1916. [102,575.]

7,334. TELEGRAPH KEY. F. Palmer. May 29th, 1915. (Patent No. 100,590.)

7,616. ELECTRIC SIGNALLING APPARATUS. F. Ritchie. May 29th, 1916. [102,445.]

8,310. ELECTRIC METERS OR RELAYS. British Westinghouse Electric and Manufacturing Co. (Westinghouse Electric and Manufacturing Co., U.S.A.). June 12th. (Patent No. 102,336.)

8,339. HOLDERS FOR ELECTRIC LAMPS. R. B. Benjamin. July 8th, 1915. [100,836.]

9,040. ALIGHTING SIGNAL APPARATUS FOR AEROPLANES AND HYDRO-AEROPLANES. August 21st, 1915. (Patent No. 101,283.)

9,179. TELEPHONE SYSTEMS. E. Merriman. June 29th, 1916. [102,454.]

9,249. MEANS FOR CONTROLLING ELECTRIC MOTORS. Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.). June 30th, 1916. [102,585.]

9,927. METHODS OF AND APPARATUS FOR PRODUCING ASYMMETRIC WAVES OF ELECTROMOTIVE FORCE. British Westinghouse Electric & Manufacturing Co. July 14th, 1915. [100,893.]

10,335. IONISATION DEVICES FOR AMPLIFYING ELECTRIC CURRENTS AND SIMILAR PURPOSES. Western Electric Co. (Western Electric Co., U.S.A.). July 22nd, 1916. [102,589.]

13,820. AUTOMATIC IGNITION ADVANCING DEVICES FOR MAGNETOS. L. Bignon and J. C. Rousset. October 2nd, 1915. (Patent No. 101,712.)

THE
ELECTRICAL REVIEW.

Vol. LXXX. JANUARY 19, 1917. No. 2,043.

ELECTRICAL REVIEW.

Vol. LXXX.] **CONTENTS**: January 19, 1917. [No. 2,043.

Page
Labour and Industry ... 57
Our Trade with New Zealand ... 59
Dublin Again... ... 59
Cable Junction Boxes, by S. G. (*illus.*) (*concluded*) ... 60
Some Considerations Affecting the Use of Electricity in Agriculture ... 62
The Erith-Riley Stoker (*illus.*) ... 64
The Australian Coal Trouble and its Effects ... 65
Correspondence—
  The Position of the Shift Engineer after the War... ... 66
  Women Tramway Drivers at Keighley ... 66
  City and Guilds Examinations ... 66
  Books for Soldiers ... 67
War Items ... 67
Capital and Labour ... 68
Electromobile Experience, by R. B. Matthews ... 69
Business Notes ... 71
Notes ... 74
City Notes ... 77
Stocks and Shares ... 77
Market Quotations ... 78
Colonial Telegraphs and Telephones, by R. W. Weightman (*illus.*) (*concluded*) ... 79
New Zealand Trade ... 80
Principles Involved in Computing the Depreciation of Plant, by F. Gill and W. W. Cook (*illus.*) ... 81
Legal ... 83
Foreign and Colonial Tariffs on Electrical Goods ... 84
New Patents Applied for, 1917 ... 84
Abstracts of Published Specifications ... 84
Contractors' Column ... Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE 1—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "Agbekay, London." Code, A B C.

Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain £1 1s. 6d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

Adelaide: Messrs. Atkinson & Co., Gresham Street.
Auckland N.Z: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31a, Strand Arcade, Queen Street.
Brisbane: Gordon & Gotch, Queen St.
Christchurch, N.Z.: Gordon and Gotch, Manchester Street.
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Perth, W.A.: Gordon & Gotch, William Street.
Rome: Loescher & Co., Corso Umberto 1° 307.
Sydney: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.
Toronto, Ont.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.
Wellington, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to The Electrical Review, and crossed "London City and Midland Bank, Newgate Street Branch."

THE UNIVERSAL ELECTRICAL DIRECTORY

(J. A. Berly's).

1916 EDITION.

H. ALABASTER, GATEHOUSE & CO.,
4, Ludgate Hill, London, E.C.

LABOUR AND INDUSTRY.

In October last we cordially welcomed the establishment of a new Government Department under the presiding influence of Mr. Arthur Henderson, then the Labour Adviser to the Government, with, among its prime objects, the laying of the foundations for a regular and definite system of co-operation and communication between industry and the Government. We regarded it as the organisation needed in order that negotiations might be conducted, and material collected, which would indicate upon what new basis we might expect to be able to build our scheme for industrial harmony after the war. It was Mr. Henderson's desire to represent industry as a whole, not unduly biased in favour of Labour, nor neglectful of the interests of Capital, and suggestions were invited from both sides. The Employers' Parliamentary Council raised objection to the appointment being filled by a Labour man, but we believe that it would have been extremely difficult to suggest a course more appropriate to the situation then prevailing. In the three or four months that have since elapsed there have been important changes in our public life, and one of these has been the falling of the reins of this new Department from the hands of Mr. Henderderson to those of Mr. John Hodge, also a Labour man. Now, unless we are strangely mistaken, Mr. Hodge means to hold the reins with a very tight hand—the whip as well, judging from his allusions to the failings of the soulless managers of Labour Exchanges. The present Minister of Labour was first revealed to us as a coming force in connection with our national industrial problems last year, when he presided over the great Labour meeting at Queen's Hall addressed by Mr. W. M. Hughes, the Australian Prime Minister. In our present very serious deliberations he is for the nation a tower of strength, because we believe him to have had ample opportunities for grasping the problems of the manufacturer as well as understanding the necessities and legitimate claims of the worker. We believe him to have the confidence of large numbers of the workers, and what, perhaps, is more to the point so far as this journal is concerned, of the workers connected with the iron and steel and engineering trades of the United Kingdom. Therefore, we desire to extend to him, as we did in like circumstances to Mr. Henderson, and as we did also to Mr. G. H. Roberts, M.P., now Under Secretary for the Board of Trade, on the occasion of a frank, but conciliatory and most useful, speech which he delivered at the Mansion House two or three months ago, a cordial welcome to a position of some considerable influence in national affairs. But other important things besides these changes in *per-*

sonnel have also taken place during the last few months. We have at various stages of hostilities discovered that it is an engineer's war, that it is a war of munitions, that it is a war in which the silver bullets must tell. Latterly, however, we have been learning that it is a war between the workers, and as we write, in the midst of the War Loan activity, we recognise more than ever that Capital, whether of the princely rich or of the small householder struggling with heavy bills in order to be able to buy a war-savings certificate, is the great essential if all the other forces—naval, military, munition, and agricultural—are to be provided with the equipment which will enable them to carry the Allied cause to the only Victory that will make life bearable. Equipment, then, and money for equipment now and in the coming months, are the needs of the moment, and it is important that the world should know that our millions of workers are solid in their determination to do their bit to defeat the would-be oppressors of Europe. Mr. Appleton, Secretary of the General Federation of Trade Unions, has rendered useful service in according an interview to an American newspaper, in which he has made it clear that, so far as he is able to represent the sentiments of British workers, it is unlikely that they will tolerate relations with the German working-class movement after the war, unless the German workers "immediately and forcibly repudiate the dastardly acts of the German Government." He appeals to the workers of America not to allow anything to stand in the way of efforts to bind up the wounds of Belgium and restore her to her place among the nations. He affirms that the sense of justice and of right of the roughest of British workmen is sound and true in this connection. Is it too much to hope that the truth will find its way into the German workers' minds, and that the scales will at last fall from their eyes, showing that the pressure that will be increasingly used by the Allies is in their own ultimate interest?

But to return to the Minister of Labour—we welcome the note of optimism with which he has commenced his very difficult work. We must remember that he has been all his life connected with our steel industries, and that, therefore, inevitably those industries loom very largely on his horizon. In Press interviews, he has just expressed the firm conviction that there is certain to be a boom after the war; also that in many factories now employed in war-work there need be no stoppage at all, only a change-over from one class of manufacture to another.

> Factories that are making steel for war purposes must be immediately directed to supplying steel for industrial purposes. Industries are now being starved for steel, and they will want all they can get. Shipbuilding will be pushed on as rapidly as possible. Therefore there will be full employment for engineers generally. Engines and cranes and machinery of all kinds are now being worn out. The present is not the time to renew them—that lies with the future. Many things that we are now making the best of in all departments of life will call for instant renewal, and it will all mean more work.
>
> I do not really think that there will have to be very much displacement of labour. I believe there will be a keen demand for open-air work when the men come back. The land will attract many thousands. In fact, for some trades, such as the leather and building trades, the difficulty will be to find the men to do the work.

Our duty, however, is to be prepared by means of existing, and, if need be, additional, organisations for facilitating the return of demobilised men to their former avocations if they desire, or to such other occupations as their state of health and altered dispositions incline them. If we make suitable plans in good time, we may be able to carry through the change with a minimum of friction, and we can the better make plans which will be acceptable to all parties if there be that spirit of co-operation between employer and employed under Government auspices, for which we are al longing.

It has been put to Mr. Hodge by some employers that in the past the Government has consulted Labour more than Capital. That is an old grievance of industry which we should not have cared to dwell upon too pointedly just now for fear of spoiling the atmosphere, but Mr. Hodge is not going to shut his eyes to indisputable facts. Whether or not he accepts the employers' complaint as being accurate, he makes it clear that, as Labour Minister, he will not pursue that policy. "Both sides must be heard; otherwise it will be impossible for confidence to be retained." We are sure that this attitude will be hailed by right-minded men on both sides as the only fair and equitable one. A number of preliminary conferences between masters and men have been held, and it appears that these are to form but the prelude to bigger conferences or co-ordinated policy which may make actual working agreement practical in due course. Indeed, it is announced that to-morrow there is to be held at Birmingham a meeting of the newly-formed National Alliance of Employers and Employed. Mr. Neville Chamberlain, who, as we have already shown, has been deeply interested in the relations of Capital and Labour after the war, is to preside, and Mr. Hodge and Mr. Appleton will probably be present.

Taking for granted a boom in trade, with plenty for the engineering and iron and steel, and some other, trades to do, and assuming a spirit of harmony between Capital and Labour, what we have to see to is that the way is clear for fighters to return to work and present workers, as far as necessary, to change over to whatever their future occupations are to be. The ease with which these operations can be conducted is dependent in part upon the number of men to be demobilised from the Army, the absorbing power of industry, and the rate at which both the Army and the munition workers are to be demobilised. We gather that the Demobilisation Committee, in an interim report, estimates that the Army will release 30,000 men per week, and we can roughly calculate over what period demobilisation would be spread if we assume the number of millions ultimately to be freed. The rate of demobilising munition workers is to be recommended in a report that is promised by the Reconstruction Committee. It depends, we suppose, upon too many factors for any estimate other than of a most speculative and unreliable nature to be made, but we must, in the absence of other information, presume that Mr. Hodge has some good reason, officially based, for his belief that there will not have to be very much displacement of labour. Nevertheless, when the soldiers do return, and when such munitions workers as are not required are to be released, we shall require a most efficient organisation in a state of complete readiness to begin operations to get the industrial, commercial, and, may we add, the professional, forces back to peaceful callings. It is one of Mr. Hodge's duties, as Minister of Labour, to see that this organisation is established on right lines, and in time. He naturally turns to the system of Labour Exchanges, which was set up some years ago, and has worked in some places satisfactorily, and in others not so. He proposes that these Exchanges form the nucleus of the said organisation, but he knows that the past has not left a halo of glory around the heads of these departments. They appear to be disliked both by employers and by Trade Unionists. Our own "Correspondence" columns, and those of other technical journals, have shown that for certain classes of engineers the Labour Exchanges have been far from satisfactory, and the mere necessity of having to apply through them has aroused a sort of professional resentment. There need be no ground for such feeling if the Exchanges be conducted in a proper manner, that is, as Mr. Hodge says, "with sympathy and understanding." We hope that he will succeed in securing the appointment of committees which shall control the policy of the managers of the Exchanges and make them "live organisations." It is of the greatest possible importance, as he recognises, that the men in charge should try to understand "what a man who registers is fitted for." Mr. Hodge says that his Department is seeking to anticipate the report of the Demobilisation Committee by planning the extension of the Employment Exchanges, "so that, in the event of Peace coming on us hurriedly, we may be in a position to handle the great problem of demobilisation promptly and efficiently." In that work of extension, the atmosphere of suspicion must be cleared away, and a spirit of sympathy must take its place, so that all the parties who ought to be able to relieve the situation may co-operate with the best possible results. We are glad to observe that, optimist though he is, and eager to weigh up the merits of all parties, Mr. Hodge does not underestimate the difficulties of the situation, and the engineering industry will wish for him, and for the other authorities who are at present engaged preparing the way, a complete success to their efforts, for the matter concerns the early future of the whole nation. We trust that to-morrow night's meeting at Birmingham will signalise a real advance in the movement toward harmony.

Our Trade with New Zealand.

We commend to the earnest attention of our manufacturers the interesting report by Mr. R. W. Dalton, H.M. Trade Commissioner in New Zealand, on the position of the import trade of that Dominion. He finds, as might be anticipated, that the sentiment is strongly in favour of manufactures from the Mother Country, not only because of kinship, but because it is recognised that trade between the Dominion and Home must be encouraged in the interests of the Empire. Doubtless owing to the heavy war demands upon our engineering factories, the exports to New Zealand fell off to some extent in 1916, but if our firms are able to take appropriate action to increase the efficiency of their selling organisations without delay, there should be little difficulty in regaining any lost ground at the close of the war. But we gather from Mr. Dalton's remarks that what we have already stated in regard to other markets is equally true of New Zealand, namely, we need to acquaint the buyer there at once with the reasons for our inability to do all that we should like to do to meet their requirements, and to assure them of the undoubtedly better position in which we shall be as electrical and engineering manufacturers as the result of our present war industrial activities. We may, however, leave the report to speak for itself on this and other interesting points, such as the danger of losing to foreign firms good agents who ought to be secured before their hands are tied.

We must remember that electrical matters are beginning to move very satisfactorily in New Zealand. The Lake Coleridge power scheme is likely to prove a success. All the power that can be produced is taken up on contract, and there is still an unsatisfied demand which can only be met by extension. The progress of this scheme has also given rise to a disposition to develop other water powers, of which there are many throughout the Dominion. A recent declaration of one of the Ministers indicated that careful inquiries were being made with a view to the provision of electrical power throughout the North Island by the construction of one or two stations. It was hinted some time ago that the Government were going to take over the Hora Hora power works, which supply power to the Waihi Gold Mines. This was subsequently denied, but there can be no doubt that electricity, and all the appliances that it brings in its train, are destined to have a big future in New Zealand. America is having a great time at present, partly because of efficient and energetic representation when others are perforce inactive, and it will require an effort on our part to recover ground which has necessarily gone to them during the war.

We are informed that the deficiencies of British trade are inexperience with high-tension plant and with water-power and turbines. It is also stated that there is a backwardness in the production of up-to-date cooking and heating appliances as compared with the American. Labour is, of course, a great problem, and any labour-saving device is at a premium. The country is one of great promise from every point of view. It can prosperously accommodate a vastly increased population, and electrically the outlook is the brightest for British firms if they can only be prepared to handle the situation enterprisingly, either now or immediately war demands begin to ease off.

Dublin Again.

As recorded in our last issue, Mr. L. J. Kettle, Deputy City Electrical Engineer to the Corporation of Dublin, is not minded to let judgment go by default; he considers that Col. d'Alton's reports reflect very seriously upon his own technical abilities, and adopts the characteristically Irish expedient of issuing a sporting challenge to the Colonel to make good his criticisms on the floor of the electricity works; he is prepared to run the works—or the undertaking—for a week or a month or a year against Col. d'Alton, and guarantees to show at least equally good results, the stakes being the salaries of the combatants—plus, we suppose, their professional reputations.

We admire the spirit of the challenge, though we do not see the remotest possibility of its being accepted. We are bound to sympathise with Mr. Kettle, whatever the merits of the quarrel, for it cannot be denied that the Corporation never gave either him or Mr. Ruddle a fair chance to do the best for the undertaking. We have neither time nor inclination to discuss the pros and cons of the controversy, which has already evoked an amazing superfluity of reports and, we have no doubt, a corresponding chaos of undercurrents such as usually confuse the issues of any Irish argument; some inkling of the situation may perhaps be gathered from the last paragraph of Mr. Kettle's letter, in which King Charles's head pops up in the shape of a reference to the need for "a good system of Home Government" as the only thing that will improve the load factor—but that is by the way. What we wish to say is this: in these strenuous times it behoves us, one and all, to sink all personal considerations and work solely, whole-heartedly, and with our utmost energy for the good of the State, and of every community in the State. It occurs to us that if Mr. Kettle could forgo his quest for blood and join hands with Col. d'Alton in the one great aim of placing the Dublin electricity undertaking on the soundest possible financial, commercial, and technical basis, he would perform a feat worthy of the highest commendation. Granted that it would necessitate an heroic effort of self-abnegation—but great deeds are not achieved by little men, and we sincerely believe that by adopting this course Mr. Kettle would not only earn the gratitude and esteem of his fellow-citizens, but would also most surely attain the goal of his ambition. There is nothing derogatory to the dignity of a central-station engineer in collaborating with a consulting engineer—it is an every-day occurrence—and it is to be hoped that, in the interests of Dublin City, both Col. d'Alton and Mr. Kettle will give the matter careful consideration from this point of view.

CABLE JUNCTION BOXES.

By S. G.

(*Concluded from page 32.*)

Disconnecting Links.—These take various forms, according to the likes and dislikes of the designers and users.

Fig. 12 illustrates an ordinary "bolted down" flat link; a brass set-screw or a stud and nut can be used for fixing. For alternating current, lock nuts or spring washers should be used.

An improvement when a stud and nut are used is shown at fig. 13. As will be seen, the stud has a projection turned on the end; this prevents the nut from falling into the box when it is being undone with the spanner.

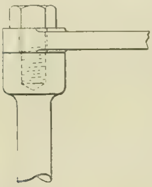
Fig. 12.

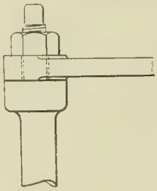
Fig. 13.

The bolted faces of all disconnecting links and fittings should be perfectly smooth; the current density on these faces should not exceed 200 amperes per sq. in., and the sectional area of the fittings should be such that the current density does not exceed 800 amperes per sq. in. in copper.

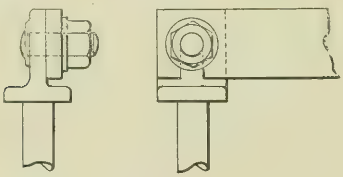
Fig. 14.

Another form of disconnecting link is shown in fig. 14. This design allows the link to be disconnected without the entire removal of the nut and washer, the link being slotted.

Fig. 15 illustrates a spring contact link. The advantage of this type of link is that it can be readily removed without the use of a spanner. The current density in the spring contact as well as the link should not exceed 800 amperes per sq. in. in copper, and the contact surface should not carry more than 200 amperes per sq. in. As will be seen, the contact clips are sweated into the contact block, and, if desired, they can be riveted in addition.

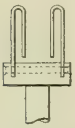
Fig. 15.

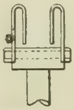
Fig. 16.

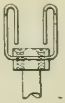
Fig. 17.

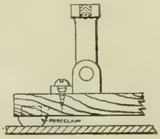

Fig. 18.

Fig. 16 illustrates similar contacts bolted to the sides of the contact block, and more easily renewable.

Fig. 17 illustrates a similar contact, the whole of the clip being made in one piece.

In order to turn out a good job with any of the above spring contacts, it is absolutely essential that the links be "ground in" properly, first using a fine powder with oil, then thoroughly cleaning both links and clips, and finally "grinding in." It is not good enough to take the clips direct from the press and the links direct from the milling machine and mount them in the box. If the job is worth doing at all, it is worth doing well and properly.

The mounting of fittings inside the box is a point which requires special attention.

In the old days, fittings were mounted on any kind of wooden base: then teak was adopted as a standard method for many years, and is, in fact, used to a great extent even now.

For the better class of insulation, porcelain has superseded teak, and now there is a tendency for porcelain to be superseded by iron or steel bars covered with micanite.

Of course, for E.H.T. work nothing, in the writer's opinion, can be compared with porcelain boxes, and for all H.T. and E.H.T. work shields or separators should be used between the poles or phases.

Fig. 18 illustrates a fitting mounted on a teak base for voltages not exceeding 500. The base should be well boiled in paraffin wax, and a strip of mica should be placed between the fitting and the base. The base should rest on porcelain buttons.

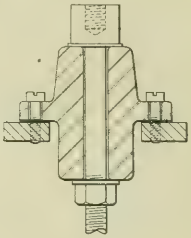
Fig. 19.

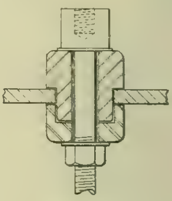
Fig. 20.

Fig. 19 illustrates a fitting mounted on porcelain insulation for either L.T. or H.T. work, the length of the insulator varying according to the voltage.

Fig. 20 illustrates another form of porcelain insulation, the difference being that two insulators are used; the hole is bushed with a mica tube, and the pair are gripped on to an iron bar by means of the contact stalk.

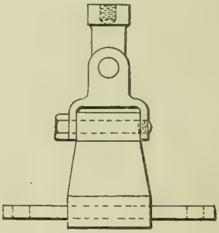
Fig. 21.

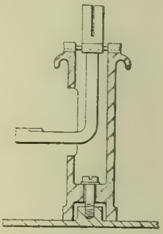
Fig. 22.

Fig. 21 illustrates another form of porcelain insulation. The insulator is threaded on to a wrought-iron bar, and the fitting is bolted on to the insulator.

Fig. 22 illustrates what is known as the "mushroom" insulator.

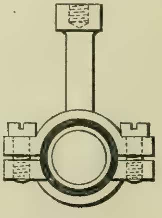
Fig. 23.

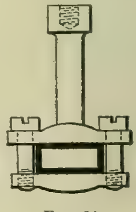
Fig. 24.

Figs. 23 and 24 illustrate how the fittings are mounted on metal bars covered with micanite; in one case a light steel tube is used, and in the other case a flat wrought-iron bar is used.

This method of insulating was first adopted, so far as the writer recollects, on controller work, about 11 years ago, with good results.

Fig. 25 illustrates a disconnecting link mounted inside a porcelain box which is provided with a glass lid. The advantage of this type of mounting is the high insulation obtainable and the small amount of risk from accidental contact with the live parts.

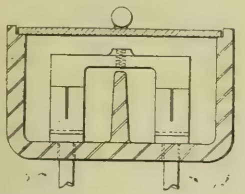
Fig. 25.

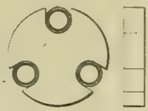
Fig. 26.

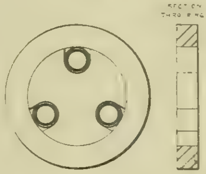
Fig. 27.

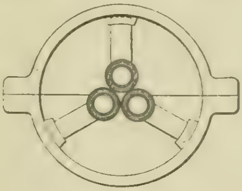
Fig. 28.

Spreaders and Separators.—Non-disconnecting joint boxes for "core" cables are sometimes, but not always, provided with these, and it is generally a matter of opinion whether they shall be employed or not. In the writer's opinion the best job, although a little more expensive, is where spreaders are used. Spreaders take various forms, as will be seen by referring to figs. 26, 27, and 28, the materials used being either teak, ebonite, or porcelain.

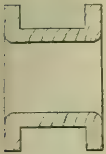
Fig. 29.

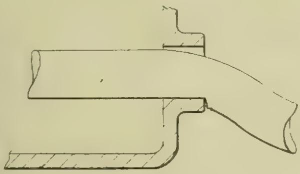
Fig. 30.

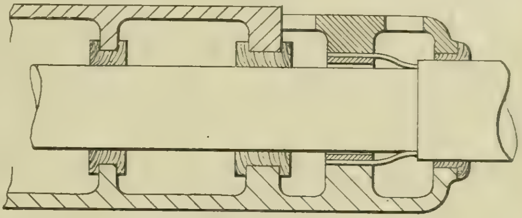
Fig. 31.

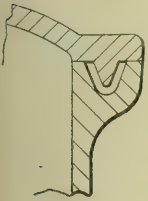
Fig. 32.

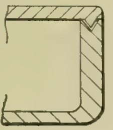
Fig. 33.

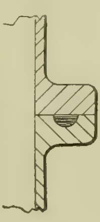
Fig. 34.

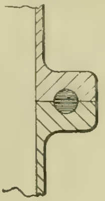
Fig. 35.

Wood Bushes.—Cables should on no account be taken through the holes in the boxes unless the latter are fitted with wood bushes, well boiled in paraffin wax, with the sharp edges of the holes taken off, as shown in fig. 29. These wood bushes prevent the cable from being damaged by the small pieces or sharp edges on the cast-iron, which, in the case of a rubber or bitumen cable, have been known to cut right through the insulation, as in fig. 30. The length of the wood bush should be considered in relation to the diameter of the cable, and the following dimensions are suggested: for lead-sheathed cables, length of wood bush = D × 1. For rubber or bitumen cables, D × 1·5, where D = the diameter over the insulation.

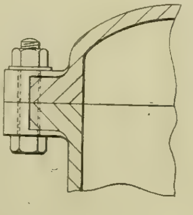
Fig. 36.

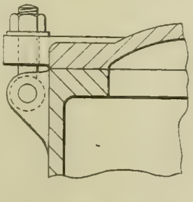
Fig. 37.

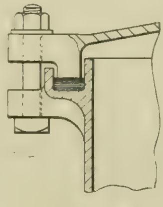
Fig. 38.

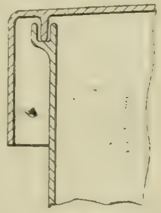
Fig. 39.

Compound Pockets.—Fig. 31 illustrates a compound pocket added to the end of a junction or network box gland. This pocket is used for sealing-off the end of the cable, and, as will be observed, improves the appearance of the joint when completed.

Lifting Handles.—All lids of disconnecting boxes should be provided with lifting handles made of wrought-iron, and cast into the lids of the boxes. Cast-iron handles are useless, as they get broken off either en route or on site.

Fixing Feet.—Sometimes boxes are required for fixing on a wall or on the floor, in which case it very often occurrs that the designer or draughtsman overlooks the fact that strength is the ruling condition. This point should receive special attention, for a broken fixing foot is almost equivalent to the whole box being broken. It is not only in the erection that breakages occur, but on the railway as well. Wrought-iron fixing straps are often used, but in most cases they look ugly.

Coating of Boxes.—All cast-iron underground boxes should be coated with compound. The compound usually used is known as "Dr. Angus Smith's Compound."

A formula for this is as follows :—

Coal tar, 1 cwt.
Slaked lime, 10 lb.
Pine resin, 4 lb.
Tallow, 7 lb.
Coal naphtha, sufficient to thin down.

If the castings, when taken fairly hot from the sand, are plunged into a vat containing this compound, left for a short time, and then allowed to drip, it will be found that when cold a very good coating is produced, which is a good protection against rusting.

Pavement Frames and Covers.—Thousands of these are at present in use, and I think there is only one point which requires the designer's special attention—and that is, when the pavement frame forms part of the cast-iron pit, it should be remembered that sometimes they are placed on pavements which have a more or less steep gradient, in which case the cast-iron pit must be provided with suitable adjusting screws to adjust the frame and cover to suit the angle of the pavement.

Lead Sleeve Joints.—Lead sleeves are very often employed in making joints on three-core cables, mostly for H.T. work. The sleeve is plumbed on to the lead sheathing of the cable, and in most cases the complete joint is enclosed in a cast-iron shell or box, both the lead sleeve and the cast-iron shell being filled with compound.

A cheap form of underground house service box is also made by means of lead sheet pressed into the required shape, and, when fixed in position, it can be "bricked up" for protection.

Lid Joints.—These take various forms according to special requirements, and to the likes or dislikes of both designers and users.

Fig. 32 illustrates a common tongue-and-groove joint which is commonly used in almost all non-disconnecting boxes: the groove can be filled with compound or packing material, such as cotton, spun yarn, &c.

Fig. 33 illustrates a miniature tongue-and-groove joint, sometimes, but not often, used.

Figs. 34 and 35 illustrate what is known as a "split" joint, the groove being filled with compound or packing.

Fig. 36 illustrates a bolted "machined" joint. This type is rather expensive, but has its advantages.

Fig. 37 illustrates a similar joint, but the parts are secured by means of a swing bolt (a wing nut can be used, if desired).

Fig. 38 illustrates what is known as a "bolted-down packed joint."

Fig. 39 illustrates a "diving-bell" lid, and is used for disconnecting boxes, where the lid can be removed quickly without having to waste time undoing a number of bolts and nuts.

Compound.—It was not until paper-insulated cables were manufactured that much, if any, attention was given to the filling of joint boxes with compound.

In about the year 1900 trouble in this respect began to show itself, and it was then that cable engineers began to look around to find means of overcoming the trouble.

It often occurred that one was called out at midnight, or in the early hours of the morning, to locate a fault, which was often traced to moisture having crept along the cable due to the end of the same not being properly sealed.

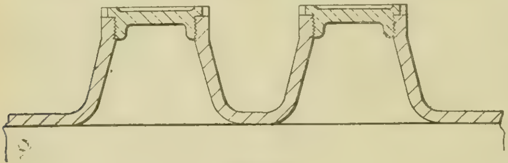

Fig. 40.

In those days faults were not so easily located as they are at present, and it very often occurred that quite a long length of excavation had to be made before the fault could be found.

Not only was there the inconvenience of getting out of a warm bed at midnight, especially if it happened in winter time and the ground was covered with snow, or perhaps it was raining very hard, but also the expense of pulling up the road and reinstating it.

In the first place, a suitable compound should be used. By suitable, I mean one which is suitable for the voltage at which the cable is working, one which will adhere properly to the cast-iron box, and one which is suitable for the climate.

The actual filling of the box with compound is a matter which requires very careful attention. It often occurs that insufficient time is allowed for this procedure; this is a grave mistake, and is bound to be discovered sooner or later.

Care should be taken when melting the compound on a fire or "devil" in a bucket to melt it slowly, and as soon as it begins to soften around the edge of the bucket, it must be constantly stirred and kept on the move by means of a ladle or other suitable metal article which is clean and near to hand. A wooden stick must not be used until all the lumps are thoroughly melted. Do not let it boil.

Whilst the compound is melting, the box must be thoroughly warmed all over with a blow lamp. This part of the business is often neglected, sometimes due to impatience on the part of the jointer, sometimes for other reasons.

I would here emphasise the fact that it is absolutely essential that the whole of the box be thoroughly warmed before being filled.

When the box and the compound are quite ready, filling can be commenced.

The jointer must keep the blow lamp playing all over the box during the whole of the time of the filling, so that the temperature of the box is not reduced. The compound must be poured in a little at a time until the box is filled.

The box can then be left to cool; when cool, and contraction has taken place, it can be topped up.

The lids of all boxes which have to be filled with compound should be domed, and the filling holes should be placed at the highest point of the dome.

An improvement on this is shown at fig. 40, two spouts being cast on the lid.

In order to overcome the formation of cavities or blowholes in the compound experienced with the ordinary methods employed in filling boxes, special filling funnels have been designed. One is known as the "Dickenson Cover," and another the "Glover Filling Funnel."

Finally, I would emphasise the fact that if the ordinary method of filling is adopted, it must on no account be rushed. It is a business which requires patience, and sufficient time must be taken to do the job properly.

SOME CONSIDERATIONS AFFECTING THE USE OF ELECTRICITY IN AGRICULTURE.

One of the most unsatisfactory features of the past two years has been the persistent indications that British farming, almost alone of all our industries, has failed to respond in anything like the required degree to the urgent call for increased effort to meet the emergency conditions arising out of the war.

This is not a matter for surprise, as the outbreak of war found our agricultural industry not only sadly neglected, in the sense that it does not appear to have been anybody's duty to provide it with the scientific and commercial organisation which is essential to a prosperous industry, but also greatly embarrassed by a long period of ruinous competition to which it was condemned for political rather than economic considerations. The seriousness of the resulting situation to a nation at war can scarcely be over-estimated, for food is an essential factor, possibly determining the issue of the conflict, which the gigantic scale of modern operations appears to render more and more difficult of decision on the battlefield. Thus it is fair to rank food as a munition of the first importance, and to secure at all costs the industry involved in its production, though—astonishing as it may seem—this view of the matter is only dimly appreciated by the average individual, and even official circles have only recently translated their appreciation into decisive action.

A recent article in the *Daily Express* appealing to the then Minister of Agriculture, and urging him "to assert himself and make his Ministry a reality," said:—"The problem of agriculture is the problem of the greater part of the nation's food. It should be dealt with as a whole, and every part should be co-ordinated to the other parts. All the indications to-day are in the direction of piecemeal compromises, which will lead us nowhere except into a position full of the gravest peril."

We refer to this subject now, as on previous occasions, because we believe that the successful future of our agricultural industry is intimately bound up with the organised application of electricity to agricultural uses on a large scale, and that if the problem is to be dealt with as a whole, as it obviously should be, then careful consideration must be given to the prospective use of electricity on farms in all those areas where a supply of electricity can be made available with our existing resources.

After all, farming, in common with every other industry employing labour, is more or less an engineering problem, to the extent that labour-saving machinery may be adopted in connection with it, and because farm power, owing to the very nature of its employment, is more than ordinarily liable to inefficient production and wasteful application under average conditions of use.

To put the matter quite frankly, the farming industry, in comparison with other leading industries, has, as regards the methods employed, been nearly stationary for more years than most of us can remember; and it is not easy to account for this, except on the hypothesis that those interested in it have never treated it seriously, and have, therefore, lacked the necessary enterprise to adapt the practical teachings of the engineer and chemist and commercial organiser to their own line of business.

It is well to note, however, that farming is "not as other industries," and factors enter into its successful conduct which differentiate it from most other industries which have adopted electrical methods, and frequently found it profitable at the same time to modify their processes and ideas.

These matters have been discussed by various writers, and Dr. Russell* points out a fundamental distinction—namely, that, except in rare cases, the farmer does not grow for contracts, but always for "stock"; the manufacturer knows exactly what he will be paid, as a rule, and, therefore, what he can afford to spend and how far he can go in introducing new methods. The farmer cannot do this; he cannot be certain either of his crops or what price he will get for them, and he lays out money on a crop which will not be sold for 15 months.

While we think that Dr. Russell has underestimated the speculative risk attaching to ordinary manufacturing operations, it is a fact that the weather introduces an unusual risk in the case of farming, interfering with labour at times, and at others seriously influencing growth and ingathering.

On the question of farm labour, Mr. Wibberley† argues that, judged from an efficiency standpoint, the rate of wages is actually higher on the land than off it; the men must be paid on the farm whether they are performing effective work or not, and practically all the tillage operations are crushed into about a ten-week period in the autumn, instead of having an even labour distribution throughout the year, unaffected by weather conditions. We may add that Mr. Wibberley goes on to urge the adoption of a system of "continuous cropping," which is described as an attempt to farm on factory lines, *i.e.*, to spread out tillage operations over the greater part of the year, an arrangement which would obviously tend to more efficient use of machinery and labour. An article in our American contemporary *The Central Station*, some months ago, referred to the "factory idea" in farming, pointing out that the real secret of the transformation is electricity, which is saving farm life from its monotonous drudgery. The transmission line gives the farmer an independence of action which he has not had before. Far-seeing owners of large interests, it says, realise that the farms of the United States, conducted on business lines, are assuming the character of conservative business propositions through the agency of central station power; further, the central station managers are urged to remember this fact—and this admonition should be noted with interest in this country. Looking at the problem of maximum production of food purely from the abstract point of view, it is evident that the farming industry, in common with others, can with advantage modify existing methods, particularly if the full benefit of engineering developments is to be secured.

Farming on a scale consonant with engineering ideas of efficiency and labour economy is clearly not easy of accomplishment in a country where farms and fields are, for the most part, comparatively small in extent, and where, moreover, the situation is complicated by the numerous tenant farmers.

However, it will be admitted that from an engineering, and especially an electrical, point of view, 20 100-acre farms can be dealt with with greater success as a single unit than if treated separately, and if, as would seem a logical possibility of the future, larger commercial and financial interests are involved in home production of food, it can scarcely be doubted that the engineering side of farming, and any reorganisation of method necessitated in its development, will be regarded as essential to success.

That the ideas outlined above are by no means utopian, is shown by a recent American venture described in the *Scientific American*, under the title "How Wall Street Tills the Soil."*

In this case a large New York City farming company has reclaimed and cultivated a marsh, now known as Oak Orchard Farm, covering apparently about 20 sq. miles, which is employed in general farming on modern industrial lines.

To quote the article, "Corporation ideals, corporation methods of handling employés, machinery, costs manufactures and sales, and corporation efficiencies—all these are being applied to the tilling of the soil. . . . Capital is growing things in the ground—after the fashion of her own successful experience in other lines." The conversion of the swamp was an engineering achievement, a wide drainage canal being dredged down the valley with 100 miles of lateral ditches; the company drained, cleared, ploughed, harrowed, sowed, and harvested certain areas within 12 months.

Practically nothing but oil tractors, ploughs, and cultivators are employed; miles of telephone wires connect the various quarters, while the villages, silos, canneries, and packing plants employ both electric light and power. It will be conceded that farming in this case is rapidly becoming a manufacturing business; an unusual amount of machinery is employed, and this appeals to the interest of the employés who learn something else but hand labour. If the farm can be made to offer an adequate return on capital, when conducted on industrial lines, what sound reasons are there for neglecting intensive farming?

The Editor of *Farm, Stock and Home*, in voicing advanced American opinion, says "we are faced with the necessity of choosing between co-operative effort on the one hand and corporate farming on the other, at least along many lines. The economic tendencies are, of course, all in the direction of *larger units of operation*."

It is safe to assume that the fuller realisation of our own recently-awakened national aspirations in the matter of food production will sooner or later result in similar developments in this country, and it is up to us to ensure that such development shall be "all-electric" wherever possible. This ideal, however, will not be achieved unless our electrical supply authorities adopt a more enlightened attitude than they have done in the past in regard to agricultural electricity supply; the knowledge that, for instance, an organisation existed with the sole object of promoting the commercial use of electricity on the farm, would encourage engineers, agriculturalists, manufacturers of plant, and others interested in this many-sided question, to arrive at an understanding, and to scheme for some definite and tangible result.

American views on this subject are, of course, well known, but we may quote the view of the *Journal of Electricity, Power and Gas*, that the future of agricultural power, particularly in the Western States of America, where electric power is available in most agricultural regions, is dependent upon the development of electric tractors and farm implements. Electric motors are practically foolproof, and require little or no attention; electric pumping has largely displaced gas-engine pumping; electric-driven saws, feed grinders, ensilage cutters, hoists, threshers, shredders, huskers and shellers are in daily use. The farmer's wife cooks, sweeps, irons, churns and performs many other household duties with electricity. The one thing needed to complete the electrical equipment of the farm, and relegate the horse to a well-earned rest, is an electric plough, low in first cost, easy to handle, of large overload capacity and rugged in construction. A great reward awaits the designer who surmounts the difficulty. Such a device, our contemporary says, would meet with a large sale, and would be a most desirable load for central stations. Electric farming will be one of the most important factors in promoting the back-to-the-farm movement, upon whose success the material prosperity of the country depends.

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* Pres. Address, Agricultural Section, B.A., 1916.

† T. Wibberley on "War-Time Farming."

* Article by J. R. Colter, August 19th, 1916.

It will be noted that this contemporary does not refer to the future development of electro-culture in farming; the careful investigation of the subject* which is being carried out in this country, however, and the promising results so far obtained, justify the inclusion of electro-culture of crops as one of the most important prospective electrical developments in farming in this country, from the agriculturalists' point of view. It is, for instance, known that beyond a certain stage the increased use of fertiliser does not yield a material increase in crop: the latter reaches a limit of growth under the conditions existing, and for the extra fertiliser to take effect, the limiting factor has to be removed. This stage is reached by the agriculturalist operating through the soil: but plant growth is dependent on both material and on radiant energy of the sun, the material being largely obtained from the air, and it is here that electro-culture may come to the aid of the older method, and possibly help to raise the limit referred to above. It may be noted here that the Royal Horticultural Society, in co-operation with the Board of Agriculture and the Imperial College of Science, is conducting an extended field trial of the effect of electricity on plant growth; investigations of a more or less scientific nature have been numerous in the past, and we believe a comparatively large scale trial of the method on commercial lines is contemplated in the West of England at the present time.

It is to be hoped that sufficiently good results may be obtained in the near future to convince even our scientific agricultural experts—who, generally speaking, have shown a marked indifference to electro-cultural developments—and even to modify the advice tendered by Mr. Middleton† recently to "speed the plough" as a means of increasing our home-grown supplies of food.

The employment of electro-culture promises a much less laborious and less costly method of increasing crop production than ploughing new land, if the results can be satisfactorily established.

To summarise the position, we have in electricity an agent which provides the following advantages in use:—

Farm Lighting.—It is hygienic, free from fire risk, and from contaminating properties, extremely flexible in application, and always immediately available.

Farm Domestic Uses.—The numerous small power and heating applications make it an ideal labour saver and the only economic means to avoid drudgery.

Farm Power.—It is the ideal power for the farm, using simple, robust, and relatively cheap apparatus specially adapted to unskilled labour; it is always available at any moment; is flexible in application, and in the case of central station supply, increased demands can be easily arranged for and met.

Transport.—The simplicity, rugged construction, and cheap operating cost of the electric vehicle will ultimately lead to its adoption for certain classes of farm transport. The electric vehicle has a low fire risk, can be driven by unskilled labour, and its battery equipment can be utilised for temporary lighting and small power applications in an emergency.

Electro-culture.—Previously referred to; may ultimately provide the farmer with a means of increasing his output beyond the limits commercially possible to-day, and at relatively low cost.

No other form of energy is capable of such a diversity of useful applications, is so economical in use and cheap in cost, or has such excellent prospect of becoming still cheaper. Moreover, no branch of science shows greater promise of increasing utility to mankind in the future. And, surely, it requires but little imagination to assume that in the greater scheme of organised agriculture in the future, electricity must, *if the position is properly appreciated*, play a prominent, and probably an indispensable part. Needless to add, this appreciation will not come about without organised effort on the part of electrical engineers in the first instance.

(To be continued.)

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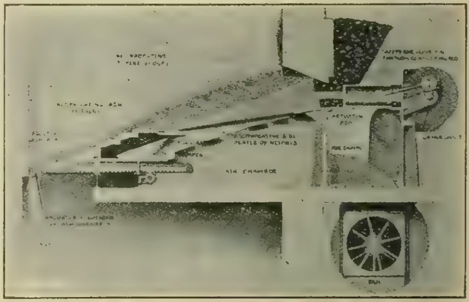
* See Electrical Review, Oct. 27th and Nov. 3rd, 1916.

† Board of Agriculture Report on German Agriculture.

THE ERITH-RILEY STOKER.

The universal adoption of turbo-generators has enormously reduced the space required for the generation of electrical power, particularly in large central stations employing large-unit generators.



Diagrammatic Section of Erith-Riley Stoker.

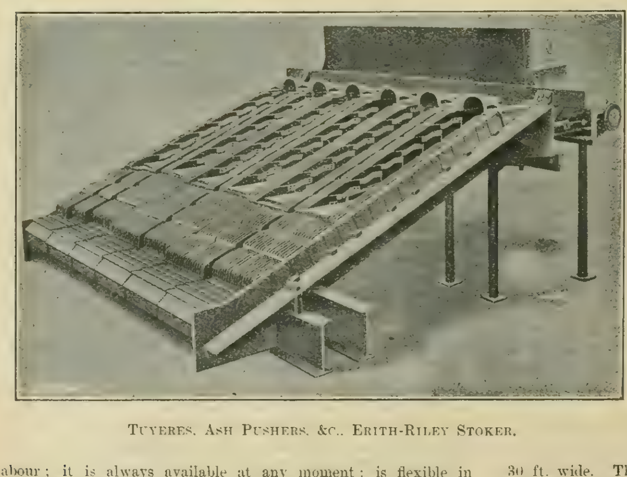
The inevitable result has been the development of large-unit boilers, to give high duty in minimum space.

This, in turn, has led to rapid developments in mechanical stokers, which are naturally essential for large boilers; for instance, it would be utterly impracticable to fire by hand labour a boiler that burns five tons of coal hourly, which is below the limit already reached in practice.

Mechanical stoking and mechanical draught is also essential for smokeless and economical combustion at varying loads, even on small and medium sizes of boilers; and the ideal system for large power plants involves continuous mechanical handling of coal to the stokers and continuous discharge of the incombustible ash.

The Erith-Riley stoker, as adopted for central stations at Manchester, Rotherham, Hull, Edinburgh, Hartlepool, Luton, Worcester, Fulham, &c., is the latest development of the Erith grateless underfeed stoker; it gives identical combustion, plus continuous cleaning; and it is this fully-automatic working at all loads which accounts for its extremely simple construction, all devices for intermittent manual operation being absent.

As our illustrations show, it is of unlimited unit capacity, being composed of any number of retort-units.



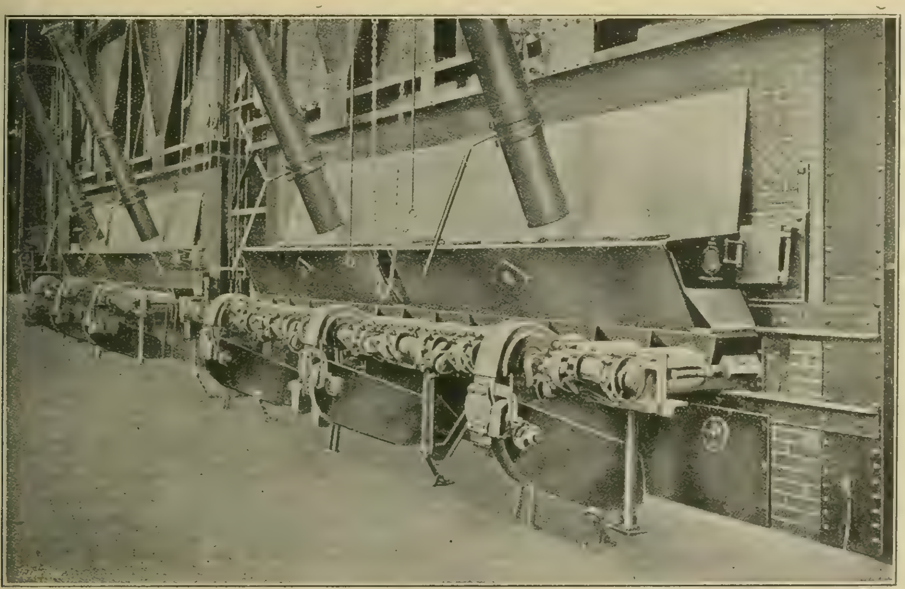
Tuyeres, Ash Pushers, &c., Erith-Riley Stoker.

In all sizes, the furnace is entirely archless and undivided, even for boilers with furnaces 30 ft. wide. This most desirable feature is only possible with entirely underfeed combustion and continuous automatic cleaning.

Just as in the Erith stoker introduced in 1900, the coal is mechanically fed into each trough or retort by slow-moving rams; the coal spreads along the retorts, and rises upwards and rearwards over the tuyeres at the sides of the retorts. Air for combustion is positively supplied by fans into the closed ashpit or air chamber on the underside of the grateless stoker, and enters the furnace exclusively through the tuyeres, which distribute it equally over the entire zone of active combustion, whatever the number of retorts used per stoker. The whole area of the retorts and tuyeres is thus devoted to active combustion: the fuel is always in three layers, viz., (1) unburnt coal in the troughs or retorts; above this (2) is the coking zone, covering a layer of ignited fuel extending over the full area, this coking zone involving only moderate temperature. Above the coking zone, but not in contact with metal, is (3) the upper layer of incandescent fire into which the fuel is constantly raised after coking; and thus combustion is smokelessly completed with a very high final temperature, and this incandescent fire radiates direct to the boiler tubes. A thick bed of fire being carried, the upper layer forms its own combustion arch, so that all occasion for coking arches is absent, and thus all partition walls and perishable firebrick arches are useless. In this way it has always been practicable to get as smokeless and efficient combustion in the water-lined furnaces of internally-fired boilers as in any brick-crowned furnace, or with any water-tube furnace setting; but by adding to these well-known features of the Erith grateless stoker the continuous discharge of ash under the Riley patents, unlimited unit capacity and completely automatic working is attained by the Erith-Riley stoker.

In all previous underfeed stokers the tuyeres were stationary and the cleaning intermittent, involving complicated mechanism as well as severe manual labour at the cleaning intervals; and, for the same reason, the length of the retorts had to be restricted to suit hand-poking for clinkers, with a corresponding limitation of tuyere capacity, and of the duty per retort.

In order to get sufficient coal-burning capacity for high-duty compact boilers, this limitation led to the development of double-ended boilers with an underfeed stoker at each end, thereby doubling the stoker cost. But, for many reasons, double-ended boilers are highly inconvenient, and they are never likely to become popular.



Erith-Riley Stoker Installation; each boiler supplies a 5,000-kw. load.

With the Erith-Riley stoker, however, there is no occasion for double-ended boilers, as the patented feature of reciprocating tuyeres keeps the fires continuously sliced, and the incombustible ash is continuously discharged at all duties, and thus all intermittent manual operations are avoided, simplifying the mechanism, eliminating the severe manual labour of dumping ash and poking down clinkers; and, further, making it easy to increase the unit capacity by extending the length of retorts and adding more tuyeres, and thereby extending the active combustion area.

The unitary construction not only assures archless furnaces without limitation of furnace width, but makes it very easy to assemble all sizes of stokers: thus one 18 retort stoker is merely two 9-retort stokers (or three 6-retort stokers) assembled together instead of separately.

The positive supply of air by a fan, diagrammatically shown in the section of the furnace, together with the entirely underfeed combustion and continuous cleaning, ensures the greatest flexibility, both air and coal responding to varying loads.

In this way, it becomes entirely practicable to eliminate banked fires, and thereby to save much fuel as well as extra boilers; when the peak load comes on, the stoker and fan are speeded up, and high rates of combustion are very rapidly attained, owing to the very large area of active combustion and the direct radiation from a hot fire to boiler tubes.

The absence of brick arches or partition walls enables the whole furnace area to be fully utilised, and makes it practicable to maintain the highest temperature of combustion.

No grates being used, riddlings are eliminated, and the positive fan draught allows the greatest range in fuels, both as regards size, heat value, volatile constituents, and ash contents: hot semi-bituminous coals, such as Welsh, give excellent results, because the hot zone of combustion is not in contact with metal, but above the middle layer or coking zone; while either clean or dirty bituminous coals are smokelessly burnt.

A very valuable feature is the provision for instantly adjusting the travel of the moving tuyeres within a wide range, so as to suit different classes of coals. In the same way, any individual row of tuyeres can be given a long stroke, independently of the others, so that its ash-pusher will discharge any exceptionally large clinker that may form; the adjustment is external, and the action is fully mechanical, avoiding occasion for hand-poking.

The Erith-Riley stoker is equally adapted to all makes of water-tube boilers, and is constructed in England by Erith's Engineering Co., Ltd., London; in France, by Erith Leroy et Cie., Paris; and in America, by the Sanford Riley Stoker Co., Ltd., of Worcester, Mass

THE AUSTRALIAN COAL TROUBLE AND ITS EFFECTS.

The Australian newspapers for the end of November, which are just to hand, contain a good deal of information relating to the experiences of electric supply authorities and their consumers consequent upon the coal trouble. Restrictions on gas and electric light and power consumption were made at Melbourne, Sydney, Ballarat, &c. The Electric Light and Power Board, which was set up under an Emergency Act, handled the matter. One paper says:—

"Immediately the orders were issued defining the industries and factories to which electric current is to be supplied the several electric supply companies concerned set about cutting off electricity from those not included in the terms of the regulations. No notifications are being issued to consumers, the practice in operation being simply that the officers of the companies visit the consumers' premises and cut off the fuses. The completion of the full round of consumers to be deprived of their current is expected by the heads of the companies to take considerable time. In this connection they wish to point out emphatically that the onus of discontinuing the use of electricity is thrown absolutely on the consumers. The companies will accept no responsibility if electricity is used in contravention of the regulations. Deprivation of current is, however, being facilitated as a consequence of the meeting of representatives of electrical supply companies, when a list of factories was drawn up and classified according to national utility, and the decision was reached to act uniformly when the regulations were issued."

Another paper says that in view of the space available in big refrigerating chambers, the Electric Light & Power Board decided that the smaller butcher and other shops utilising public supply of electric power would be deprived of current at noon on Saturday. From the previous Wednesday until then about 100 places with small installations had an opportunity to secure space for their goods in the refrigerating rooms of the City Municipal Cold Storage and other such buildings. The Board sat daily to hear applications. An application was made by one man for power to crush 10 tons of wolfram, which was eventually to go to the British Government. On condition that the wolfram was dispatched from Australia through Dalgety & Co. (British Government buyers) the power was granted.

A telegram was received from the Federal Treasurer asking that a certain contractor might be given electric power to help in the manufacture of a secret ink which is used for paper money. This was granted.

A somewhat similar application from the Commonwealth Bank—for power to operate a paper-money destroying machine—was allowed.

On November 29th, 14 persons were proceeded against, on information that they had suffered electricity generated by the Sydney Municipal Council to be consumed. One of the cases was dismissed, and in the remaining 13 instances fines ranging from £1, with 6s. costs, up to £5, with 6s. costs, were inflicted. Mr. Waldron, the City Solicitor, prosecuted.

The Magistrate (Mr. Macfarlane) said that he did not intend to impose heavy penalties in the cases before him, as he hoped that the prosecutions would act as a warning to other people. In the event of further breaches of the Act he would impose the full penalty of £500.

George Crowley, Wright's Road, Drummoyne, had electric light in the hall and stairway, and also in the billiard-room, on November 23rd. He pleaded guilty, and was fined £3, with 6s. costs.

Dr. Keith Smith said that he had burnt electric light in the hall and surgery of his residence at 7, Duke Street, Kensington, for the purpose of examining a patient who had come in with an injured arm. A fine of £2, with 6s. costs, was imposed.

Dr. N. H. Bridge pleaded ignorance, as he had been too busy to read the newspapers. He was fined £2, with 6s. costs.

One electric light and power company which had taken special precautions to protect itself against strikes, and had stored coal sufficient for three months' supply, protested against its coal being taken by the Government. The directors had no objection to it being taken for the use of transports, munition works, &c., but they emphatically objected to coal being taken from them in order to maintain other undertakings which had not the foresight to conserve a reserve supply.

The strike was settled on November 30th, and concessions were immediately made respecting supply of gas and electricity to factories engaged on war work.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Position of the Shift Engineer After the War.

Mr. John Marks's interesting article ventilates a very important subject, and will interest a wide circle of readers. There is no doubt that, in the near future, a very considerable change in the status and responsibilities of shift engineers will take place; this may, as Mr. Marks believes, be in the direction of a gradual degradation, or it may, as I hope, take the form of a very notable improvement. Broadly speaking, there are two possibilities: either the present era of isolated plants, usually small and circumscribed by municipal boundaries and municipal jealousies, may continue, in which case Mr. Marks's expectation will certainly be fulfilled; or else the numerous petty generating stations of the present time will be superseded by really large centralised plants, which will require an entirely different and improved type of shift engineer.

Let us consider the duties of a present-day shift engineer. In the great majority of cases the principal scene of his activities is the engine-room, an uncertain amount of cursory attention being given to the boiler-house. Now, up-to-date engine-room plant is very reliable, its efficiency depends chiefly upon its design and lay-out, and is only to a very small extent susceptible to improvement at the hands of the running staff; while the boiler-house plant demands very much more than cursory attention if high efficiencies are expected. In these circumstances, the shift engineer feels that he is ineffective, and is often conscious, not only that the engine room offers him but little scope, but that his training, which has frequently been confined to engine-room working, and often, even, to switchboard or sub-station operation, has not qualified him successfully to attempt improvement in the methods of the firemen. Generally, one of two consequences ensues: if he is a good man, and ambitious, he probably does his best to follow Mr. Marks's example and get out of station work altogether, while if he is of a more mediocre type he soon becomes apathetic, and degenerates into little better than a "passenger," whiling away the laggard hours of his shift in the office chair, with his feet on the table, or varying the tedium by occasional more or less aimless walks round the station. There are, of course, bright exceptions who by sheer force of personality rise above their present-day circumstances, and do succeed in making their position one of importance, but they are rare, and their capabilities are not at present realised to the full in central-station employment.

Under the conditions in vogue at the present time, instead of the steam-raising plant being operated under expert technical supervision, which is of the highest importance to secure efficiency, it is left almost entirely to semi-skilled men who in general, however willing and hard-working they may be, lack both the skill and the capacity to understand the problems presented by what is, in reality, a rather delicate chemical operation. In the result, large quantities of coal are wasted which could, and should, be saved. We are led to the conclusion, then, that in the large power stations of the future the shift engineers must be primarily steam-raising experts, and only secondarily electrical men; the "glorified switchboard attendant" type finding his level in the sub-station and mains departments.

As for the contention that supply authorities cannot afford high salaries to such men, I think this is baseless. On a reasonable estimate, 5 per cent. of the coal now used could be saved by the change I have indicated; therefore in a moderately large station burning, say, £2,000 worth of coal weekly, there would be a saving of £100 every week to pay increased salaries out of, which would leave a handsome surplus to the undertaking.

In order to avoid personal applications of these strictures on shift engineers, I hide my identity behind the pseudonym of

Ex-Shifty.

Women Tramway Drivers at Keighley.

I notice in your issue of January 12th an item with reference to women drivers, under the heading of Keighley, in which you state that the Corporation has decided to abandon its experiments of employing women drivers on electric cars. I should like to repudiate this statement, as neither the Tramways Committee nor the Corporation have arrived at any such conclusion. I understand that something of the sort appeared in the *Yorkshire Observer*, but it was put in by some unauthorised person. In fact, we have an idea that the Amalgamated Society of Tramway and Vehicle Workers was responsible for it.

The real position is that very severe weather set in about the time when we started training women for driving work, and we were unable to equip them with suitable clothing to continue under such bad weather conditions. As far as the Corporation are concerned, the matter is now postponed until the severe weather has abated somewhat, and proper garments can be provided.

Harry Webber,
Borough Electrical Engineer & Tramways Manager.
January 15th, 1917.

City and Guilds Examinations.

We noticed your comments on our letter in your issue of 5th inst., and hope you will allow us to reply thereto. We have purposely delayed this reply so as to be able to deal at the same time with any remarks that might emanate from your readers. But, in spite of the importance of the matter, none of the many teachers and others who are concerned with it have had the energy to write a line, either in support or disapproval of our views.

When we stated that electrical installation work was the fundamental electrical engineering subject, we meant, of course, as regards the whole group of applied electrical subjects dealt with in a technical college. Consequently, what you say about manufacture has nothing at all to do with our topic, for manufacturing is not taught in technical colleges.

Your variation of our military metaphor amounts to saying that the electrical officers do all the real fighting work of spreading the applications of electricity. With this, of course, we don't agree.

As regards the construction we have put on the various percentage results quoted, we were quite prepared to find you disagreed, but we should have liked to know exactly how you interpreted them.

Lastly, you do not say whether you agree or disagree with our main contention, that the subject of electrical installation work is grossly neglected at our institutes and polytechnics.

A. P. Lundberg & Sons.

London, N., *January 12th*, 1917.

[It seems clear that we are to some extent at cross purposes with our correspondents; apparently, while we are thinking of the electrical engineering industries as a whole, and the objects and methods of technical training in connection therewith, they are discussing a part of the subject only. The distinction between the respective functions of the technical college and the trade school comes into the question, which is complicated by the fact that some institutions combine both functions, inclining to the former in the day-time and to the latter in the evening; and the cognate division between technical training in the broader sense and manual training or handicraft instruction is also involved. We agree that electrical manufacturing *as a handicraft* is not, and cannot be, taught in technical colleges, but we maintain that the training given in such colleges is directed mainly to the production of men qualified to take part in the design, manufacture, and erection of electrical plant of every description. On the other hand, in the trade school the actual manipulation of materials and apparatus is the main subject of instruction, together with sufficient explanatory tuition to enable the pupil to understand the reasons for the processes and precautions which he is taught. Of these two divisions, the former is of far greater importance than the latter, for it cultivates the intelligence and lays the foundation for individual initiative far more efficiently than the latter.

As regards the comparative results of the City and Guilds examinations in "Electric Wiremen's Work" and "Electrical Engineering," we consider the respective numbers of students in attendance reasonably proportioned; a smaller proportion of the wiring students present themselves as candidates for examination because they are probably drawn from a class of worker that has no liking for such functions, or for mental effort, but the data for 1916 are undoubtedly affected very materially by the war conditions, which not only reduced the percentage of candidates able to sit for examination, but, by taking away all over 18 years old, reduced the percentage of passes.

We do not consider that the subject of "Electrical Installation Work" is "grossly" neglected; where there is a demand for classes to be held, they are usually provided. It should not be forgotten, either, that Grades I and II in "Electrical Engineering" have a direct bearing on wiremen's work.—Eds. Elec. Rev.]

Books for Soldiers.

I am anxious to know if one of your numerous readers could oblige me with a second-hand text-book on "Storage Batteries and Accumulators."

Prior to enlisting I was employed with an electrical firm, and I was anxious to further my knowledge as regards this subject, but this war terminated the desire, at least, for a while.

Having a little time to spare, when we are not engaged in "strafing" the Turks, I thought I could not be better employed than endeavouring to further this desire of mine, and I thus appeal, through you, to some kind reader who will help me out of my difficulty.

Things are rather slow here at present. The climate is the main thing to contend with, especially in the summer, when all kinds of diseases and fevers are prevalent. Strange to say, we Britishers stick the climate better than the Indian troops. It is very little news we get out here other than that in the *Basrah Times*, a copy of which I enclose, and you will agree that this, even, is very scanty.

I must now close, and tender my best thanks in anticipation to whosoever replies to my request. Wishing yourself and readers a right merry Christmas and a happy New Year.

Sydney James Knight (Corpl.).

Mesopotamia Expeditionary Force,
December 7th, 1916.

[Offers of books on technical subjects generally will be welcome, as we receive many requests for them.—Eds. Elec. Rev.]

WAR ITEMS.

Prohibited Exports.—By an Order in Council, the Customs (Exportation Prohibition) Act, 1914, is amended as follows. The following clause is deleted:—

(C) Telegraphs (except wireless) instruments and material for (not including insulated wires and cables, the exportation of which is prohibited to all ports and destinations abroad other than ports and destinations in British Possessions and Protectorates).

The following heading is added:—

(B) Telegraphs, instruments and material for, the following:—

Wheatstone automatic apparatus:—Automatic transmitting and Wheatstone transmitters.

Parts of Creed apparatus:—Creed engines, Creed relays with pneumatic valves.

Auxiliaries to Creed apparatus:—High-tension keys operated by pneumatic pressure; high-tension keys operated magnetically; Dictaphones and dictaphone cylinders; Einthoven galvanometers; paper tape photographically sensitised.

(C) Telegraphs (except wireless) instruments and material for, not otherwise prohibited.

Munition Work in Switzerland.—The Paris correspondent of the Exchange Telegraph Co. quotes in the *Times* a statement of the Zurich correspondent of the *Journal* regarding German efforts to increase the production of munitions. Very important orders have been placed in Switzerland. "It can be affirmed that a great number of workshops, employing more than 4,000 hands, are working on behalf of the German Government. Captain Schmitz, Attaché to the German Embassy at Berne, is organising the distribution of the work, assisted by the Allgemeine Electrizitäts-Gesellschaft, which is itself carrying on operations under cover of a Swiss company of electric appliances—namely, the Prothos Co. This company, which for the past three months has manifested renewed activity out of all proportion to its antecedents, is erecting an important branch factory at Altstetten, near Zurich, for the manufacture of fuses and grenades for the German military authorities. A single firm at Schaffhausen has delivered to Germany 300 motors for submarines. The Swiss people who are working in these factories are receiving very big salaries, and this constitutes for Germany an excellent means of propaganda. In view, however, of the development of German industry in munitions in Switzerland, the German Government is proposing to send to these factories her own subjects who are residing in Switzerland, in conformity with a special clause in the new law relating to compulsory national service."

Exemption Applications.—At the Falkirk Tribunal, exemption was claimed by an electrical supply company in respect of two linesmen. An agent said the company generated 13 million units per annum, 84 per cent. of which was supplied to works and collieries. There were 40 miles of underground cable. The subjects of the application were skilled linesmen, and their particular duty was the setting up of telegraph poles and binding the wires. They had 75 miles of overhead wire to look after. A representative of the company said that, owing to the shortage of men, they had been engaged on certain work for the past six months which would otherwise have been completed in one month. Both men were granted conditional exemption.

At Ramsbottom, the District Council appealed for the trackless car depôt foreman, single, aged 24. It was stated that he was an electrician, and had charge of the electric sub-station. He had been at the depôt three and a half years, and if he was taken the service of cars could not be continued. Conditional exemption was granted, but the Military Representative gave notice of appeal.

At Blackpool, application was made on behalf of the Tower Co for a switchboard attendant (27), an electrical engineer (36), and an assistant chief, and an electrical mechanic and clerk of works. The engineer's case was not assented to, and the switchboard attendant's claim was also refused. Temporary exemption was granted to May 31st in the other two cases. The Winter Gardens Co. appealed for an electrician, aged 29, but the claim was refused.

At the Flintshire Tribunal, R. Jones (39), stoker at the Rhyl electricity works, appealed against a refusal of exemption, and was granted three months' exemption.

The Exmouth Tribunal have granted conditional exemption to the following members of the staff at the electric light works:—Mr. F. C. Mann, electrical engineer and manager; J. T. Pyne and S. H. G. Carter, stokers; and C. E. Stott, mainsman.

At Southend-on-Sea, 12 tram drivers were appealed for by the Corporation. Mr. R. Birkett, electrical engineer, stated that efforts to replace the men had failed; they had engaged 23 men as drivers, and 21 had thrown up the job. The Mayor observed that the Corporation must set a good example; it might even happen that the trams would have to shut down. The railways had begun, and the trams might have to follow. The men would be exempted until March 1st, when the cases would be reviewed.

At Dover, on January 10th, Mr. Woodman, borough electrical engineer, appealed for C. C. Bailey (31), collector of electricity charges, &c., and six months were allowed.

At Coventry, an appeal was made by Mr. C. H. Patrick, electric light and power contractor, who is in Class C 3, and is engaged on Class A work for local munition factories. Exemption until May 1st.

An appeal was made at Tredegar for an electrician (30), engaged with the Powell Duffryn Co., Ltd. It transpired that applicant was filling a place vacated by a man who had joined the Army, but it was pointed out that the company were now in want of four electricians. If a substitute could be found the company would take him. A month only was conceded.

Before the Hoylake and West Kirby Tribunal, exemption was sought for an electrical engineer having charge of the plant supplying current to the village of Caldy. Exemption to March 31st was granted.

Exeter Tribunal has reviewed certificates of conditional exemption held by Messrs. A. C. G. Buchanan and A. G. Powell, electrical engineers at the Corporation works, and Mr. L. W. Cornish, assistant mains engineer. It was stated that the conditions remained practically unchanged. Each certificate was cancelled: Messrs. Buchanan and Powell were exempted until May 31st, and Mr. Cornish until March 31st

At Hitchin, on January 8th, a review was asked for the cases of P. Wilson and A. Dodds, on the Hitchin staff of the Electric Supply Corpn., who had been conditionally exempted on account of their occupation. The local manager (Mr. Laverty) said that the Corporation wished the whole of the applications from their 18 stations to be heard by the City of London Tribunal The Military Representative objected, saying that the certificates had been obtained locally, and they had been willing to rest on them. He asked what reason had they to fear coming to the Local Tribunal for a review. The Tribunal decided to deal with the cases after the two men had been medically examined and classified.

Before the West Kent Appeal Court, the Military appealed against exemption held by J. S. Newnham (29), the only outside electrical fitter with the Beckenham U.D.C. He had been passed for general service, and he stated that he worked 84 hours per week for a wage of £2 15s. The appeal was successful, and the Court allowed one month, with no further application without leave, a substitute to be found if possible.

At Dewsbury, the Military appealed against a draughtsman with the Yorkshire Electric Power Co. It transpired that at the outbreak of war the man gave up a good position with the Rio Tinto Co., in Spain, to come home and do some work for the country. He asserted that he would now have been in Woolwich Arsenal if the Military Representative had not refused to give him a permit, and he resented the suggestion that he only came home on holiday. Had he stayed in Spain his salary would have been increased by £1 per week. The Tribunal expressed the opinion that his coming home was to the man's credit, and they exempted him as being in a certified occupation.

Messrs. Binney & Son, electrical engineers' furnishers, appealed at Coventry, on January 11th, for exemption for Mr. J. W. Vallis, for 20 years manager of the Coventry business, and passed for garrison service at home. The firm, it was stated, provided supplies for transmission of power to local factories which were being extended, and, in addition, they had to supply from stock in case of breakdowns. Six months' exemption was conceded.

Before the East Kent Appeal Court, on January 8th, Mr. F. J. A. Kingston (33), of Messrs. Kingston & Co., Ltd., electrical engineers, of Margate, appealed against the withdrawal of his certificate of conditional exemption. It was stated that since the outbreak of war the firm had voluntarily granted the use of their X-ray apparatus and instruments for the benefit of wounded soldiers, and applicant had carried out the work. The Military Representative said that the exemption was granted upon the grounds of munition work, but the amount done was so small as not to warrant exemption. The appeal was dismissed.

At Coventry, Mr. W. J. Blomfield (39), electrical engineer, asked for extended exemption, pleading that his work was of national importance. He was a Special Constable, did motor patrol duty, and was passed for general service. He was allowed exemption until April 8th, and was advised in the meantime to use every effort to get someone to take his place.

CAPITAL AND LABOUR.

We have received a copy of a pamphlet containing three addresses delivered respectively at Bolton, Manchester, and Liverpool, in October and November last, by Sir William Lever, Bart. Two of the addresses relate to "Harmonising Capital and Labour" and "Industrial Administration." In the former address, Sir W. H. Lever makes some reference to the prosperity-sharing scheme which has been adopted by Messrs. Lever Bros., of Port Sunlight, and an appendix to the address in the pamphlet gives full details of this scheme. He emphasises the fact that the old false idea that Labour is merely the paid tool of Capital has got to go "bag and baggage." Business is not only the science of the production and distribution of goods, it is also a social science. The so-called "practical" business man, ostrich-like, buries his head in his ledger and ignores the writing on the wall. Labour as a human element in production and distribution has not been scientifically analysed as Capital has been for the guidance of Capital. The workman is no longer a "hand," he is an educated man, and his wants are growing and his outlook extending. "Cannot Capital and Labour," he asks, "after having fought and died side by side in the trenches of Flanders and France, be won over to fight for the success of our Empire industrially after the final war victory?" Too long has there existed a wide gulf between Capital and Labour; for too long have suspicion and distrust produced active opposition between these twin brothers in productive enterprise. The claim of Capital for as big an output as possible at as low a cost as possible has hitherto had to pull against the claims and aims of Labour for as high wages as possible with as restricted an output as possible. The new lesson for the capitalist is that high wages, short hours, and good healthy conditions, by increasing intelligence and efficiency, increase output and actually reduce costs; while the new lesson for Labour is that increased output stimulates consumption and, consequently, demand for production and distributive labour, the fact being that consumers of all classes supply themselves where they can be best and most economically served. Labour, however, will not be brought to work side by side with and to harmonise with, Capital merely by ever higher and higher wages, shorter and shorter hours, combined with better and better welfare conditions. Only by entrance into co-partnership together can the twin brothers be brought to pull in one direction.

If high wages, short hours, and good housing meant finality to Labour unrest, the labourer would not be a man, but a vegetable. For one thing, a ladder must be provided from the humblest position in industrial organisation to a seat on the board of directors—Labour must have a share in management; for the other, Capital and Labour must both be provided with the same outlook by dividing the profits their joint labour has created, fairly and squarely between them. On this system each will also automatically share and suffer from losses when they have to be faced, and consequently become more interested in the policy of the business as a whole, and associate themselves more and more with careful and skilled management. With co-partnership, the spirit of greed cannot intrude between Capital and Labour. Co-partnership can only fail when Capital or Labour expect too much as a result of it, and where Labour, after being taken into co-partnership is not treated as a partner. Capital must not expect that Labour after co-partnership will cease to make demands for higher wages, or relinquish its right to combine in Trade Unions; and equally, co-partnership must not be shipwrecked by Labour expecting that Capital shall cease to fill its function of control and maintenance of discipline. Co-partnership means much more than sharing profits as an addition to wages. It means that spirit of comradeship; the spirit that recognises equality and brotherhood.

Dealing with "Industrial Administration," Sir William affirms that the biggest problem the employer has to face, and one that is always present with him, is to surround himself with a permanent efficient staff, happy and contented in their employment, who will not only work *for* him, but, what is much more valuable, will work *with* him. To ensure this, it is absolutely essential to convince the employé working for a salary or wages that the welfare of the employer and employé are identical. The chief basic principle of industrial administration is increased production—with consequent reduction of overhead charges and reduced operating costs—combined with shorter hours for workers, the whole resulting in better working conditions, greater efficiency, higher wages, and better profits. The workman to-day claims rights, and does not deny that the exercise of rights will bring with it the responsibility for the performance of duties, and these duties he is willing to undertake. Of course, we must have authority and law, and due observance of discipline in the factory and workshop, as on the steamship, and as for the nation and State. The question is: has the authority to be autocratic or democratic?

Scientific administration will make clear that restriction of output is not only immoral for the man who might have made two articles but who only made one, and who has thus robbed his fellow-man even more wickedly than the thief who had stolen one out of any two articles one of his fellow-men might have made; for whilst, in the case of the robber, there would still be the two articles, and both would be of service, there would be only one article in the case of restriction of output, and the lapse in production could never be made good.

Parliament has passed Industrial Acts preventing the thraldom of Labour; it may also be forced to pass laws to prevent restriction of output as an act of robbery against the common weal. Industrial administration, by providing the means for intensive mechanical production by increased steam power and more efficient plant and machinery, demanding less and less exhaustive strain on the employés, has unlimited opportunity for increased output at reduced cost after paying the highest world's scale for wages; and this can all be accomplished provided the falsehood of restriction of output is not permitted to spoil the working of these economic principles.

Mechanical utilities, mechanical horse-power, and standardisation of products, are the keystone of the arch of better conditions for employer, and still more so of better conditions for employé. High wages cannot be paid without correspondingly increased output by employés. The lowest output, and the longest working hours per wage-earner in the world, are to be found in China and India; and in these countries there is also the lowest mechanical horse-power per wage earner, and the lowest wages earned per wage-earner. The example of the highest of all these will be found in the United States. The mechanical horse-power per wage-earner in the United States is two or three times that per wage-earner in the British Isles, and the output is also two or three times that of the British Isles; but the wages in the highly-skilled trades in the U.S.A. are over four times per wage-earner of those paid in the British Isles, and even in the less skilled trades over three times.

Sir William proceeds to prove by pre-war statistical tables that in the U.S.A., by increased mechanical horse-power combined with increased output the cost of coal to the consumer has been reduced, and the employers have been enabled to pay more than two or three times the rate of wages per wage-earner in mines, as in all other industries in the U.S.A. than can be paid in the British Isles. Whether this is owing to the "ca' canny" or other restriction policy adopted in the coal industry in England or not, Sir William does not presume to say. The tragedy of it is that it makes the cost of cooking, heating, and lighting oppressive for the wage-earner, and creates a handicap to every British industry that uses coal, making the cost of production of all articles higher. It threatens our iron and steel industries, and with them our world supremacy in shipbuilding and our mercantile marine, upon which we absolutely depend for our very existence as a nation. The first of all false policies to be scrapped by Trade Unions ought to be that of restriction of output. Sir William Lever concludes that in the after-war struggle for industrial position, defeat is certain if our industrial organisation is founded on attempted oppression of Labour on the one hand, or restriction of output by Labour on the other.

ELECTROMOBILE EXPERIENCE.

By R. BORLASE MATTHEWS, Wh.Ex., M.I.E.E., A.M.I.C.E.

Many cart and delivery-van owners are now seriously considering the employment of electric vehicles, and are, therefore, greatly interested in what others are doing, and have done, in this field. Accordingly, some particulars gleaned from the lengthy experience extending over some 15 years of a very large garage will, doubtless, be welcome at the present time. It will be news to many to learn that as many as 120 electric vehicles are housed and maintained by the Hertford Street Motor Co., Ltd. (incorporating the Electromobile Co.). Further, it is of interest that all the cars are British built, with British batteries.

Long Life.—A visitor to the large Mayfair garage of this enterprising undertaking will have a very practical demonstration of the long life to be anticipated from an electric chassis. This firm still has in daily running, side by side with modern cars, vehicles that first began their career 10, 11, and even 12 years ago. May one be permitted to ask: Where are the petrol vehicles of a decade past? It would be better to draw the veil than to press for the reply.

Advantages of the Electric.—Some years ago the Automobile Club held a test for town motor cars, and the Electromobile was awarded first place and a gold medal for (*a*) general design of a complete car; (*b*) absence of noise with car stationary or running; (*c*) absence of smell and smoke; (*d*) absence of leakage of lubricant; (*e*) absence of vibration with car stationary or running; (*f*) smoothness of running and comfort of passengers; (*g*) ease of access for repairs; (*h*) ease of starting; (*i*) ease of stopping and speed changing without jerks and noise; (*j*) ease of manœuvring. Quite the most humorous and, at the same time, convincing feature of this competition, was that the Electromobiles entered, instead of being brand new cars, had previously run over 20,000 miles. Again the question arises: Whatever chance would a petrol car stand in a competition of this nature after such a mileage? It would be a mere farce to enter such a be-travelled petrol vehicle. The above are, of course, features inherent in electric vehicles generally, and they are very valuable advantages, for if, as is the case, they can be obtained commercially, they are ideal.

Care of Batteries.—While the principal business of the company is the hiring-out of high-class private carriages, cars are also garaged on the premises, and batteries belonging to a number of private owners are charged and maintained. In addition, the company especially caters for the maintenance and charging of batteries for commercial vehicles. Users of electric vehicles who would like to have the whole responsibility of the care of their batteries taken off their shoulders, could not do better than make an arrangement with such a company as this. If, however, they own a sufficient number of vehicles, they should inaugurate a battery maintenance system along similar lines. This would result in a longer life for their batteries, though it must be admitted that even where unskilled labour is employed, the length of life has been proved to be quite satisfactory. A company such as the above excels in the organisation of the battery maintenance system, and, where economy to the absolute limit is a consideration, this point is of the utmost importance.

Battery Life.—In accordance with this company's experience in the case of ordinary lead battery plates, a distance run of 4,000 to 5,000 miles should be expected from the negative plates. With modern lead-plate batteries and proper attention to charging, considerably greater length of life is obtained. As a result of the care and attention given to their batteries—notwithstanding the rough conditions of road usage to which the batteries are subjected—the above mileages are often greatly exceeded.

Interchangeable Batteries.—A very special and important characteristic of the company's system of operation is the fact that no battery is allocated to any car, but that the batteries are all interchangeable and are always charged off the car. This means the maintenance of a very close supervision over the batteries. When a car is ready to leave the garage, it is supplied with a freshly-charged battery of suitable mileage capacity for the journey to be undertaken. If boosting is required during the course of the day, this is done while the battery is on the car. Boosting, however, is an unusual practice where this firm is concerned, as the ordinary battery plates that it employs last better under normal conditions of discharge. Further, it is so easy to put a fresh battery in place, that that may just as well be done as to give a boosting charge. Where exceptionally long distances have to be covered, or where time is not so pressing, as is the case with many commercial vehicles which have to spend some hours loading up and discharging, boosting is of great value, and several types of modern batteries are well adapted to it, much more so, in fact, than those equipped with the ordinary form of plate.

Value of Good Discharging.—Experience has shown this company that there is nothing so good for a battery as to be well discharged before recharging. A voltage when discharged of 1·8 per cell when tested on a closed circuit, is that which they find the preferable point at which recharging should take place. If the voltage is either higher or lower, it is not so good for the life of the cells. However, under practical conditions of working, this ideal cannot be obtained as often as desired. Instructions are given to the drivers to crawl home at an economical speed, as soon as they notice the voltage falling off seriously, and even then a battery occasionally gets discharged to too low a point.

Battery Ills.—Prospective battery troubles are a bogey to many would-be users. Nevertheless, these difficulties do not occur with the modern lead-plate battery as they used to do with the older types employed in electric vehicle practice of a few years ago. Injurious sulphating is a trouble unknown to this company, for, as one will be told with a smile, their batteries are too hard-worked to suffer from an ailment due more to standing idle than anything else. Evidently the moral is to use one's batteries constantly. Inquiries as to other battery ailments elicited the fact that, with their careful supervision, very little ever went wrong, and that it was outside their experience ever to get hung up on the road through the fault of a battery. A great deal of care is taken to ensure the use of the best acid, fresh distilled water, and the purest of materials generally, thereby eliminating entirely many a battery trouble. Of course, in the case of bad conditions of discharge, or of considerable over-discharge, as must occasionally happen in in a business where the distance a car will have to run is often not known on setting out, reversal of plates in a single cell may occur. Now and then an individual cell may fail, but this would always be noticed in the charging room by the low maximum voltage obtained. Such a battery would be transferred immediately to the testing department—a great advantage of interchangeable batteries. When the faulty cell is discovered, a special test is made by the aid of a cadmium electrode and a low-reading voltmeter to ascertain whether the positive or negative plates are at fault. Moreover, an inspection of the record card which accompanies each battery, and gives details of its performance, will always give an indication as to whether or not there is any likelihood of trouble.

Over-charging.—Over-charging, too high a rate of charging, excessive gassing, and similar troubles are avoided as a result of the system employed for charging, which includes the fact that the men responsible are fully experienced, and do nothing else. Further, all the charging apparatus is particularly designed for doing this special work. For instance, as the result of experience, the seven-point charging resistance is so proportioned as to give suitable gradations, which would not be obtained with equal steps or divisions.

Since the batteries are always charged away from the the cars by properly-qualified men, there is no need to fit on each vehicle an ampere-hour meter with differential winding (to allow for the inefficiency of the battery on discharge) and an automatic cut-out. Naturally, it is usually advisable to equip ordinary lead-plate battery vehicles with such an instrument, where such full attention cannot be given to the charging operation. All the cars are equipped with a voltmeter and an ammeter in a combined case, also an odometer or mileage recorder.

Operating System.—When a car is about to leave the garage, it is run over a small battery lift in the floor, on which a trolley is brought up from the basement carrying a freshly-charged battery. Here is a striking example of one of the systematic details adopted for keeping a record of the performance of the batteries, for with the fresh battery is a card having ready inserted upon it the number of the battery and the charging data—which comprise the duration, rate, input in ampere-hours, and potential difference at the end of charge (on closed and open circuit). Before the carriage leaves, its number is entered on the same card, also the odometer reading and general particulars as to date, hour, driver's name, user, &c. On the return of the carriage, the odometer reading is again recorded, also the difference, giving the total mileage, together with the time of return. The battery is then taken down to the battery room, and a test is made of the voltage after running, on open and closed circuits respectively. Should a charge be taken when away from the garage, particulars are entered on the back of the card. Naturally, the battery would not be removed from the car unless not less than about 35 miles had been travelled, or unless the remaining charge was insufficient for the next run.

The information on the battery card is entered up in the record books and further analysed for ampere-hours per mile and watt-hours per mile, &c. Separate records are kept of the mileage of the negative and positive plates respectively.

Battery Details.—When a battery with ordinary lead plates has travelled about one thousand miles, the collected sediment in the bottom is cleaned out. This is considerably oftener than is the custom of some other battery users, who either let it run more like 2,000 miles before cleaning, or else, if the design of the vehicle permits, use cells that have sufficient sediment space to permit running for the full life of the plates. However, with the facilities at this garage, and with the limited space available on the standard vehicles for the batteries, no doubt the practice they adopt is very sound, as the risk of short-circuiting the bottoms of the battery-plates is rendered very much less. Half-an-inch is provided in the standard batteries used by the Hertford Street Motor Co. for sediment space. Each battery has 45 cells, arranged 9 × 5, with 17 plates per cell, the thickness of the plates varying from 3 to 4 mm., according to the make. The rating is 150 ampere-hours at 30-ampere rate of discharge. When new, the batteries have a capacity of about 40 miles on the average car without boosting. As a battery gets towards the time when replating is necessary, the mileage falls off to about 25 miles per charge. Under the latter condition the batteries are very useful for short runs, or the completion of a day's work. Perforated ebonite separators are employed between the plates instead of wood, as they have been found to give every satisfaction as regards circulation, and have a very long life. The company exercise a very catholic opinion as to make of plates, which they purchase separately, for building into their own batteries, not necessarily getting the positive and negative plates from the same manufacturer. Also, they occasionally purchase the plates ready formed, and sometimes unformed. In the latter case they have to be formed on the premises, a special space in the battery-charging department being allocated for this purpose.

Car Particulars.—In the modern chassis employed by this concern there is very little to get out of order. Ball bearings are employed throughout, even on the motor, so as to reduce friction to a minimum. The wheels are fitted with pneumatic tires, and 4,000 miles is considered as the minimum normal life of a studded tire, which is far better than is normally obtained on a petrol vehicle. All parts are made interchangeable, even the armatures and field coils of the motors. One 8-H.P., 1,500-R.P.M. motor is employed on each car. As the motor has a double commutator, a series-parallel control at constant voltage is obtained, as is done in the case of an ordinary tramcar equipment. The commutator or speed controller is of very simple design, operated by a small lever under and concentric with the steering wheel. No breaking of the circuit with resultant sparking takes place on the commutator, as the main switch (which is fitted with a magnetic blow-out) is opened for each change of speed by a foot lever, and the latter is also connected to a mechanical brake. In addition to the foot brake, two electric braking positions are provided on the controller. The motor drives the differential through double-reduction double-helical gearing. The efficiency of the motor is 80 to 87 per cent. The standard chassis has a wheel base of 7 ft. 6 in., with a track of 4 ft. 6 in., and weighs 9½ cwt. without the battery, and the latter turns the scale at 11 cwt.

Garage Arrangement.—It is of historical interest to note that the garage is erected on the site of the once far-famed Mayfair Ducking Pond. It covers an area of half an acre, with a total floor space of two acres, comprised in a basement, ground and first floors, and a flat asphalted roof. The structure is carefully designed and fireproof. Large hydraulic lifts are employed for handling the cars, and two small ones for the batteries. The east bay of the basement is devoted to mechanical repairs on the chassis and the body; while the central and west bays are set apart for the battery charging, cell forming, and maintenance departments. The dynamo room is also situated in the basement. The ground floor is, of course, chiefly occupied by the vehicles in use; the electric batteries are attached or detached to or from the cars on this floor by the aid of two lifts from the basement below. The offices, together with handsome reception and waiting rooms, are also here. A separate department is provided for the tire storage and repairing and vulcanising plant, &c. For, similarly to the batteries, the tires get very careful attention. Compressed air is laid on through the building wherever accessible by cars, so there is no excuse for not properly inflating the tires. The second floor is utilised for storage, coach-work repairs, repainting, upholstering, &c.

The dynamo room is equipped with two 90-KW., one 118-KW., and one 130-KW. motor-generator sets, to reduce the supply voltage as received from the Westminster Electric Supply Corporation at 400 volts to 113 volts, which is the standard for the garage. The annual consumption of energy is something like half a million units.

Costs.—The average cost of current for running does not exceed that of modern electric passenger-car practice, as over two car-miles per unit is obtained. This is obtained, inclusive of the loss of transformation in the motor-generators from the 400-volt mains to the 113-volt charging supply, and hence is an indication of the very cheap cost of operating electric vehicles as far as power is concerned. The cost per car-mile of plates and maintenance is less than that of the tires. This indicates that electric vehicle operation is a sound commercial proposition that offers very considerable advantages over petrol or horse-traction systems, provided the mileage does not exceed that of the capacity of a single battery, or, alternatively, that facilities are provided for picking up other ready-charged batteries as required. The present difficulties in the way of the latter arrangement will prevent electric vehicles from competing with petrol-driven cars on the longer distances, for if the weight of the battery were increased beyond that which has been found to be the economical weight, there would be the serious drawback of having to haul about non-earning deadweight.

In Conclusion.—The writer wishes to express his indebtedness for the courtesies extended to him, in his quest for information, by the management of the company, and in particular to Mr. W. H. Hixson, the chief electrical engineer and works manager, who personally took a great deal of trouble in explaining the details of the methods, organisation, and system adopted and so thoroughly worked out by this company. Their carefully-kept records and statistics afford extremely valuable information, of which they have taken full advantage, with the result that they can probably run an electric vehicle more economically than anyone else.

BUSINESS NOTES.

Book Notices—We have received a copy of the special January number of the *British Trade Review* (113, Cannon Street, E.C.). We are informed that the *Review*, which in the past has circulated almost exclusively abroad with the object of encouraging our overseas trade, is now to open its subscription list to United Kingdom manufacturers. The issue before us is a very bulky one, and its editorial matter necessarily covers a host of subjects in view of the breadth of its title. Some of the special articles are: The Financing of Trade after the War; Catalogues as Salesmen; British Aeroplane Industry in 1916; Electrical Progress in 1916; The Paper Trade in 1916; The Metal Market in 1916. There are many reports on the state of markets in different parts of the country, and altogether the number forms a very useful and businesslike review of the numerous and important trade matters that are now interesting a far wider circle than formerly.

We have received a "special number" of the new *Revue Générale de l'Electricité*, containing the programme mapped out by its founders, from the pen of M. André Blondel, who has been for 25 years associated with *La Lumière Electrique*, and was largely instrumental in bringing about the fusion of the two journals, which now appear united under one cover. M. J. Blondin, who was editor-in-chief of *La Lumière Electrique* from 1895 to 1902, and founder of *La Revue Electrique* in 1904, shares with M. J. de Soucy the office of editors-in-chief of the *Revue Générale*, and an article over their joint signatures outlines their plans for the realisation of the project, while the remainder of the issue sets forth the system of classification which has been adopted, the membership of the administrative council and the editing committee, and the list of shareholders.

The first number of the paper has also come to hand, containing a number of articles by men of eminence in scientific, technical, and legal circles, as well as the fortnightly *Bulletin* of the Union des Syndicats de l'Electricité, of which the journal, in succession to *La Revue Electrique*, is the official organ. We offer our hearty congratulations to our *confrères* on the impressive make-up of their new paper, which not only embodies the realisation of some features of their ambitious programme, but also gives every reason to anticipate for it a successful future. The *Revue Générale* will appear weekly, the annual subscription outside France being 50 fr.

"*Journal* of the Institution of Electrical Engineers." Vol. LV. No. 262. January, 1917. This issue contains the following papers and lecture:—"Parallel Operation of Electric Power Stations," by Mr. J. S. Peck; "Colonial Telegraphs and Telephones," by Mr. R. W. Weightman; lecture to Newcastle Local Section by Mr. H. W. Clothier.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXVI. No. 1. January, 1917. New York: The Institute. Price $1.

"Memoirs of the College of Science." Kyoto Imperial University. Vol. I. Nos. 8, 9, and 10. Kyoto: The College of Science.

"Practical Electrician's Pocket Book and Diary, 1917." London: S. Rentell & Co. Price 1s. 6d. net.

Catalogues and Lists.—Messrs. Taylor, Taylor, and Hobson, Ltd., 62, Oxford Street, London, W.—Pocket booklet giving particulars and prices of their engraving machines for engraving on brass, iron, steel, &c.

Pirelli-General Cable Works, Ltd., 144, Queen Victoria Street, London, E.C.—28-page illustrated brochure, giving an account of the origin of the undertaking at Southampton, which rests upon the universal reputation of two well-known Italian and British electrical companies who, in co-operation, have been able to equip the works on the most modern, and therefore the most efficient, lines. Notes on a tour round the works are illustrated by views of different departments. Excellent and interesting photographic pictures are included of the Southampton works, the Pirelli Italian and Spanish factories, and some of the factories of the General Electric Co., Ltd., in England.

Calendars.—Messrs. Austin Walters & Son, of Gaythorn Electric Works, Manchester, have sent us a calendar for 1917, with monthly sheets with bold black date figuring.

Messrs. Stewarts & Lloyds, Ltd., have sent us one of their neat white and gold framed calendars for 1917.

The Value of Good Lighting.—In a pamphlet recently issued by the Westinghouse Cooper Hewitt Co., Ltd., Mr. A. S. Hubbard demonstrates the importance of illumination as a factor in manufacturing costs by an ingenious argument, showing how the loss of a few minutes' working time costs an employer more than would provide a workman with a good light all day. He proceeds to discuss the connection of good lighting with efficiency of labour, and defines the optimum conditions giving the maximum distinctness of vision with the minimum of glare and irregularity. For the mercury vapour lamp it is claimed that its bluish-green light affords greatly increased acuity of vision and diminishes fatigue, and where colour values as they appear in daylight need not be distinguished, this lamp, with its low intrinsic brilliancy and high efficiency, is recommended as the best substitute for daylight in workshops.

Patent Restoration.—Application has been made for the restoration of Patent No. 25,008 of 1911, entitled "Improvements in and relating to indicating mechanism applicable to meters," granted to T. F. & H. T. Thorp.

Factory Property in 1916.—Messrs. Leopold Farmer and Sons, London, E.C., have issued their report on factory and commercial property sales during 1916. They state that the sales and letting of factory property, wharves, land, &c., show far better results than was the case in 1915. "This result is, in a large measure, due to the war, which has produced a great demand for factories and commercial property of all descriptions. . . . We have disposed of a large number of factories, with and without plant and machinery, at figures running into many thousands of pounds, and an unprecedented demand still exists for properties of all kinds. Premises that previous to the war had failed to find tenants for years have been rapidly taken up, owners in many cases having obtained, through competition, increased prices to those asked." Many factories have been disposed of to the Government, Government contractors in all branches of manufacture, English firms starting to manufacture goods previously imported (now barred through the war), and Belgian manufacturers who largely exported goods to this country, but are prevented from doing so now owing to their works having been destroyed by the Germans.

"To say the industrial world of England is busy, is a mild term to use: it is in the throes of a boom, and, so far as one can judge, is likely to be for some years to come."

The outlook for further deals in factory property is good, and the firm hope to report a continuance of the demand and supply of commercial properties of all descriptions in the present year.

Trade Review.—Messrs. Bolling & Lowe have issued their annualreview of the iron and steel trades for 1917.

Trade with China.—Mr. Archibald Rose, H.M. Assistant Commercial Attaché at Shanghai, is now in this country. He is prepared, by appointment, to give interviews to representatives of British firms, and especially to answer any questions that they may desire to put to him concerning (1) methods of trade in China; (2) appointment of agents; (3) extent of Japanese competition. Applications should be addressed to the Comptroller-General, Department of Commercial Intelligence, 73, Basinghall Street, London, E.C., not later than January 25th in the case of firms in the provinces and February 1st in the case of London.

Liquidations.—Schoen Bros., 29-30, Cock Lane, Snow Hill, London, E.C.—The Controller, Mr. J. W. Barrett, has applied to the B. of T. for his release.

Stolz Electrophone Co. (1913), Ltd., London, E.C. Liquidator released January 8th.

Bankruptcy Proceedings.—C. B. Ogilvie, electrical engineer, Whalley Range.—First meeting January 24th; public examination February 6th, the former at Manchester and the latter at Salford.

LIGHTING AND POWER NOTES.

Argentina.—The town of Dolores (Province of Buenos Ayres) has been in darkness since December 1st, when the local electric lighting company cut off the current owing to non-payment by the municipal authorities of the public lighting bill.—*Review of the River Plate.*

Australia.—At a recent sitting of the Royal Commission appointed to inquire into the admistration of the work at the Federal Capital, Mr. J. Bethel, the chief storekeeper of the Metropolitan Board of Works, who had been instructed to inspect and value the plant and material in hand, stated that a large and valuable stock of electrical materials was lying at the depot. Much of it had been kept in hand for a considerable time. No record was kept of it when used, the men taking what they required without check of any kind. Of 94 electric motors there 23 were lying disused, and 36 were in temporary use. Much of the present material lying in the store and yards would never have been ordered if a proper system had been in vogue. He found five motor-cars there, valued at £1,330, and two motor-cycles.

In reporting on the Brunswick (Vic.) electric lighting system, Mr. N. Murray stated that the installation has cost £33,000 to date. While Brunswick was considered the most extensively lighted suburb, the cost was stated to be about 25 per cent. greater by the series system than with the parallel system. The high-tension circuit throughout the city is considered to be a decided hazard to life and property.—*Melbourne Age.*

The Sydney City Council has accepted a tender for the erection of a sub-station in Castlereagh Street, at a cost of £21,000. The front portion of the premises will be utilised as showrooms for electrical fittings, motors, and also electrically-driven motor-cars.

The Council is about to proceed with the erection of a nine-storey building in Kent Street for stores and workshops.—*Sydney Telegraph.*

Ayrshire.—The Troon T.C. has decided to ask Kilmarnock Corporation, which desired to erect an overhead transmission to a new hosiery factory, to lay the cable underground.

Bedford.—Plant Extensions.—With reference to the scheme of extension recently put forward by the Electricity Committee, and rejected by the Council (see last week's notes), as a result of the interview of the Special Committee appointed to secure better terms for the proposed supply outside the borough, the consumer has agreed to raise the minimum guarantee to £3,250 per annum for seven years, and, if necessary, to take current, if required, from the Corporation for the period of the loan. Similar rates to those in the borough are to be charged. These concessions are far less than the demands of the Special Committee, and, the *Bedfordshire Times* remarks, do not amount to very much in reality; however, the resolution to adopt the revised agreement and proceed with the extensions was carried unanimously, and negotiations are to be commenced for obtaining a loan. As we understand it, the undertaking requires the addition of modern generating plant, and the authority behind the new consumer outside the boundary will ensure that the new plant, which would otherwise be difficult to obtain, will be secured.

Bradford.—The Parliamentary Sub-Committee of the Corporation has decided, we understand, to oppose the Electrical Distribution of Yorkshire, Ltd., in the provisional orders which it is asking for from the B. of T. to supply several West Riding districts. Bradford is primarily concerned about the districts of Clayton, Queensbury, Rawdon, and Yeadon, and as these come into the areas for which powers are being sought, it may be expected that strenuous opposition will be forthcoming when the application is heard.

Cardiff.—YEAR'S WORKING.—The accounts for the year's working of the Corporation electricity department for the year ended March 31st last show a total revenue of £67,842, works costs amounting to £38,931, and a gross profit of £28,911; interest and sinking fund, &c., absorbed £19,544, and the net profit was £9,367. The units sold amounted to 7,452,034, an increase of 129,822 units over the previous year; the consumers numbered 4,108; 1,031 motors, totalling 6,574 H.P., were connected. The maximum load was 4,208 KW. and load factor 20·21 per cent. 2,730,906 units were used for power supply purposes during the year, an increase over the previous year of 171,390 units. Supplies for domestic purposes, particularly for heating, show a steady improvement, the output on this account being 394,504 units as compared with 259,992 units for 1915. The total connections for heating installations at March 31st, 1916, represented 1,194·08 KW., an increase of 315·76 KW. on the previous March figures.

Carlisle.—PROPOSED PLANT EXTENSION.—The Corporation has decided to apply for permission to install additional generating plant, at a cost of £9,000.

Chile.—Permission has been granted to Don Martin Pizarro to install an overhead electric lighting system in the town of Pozo de Almonte. *Board of Trade Journal.*

Epsom and Wimbledon.—E.L. PROPOSALS.—At the last meeting of the Surrey County Council, the Parliamentary Committee reported in regard to Electric Lighting Orders promoted by the Epsom and Wimbledon authorities, that the Committee proposed to make representations to the B. of T. that, in view of the general questions relating to the supply of electric energy raised by the two London Electric Supply Bills, which will be revived after the war, it is not expedient that any new powers should be granted or vested interests acquired until such questions are settled; also that the time is inopportune for the consideration by Parliament of proposals which must involve the raising of new or additional capital. The report, which was vigorously opposed by the two Wimbledon representatives, was carried with three dissentients.

Featherstone.—PROV. ORDER.—The Urban Council has decided not to oppose the application of the Electrical Distribution of Yorkshire, Ltd., for a prov. order in the Council's district.

Grimsby.—WOMEN LABOUR.—At the last meeting of the Corporation Lighting Committee it was reported that some 35 unskilled and semi-skilled employés of the electricity department had been debadged; the Committee decided to employ women and girls to replace men wherever possible inside the works, and to release the others as quickly as substitutes were found.

A scheme was also approved by which the Corporation and the G.C. Railway Co. could either, in emergency, supply the other with electricity in bulk to a certain amount at fixed rates.

Halifax.—ANNUAL REPORT.—The year's working of the Corporation electricity department to March 31st last shows a total revenue of £71,766; working expenses amounting to £36,051, and a gross profit of £35,715; after providing for interest, income-tax, and sinking fund charges, £20,765, there was a net balance of £14,949, which was carried to the appropriation account, from which £3,345 was transferred for the relief of rates and £3,857 to the renewals fund, the remainder being spent on capital account, &c.

A total of 13½ million units were sold; we note that the net amount transferred in aid of rates during the last 16 years amounts to £35,294.

Morley.—An explosion of an electric switch box, last week, is believed to have been caused by gas which had made its way into the box from an adjoining main.

Paraguay.—On December 11th a general strike, declared by the Paraguayan Regional Workmen's Union, commenced in the capital. The tramway service stopped during the morning, and in the afternoon the power house ceased operation, owing to the employés having left to join the strikers; the railway staff also joined the movement. During the day the inmates of the public prisons, accompanied by the police, were taken to the power house to assist in the working of the plant, in order to provide lighting for the city. The President of the Republic intervened to bring the strike to a conclusion. *Review of the River Plate.*

South Africa.—The Cape Town Corporation has been considering the question of placing a limit upon the amount to be contributed in aid of rates by the electricity undertaking, and has decided that the contribution should be at the rate of 3 per cent. on the capital invested; any surplus over this sum to be utilised for reducing the charges made for electricity to consumers. According to the estimates, an excess profit is anticipated this year, but the Corporation has decided, owing to the abnormal conditions, not to make any reductions in the charges at present.

Messrs. Merz & McLellan have been asked to undertake an investigation into the financial position of the Durban Corporation's electrical undertaking. The circumstances under which this arrangement has been made are indicated in a report of the Corporation, which stated that last July the necessary documents should be forwarded to the London agents. The references were:

(*a*) Whether the plant of the electrical undertaking is worth the amount of the liability placed upon it.

(*b*) Whether the provision out of revenue for depreciation and renewals has been sufficient; and

(*c*) On what basis should depreciation and renewals allowances be made in future.

(*d*) Are all the tariffs in force by the department for the supply of current profitable to the department, and if not, what suggestions as to their alteration could be made?

(*e*) What is the lowest price at which power could be sold, keeping in mind the cost of production, capital expenditure, &c.?

Southend-on-Sea.—PROPOSED PLANT EXTENSION.—The engineer has been instructed to inquire as to the cost, &c., of two 750-KW. generating sets, which will be required to meet future demands; also as to the possibility of enlarging the existing condenser.

Stretford.—It was reported at the last meeting of the Council that, owing to the exceptionally heavy demand for current, the coal consumption had gone up to 280 tons per week, necessitating taking coal out of stock, as the deliveries only average 220 tons per week. At present it was possible to deal satisfactorily with the load, but consideration would have to be given before granting increased supplies.

Swansea.—The electrical engineer has reported that a water-tube boiler, with auxiliaries, induced-draught fan, and feed pump, should be installed at the station as soon as possible. The engineer has suggested that certain of the Corporation houses on the Trewyddfa Common might be dealt with under the scheme of free-wiring, and the Electric Lighting Committee and the Housing Committee have approved of this suggestion.

Tasmania. — HYDRO-ELECTRIC PLANT EXTENSION.—Additional plant is to be installed at the Lady Margaret hydro-electric station of the Mount Lyell Mining Co.; the power at present available is about 5,000 H.P., which is to be raised to 6,600 H.P. The cost is estimated at £30,000. The utilisation of the full resources of the lake is contemplated at a further cost of £30,000, making £60,000; the power then available would approximate 10,000 H.P.

Two working methods for the extraction of sulphur from pyrites prior to smelting have been elaborated by the experts of the Mount Lyell Co. One is the liberation of the sulphur in a closed retort furnace externally heated by means of the electric current. The other consists in the employment of a modern circular reverberatory furnace, mechanically rabbled, built to exclude the admission of air, and coal fired. No difficulty is experienced in either case in driving off the sulphur, but it is necessary to devise permanently effective mechanical means of stirring the ore under the novel conditions obtaining, for which there is no precedent. The low cost of the electric current seems to favour the commercial application of the first-mentioned type of furnace. The attempt to recover sulphur from the furnace gases has been given up as uncommercial.

Whitehaven.—The Water and Lighting Committee of the T.C. is to consider the desirability of extending the electricity mains to Kells, authority for which has been received.

Worcester.—EXTENSION SCHEME.—The Council has confirmed the Sub-Committee's action in connection with an increased supply to a local firm, and that steps be taken to secure a loan of £720 to cover the cost. Under the original terms it was found that concessions to the firm in lighting supply would represent some £500 a year, but, as the result of negotiation, this was reduced to from £225 to £250 during the war and a smaller amount afterwards. Under the scheme the firm contributes towards the cost of a ring main, which will enable fresh business to be obtained.

Worthing.—The T.C. has decided to realise a portion of the reserve fund to meet an estimated deficit of £1,954 on the electricity undertaking at the end of the present financial year. This reserve fund at present stands at £4,500.

TRAMWAY and RAILWAY NOTES.

Accrington.—It is stated that the female conductors on the cars are much dissatisfied at their exclusion from the recent award granting a war bonus to male employés, and intend to take steps to bring their claims before the tramway authorities.

Ashton-under-Lyne.—Tramway Purchase.—A public meeting of ratepayers, on Wednesday last week, authorised the Corporation to proceed with a Parliamentary Bill to obtain powers to purchase the Oldham, Ashton, and Hyde Tramway Co.'s undertaking within the borough and in the adjoining villages of Waterloo and Bardsley; power is also sought to construct connecting tramways, at a cost of about £5,000, and to run a motor-'bus service.

Australia.—The Premier of Western Australia recently called a conference of representatives of the Perth, Subiaco, and Victoria Park Municipal Councils and the Perth and Claremont Road Boards, to discuss a proposal to vest the management of the Perth Tramways in the Municipalities concerned. The Premier pointed out that the Government absolutely believed in the local authorities carrying out their responsibilities, and one of these was the tramway service. A Committee was appointed to inquire and report to a future conference.—*Tenders.*

Bradford.—Electric Vehicle.—The Lingfield Dyeing Co., Ltd., has recently taken delivery through the local agents of a 2-ton G.V. electric delivery van, fitted with Ironclad Exide battery.

Cardiff.—Year's Working.—The report of the year's working of the Corporation tramways to March 31st last shows that the total revenue was £167,794, working expenses amounted to £90,733, and the gross profits to £78,350. After payment of interest, £24,803, sinking fund, £23,988, income-tax, £3,708, and allowances to employés on war service, £5,326, there was a net balance of £20,525, as compared with £16,949 in the previous year. Of this £6,947 has been carried to the depreciation account, and the balance, £13,578, to reserve. The car-mileage was 2,399,240; the passengers carried numbered 30,878,116. The average revenue per car-mile was 14·343d.; the working expenses, including power, were 7·514d. The total amount of sinking fund and loans repaid was £310,606, and other funds in hand amount to £110,359.

Carlisle.—The City Council has approved the action of the Watch Committee in refusing another application of the Tramways Co. to licence women as drivers of the cars.

Continental.—Spain.—A concession has been awarded to the Sociedad Los Tranvias de Zaragoza for the construction and working of an electric tramway in Saragossa.—*Board of Trade Journal.*

Edinburgh.—Tramways Purchase Scheme.—The proposal to adopt the overhead trolley system for the city tramways when they are taken over by the T.C. has led to opposition on the part of the Cockburn Association, one of the influential societies in the city, and it is intended to petition against this part of the proposal.

The T.C. has decided to purchase the cable cars from the Tramway Co. at the end of the lease for £50,000.

Glasgow.—A meeting of the Tramways Committee has been held with a view to considering the growing development of traffic, and efforts are to be made to secure a rearrangement of hours of factories, &c., and alteration of shopping times, with a view to relieving congestion.

Gosforth.—The U.D.C. has decided to draw the attention of the B. of T. to its complaint regarding the inconvenience of the front-entrance cars, and the irregular service given by the Newcastle tramways.

Halifax.—Year's Working.—The annual report of the tramways department for the year ended March 31st last shows a net profit of £19,055, as compared with £16,211 in the previous year. Whilst the working expenses of the year were reduced by £1,258, the total revenue increased by £432. The passengers carried numbered 21,024,003, as against 20,707,071. There are 86 female conductors on the system.

In its reply to the L.G.B., stating schemes which it has in prospect for after the war, the Corporation includes as "urgent work" the relaying of tramway track at a cost of £31,556.

Hyde.—Proposed Tramway Purchase.—The T.C. has decided to proceed with negotiations with the Oldham, Ashton and Hyde Tramway Co. for the purchase of the length of line within the borough. Negotiations are to be entered into with the Tramway Co. and the Stockport Corporation for the working of the tramway from August next until the purchase has been completed.

Leeds.—The effect of the railway restrictions has made itself manifest by the extraordinary increase of the number of people using the tramway cars since the restrictions came into force; the last week's receipts were up by £700. The number of passengers carried was 2,198,614, against 2,056,373 for the corresponding period of last year. At the present time there are nearly 80 cars withdrawn for repairs.

Manchester.—Traffic Conference.—An informal conference has been held by the Manchester and Salford tramway departments. The increased traffic on the cars, due to the restricted railway service and the increase of fares, was one of the subjects under consideration, and special attention was devoted to the question of "rush" traffic in the mornings and evenings. The use of trailers and the employment of women as drivers were other matters touched upon, whilst there was also discussed the problem of fares and the question of increasing them or reducing the length of the stages. The conference is probably the prelude to joint action between the two authorities.

Oldham.—The manager (Mr. Priestley) of the Corporation tramways reports that the recent arbitration award, in which Oldham was included, will mean an increase of £3,500 per annum in wages in that department alone. The suggestion was made at the meeting of the Committee that the town might reap benefit from the curtailment of the train service by more through-cars being run to and from Manchester, but the manager said the Manchester Corporation was unable to help, owing to the shortage of labour. There were nine cars running through, but 13 would be required for a 10-minutes' service. The question of running non-stop cars was raised, but the manager pointed out that the B. of T. compulsory stops would have to be observed, and they had not the men to work such a system.

Rotherham.—Suggested Tramway Purchase.—The Corporation has decided to inquire upon what terms the undertaking of the Mexborough and Swinton Tramways Co. may be acquired by the municipality.

Salford.—The question of revising fares and other working arrangements in connection with the tramways is to be considered by the Tramways Committee in Salford and other south-east Lancashire towns.

Southend-on-Sea.—The Tramways Committee has inspected a car in which the lighting has been rearranged, and a similar improvement is to be made in the lighting of other cars. The electrical engineer has been in communication with the B. of T. upon a proposal to convert certain of the tramcars into double-decked cars. The Board suggests that the conversion should, in the first place, be carried out on large bogey cars, and inquiries are to be made of other towns where a similar gauge of light railways is in use as to their experience of the running of double-decked cars.

Stretford.—Tramway Stoppage.—As a result of the breakdown of one of the engines at the electricity works, the tramway service of the Manchester Corporation in the district was temporarily interrupted; after a delay of about two hours a temporary supply was obtained from the Manchester electricity works. The cause of the breakdown was the extraordinary demand for power for factories.

Surbiton.—Electric Dust Vans.—A deputation of the D.C. has waited on the L.G.B. urging the necessity that permission should be granted for the purchase of two electric vehicles for the collection of house refuse. At a recent meeting of the Council it was decided that Edison Accumulators, Ltd., be informed that, in the event of the refusal of the Board for permission to purchase by instalments, the Council will purchase one vehicle for cash and hire another for 12 months, on the understanding that the Council will purchase the vehicle for the sum mentioned in the specification, less hire cost, at the expiration of that period.

Walsall.—Curious Accident.—As the result of a tramcar losing its driver, a curious accident, or, to be more correct, a series of accidents, occurred between Walsall and Willenhall, on Friday in last week. The driver of the car, in looking round at his trolley, fell off, and as a large picture belonging to one of the passengers obscured the view of those inside, neither the conductress nor the passengers were aware of the mishap for a time. When the conductress discovered the absence of the driver she immediately applied the brakes, but as the car was then descending a slope, the brakes were not sufficient to stop its career. The consequence was that it dashed into a two-horse laundry van. Directly after this collision a youth got on to the platform, and, fortunately, succeeded in bringing it to a standstill. The driver of the van, and a child who accompanied him, escaped uninjured. Meanwhile the driver of the car, after falling off, ran after it for some distance, then tried to get on to a motor-lorry going in the same direction, but slipped, and one of the wheels passed over his legs, which was badly crushed. He was taken on the lorry to where the car had stopped before it was realised how serious his injuries were.

TELEGRAPH and TELEPHONE NOTES.

Grant to Bell Employes.—The American Bell Telephone System has decided to distribute more than $6,000,000 among its employés, to help to meet the increased cost of living.

U.S. Wireless Law.—A Bill has been introduced into the U.S. Congress to strengthen the Government control of radio-communication.—*T. and T. Age.*

Midway Island.—To convey their "cordial greetings and best wishes for the New Year," the Commercial Cable Co. have sent us a coloured card illustrating Midway Island as a barren waste in 1900, and as a cultured colony in the occupation of the Commercial Pacific Cable Co.'s cable staff. We gave some particulars recently of the transformation effected by the company (E.R., October 13th, 1916).

Railway Signal Breakdown.—The fusing of a cable connected with the electrical signalling apparatus at London Road (L. & N.W. Railway) Station, Manchester, last week, greatly interfered with traffic. The points being affected, trains were unable to complete the journey, some of them being held up for long periods, whilst many passengers from Longsight walked along the track as the quickest way of reaching town.

Wireless Record.—According to the *T. and T. Age*, the steamer *Floridian*, San Francisco to Sydney, maintained communication with the Marconi station at San Francisco up to a distance of 3,000 miles, and her position reports were received up to a distance of 5,227 miles. The standard Marconi 2-KW. 500-cycle set was used on the ship.

Mr. David Sarnoff has been appointed manager of the commercial department of the Marconi Wireless Telegraph Co. of America.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—Feb. 19th. Municipal Council. Meters, maximum-demand indicators, feeder regulators. Specification from E.L. Department, Town Hall.

March 5th. Council. One 7,500-K.V.A. turbo-alternator. See "Official Notices" January 5th.

Bambridge.—February 3rd. Urban Council. Public lighting of the district with gas or electricity.

Bedford. — Electricity Department. Extensions, comprising buildings, boiler-house plant, turbo-generator, steam and water auxiliaries, switchgear, &c. See "Official Notices" to-day.

Halifax.—February 12th. Corporation Tramways Committee. Stores and materials, including lighting materials, wheel brake blocks, trolley and overhead line materials, &c., for twelve months. Tenders to Tramways Engineer.

London. — BATTERSEA. — February 6th. Electricity Department. Oils, engine-room stores, meters, joint boxes, &c. See "Official Notices" to-day.

Manchester. — February 2nd. Electricity Committee. Cooling towers. See "Official Notices" to-day.

Middlesbrough. — February 1st. Corporation. Twelve months' supply of electric lamps. Mr. S. E. Burgess, Borough Engineer.

New Malden. — January 31st. Malden and Coombe U.D.C. Installation of fire-alarm system. Particulars from the Council's Engineer.

New Zealand.—TAURANGA.—February 12th. Borough Council. Supply of six three-phase transformers, 11,000-400 volts. Messrs. H. W. Clime & Sons, Consulting Engineers, Raetihi.—*N.Z. Shipping and Commerce.*

Salford. — Tramways Committee. Steel tires, pinions, and gear wheels. General Manager, 32, Blackfriars Street.

South Africa.—DURBAN.—February 12th. Six four-ton electric travelling portable jib-cranes for the harbour.*

March 8th. Department of Post and Telegraphs. Installation of an automatic telephone exchange at Pietermaritzburg. See "Official Notices" to-day.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Cape Town.—The tender of Messrs. E. A. Shaw & Co. for the wiring of the Victoria Court Flats, at £800, has been accepted. The work comprises about 245 lighting points and 34 bell points.

Sleaford. — U.D.C. Coal for the electricity works to June 30th: D. Pattinson & Co., 27s. per ton.

Southend-on-Sea.—Town Council. Contracts placed :—

John Brown & Co., Ltd.—Tires, £373.
P. R. Jackson & Co.—Armature coils, &c., £303.
S. Stone & Co.—Bar steel, iron, &c., £190.
Hider Dempster.—Springs, white metal, &c., £219.
British Thomson-Houston Co.—Field coils, £162; gear cases, &c., £68.

Messrs. Chamberlain & Hookham have given notice, under the provision of their contract for house-service meters, of intention to terminate the same, and have quoted amended terms for the continued supply of such meters. The electrical engineer is to report thereon.

FORTHCOMING EVENTS.

Royal Institution of Great Britain. Friday, January 19th. At 5.30 p.m. At Albemarle Street, Piccadilly. Lecture on "Soap Bubbles of Long Duration," by Prof. Sir James Dewar, F.R.S.

Institution of Mechanical Engineers.—Friday, January 19th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. General meeting.

Association of Mining Electrical Engineers (West of Scotland Branch).—Saturday, January 20th. At 4.30 p.m. At the Royal Technical College, Glasgow. Paper on "Modern Switch and Fuse Gear: Its Defects and some Suggested Remedies," by Mr. A. McPhail.

Association of Mining Electrical Engineers (Notts and Derbyshire Branch) and the National Association of Colliery Managers (Midland Branch).—Saturday, January 20th. At 3.30 p.m. At the University College, Nottingham. Paper on "Electrical Experience at Collieries," by Mr. C. Jones.

Salford Technical and Engineering Association.—Saturday, January 20th. At 7 p.m. At the Royal Technical Institute, Peel Park. Presidential address, by Mr. J. Morris, and musical social evening.

Institution of Civil Engineers.—Tuesday, January 23rd. At 5.30 p.m. At Great George Street, Westminster, S.W. Paper on "The Physical Features of 'Adam's Bridge' and the currents across it, considered as affecting the proposed construction of a railway connecting India with Ceylon," by Mr. F. J. Waring.

Liverpool Engineering Society.—Wednesday, January 24th. At the Royal Institution, Colquitt Street. Paper on "The Education of Apprentices to Engineering and Allied Trades," by Mr. T. R. Thomas.

Greenock Electrical Society.—Thursday, January 25th. At 7.45 p.m. At 22, West Stewart Street. Open night for discussion.

Physical Society of London.—Friday, January 26th. At 5 p.m. At the Imperial College of Science and Technology, South Kensington, S.W. General meeting.

NOTES.

F. L. Rawson.—We read in the *Times* that on Tuesday last the police raided 90, Regent Street, W., the premises at which Mr. Frederick Lawrence Rawson carried on the business of a "Divine Healer." The *Times* says:—"Since the outbreak of war he claimed that he could allay, by his magic, the sufferings of the wounded, the perils of the missing, and the pangs of the starving prisoners in Germany. During the last fortnight public attention has been focussed on Mr. Rawson's exploits by a series of articles in the *Daily Mail*. A large staff of clerks, shorthand typists, and practitioners were employed in the business, and thousands of letters were said to go out every week to all parts of the world. Before taking up the career of a "divine healer" Mr. Rawson was in business in the city. On Monday the police visited the Regent Street premises and removed to an internment camp a Hungarian who was in Mr. Rawson's employment. On Tuesday Chief-Inspector Fowler, of Scotland Yard, with other officers visited Mr. Rawson's rooms and seized letters, documents, and books relating to his business. They were conveyed to Scotland Yard."

"Safety First" Council.—The first meeting of the London "Safety First" Council was held on January 15th, the Council, as constituted, consisting of representatives of 34 local authorities of the metropolitan area, 9 associations representing road users, 6 railway companies, most of the tramway and omnibus undertakings, the three Trade Unions connected with transport workers, and a number of prominent lighting and carrying companies. The following officers were elected:—President, Lord Sydenham; vice-president, Sir George Gibb, chairman of the Road Board; chairman of Council, Mr. J. W. Joynson-Hicks, M.P.; vice-chairmen, Sir Edward Smith, L.C.C., and Mayor of Hampstead (Alderman O'Bryen): hon. treasurer, the Mayor of Westminster (Sir George Welby); hon. secretaries, Messrs. H. E. Blain, A. P. Johnson, and A. E. Cave. Four Committees were elected, namely, General Purposes, Street Dangers, Publicity, and Drivers' Educational. The Council then proceeded to consider a number of "safety first" suggestions which had been received. Discussion took place with regard to the lighting regulations, and a resolution was passed asking the Street Dangers Committee to consider the question as early as possible.—*Daily Telegraph.*

Prohibited Exports.—A supplement to the *Board of Trade Journal* of January 18th contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported to various destinations from British India, Canada, New Zealand, South Africa, Newfoundland, Egypt, Malta, Cyprus, Mauritius, and Ceylon.

Bachelet Patents for Sale.—From an announcement appearing in our advertisement pages to-day, it will be observed that the liquidator of four Bachelet companies is offering the patents for sale.

Decimal Coinage and the Metric System.—The Manchester and District Decimal Association has issued a preliminary circular focusing attention upon the considerations which have induced it to advocate the reform of British coinage and the adoption of the metric system of weights and measures. It is held that much of the new plant which has been so generally installed for the manufacture of munitions of war, and thousands of our workpeople, may be thrown idle at the end of the war unless we *now* remove all obstacles that would otherwise hinder the enormous expansion of our export trade that will be imperatively required to ensure continuity of employment and the maintenance of our national economic stability, amongst the chief of which is our archaic collection of systems of coinage and measurement. The Lord Mayor of Manchester is the president of the Association, and in the list of vice-presidents and Council there are numerous representatives of manufacturing firms of world-wide reputation, including electrical firms such as Messrs. Mather & Platt, Ltd., Vickers, Ltd., W. T. Glover & Co., Ltd., the British Westinghouse Co., Ltd., Electromotors, Ltd., Ferranti, Ltd., and the Lancashire Dynamo and Motor Co., Ltd., as well as mechanical engineers, textile manufacturers, shipping merchants, &c.

Pointing out that the British Empire, Siam, and Persia are the only nations that have not adopted a decimal system of coinage, and that all our financial transactions are based on a rate per cent., which indicates the fundamental necessity of a decimal system in business, the circular advocates the adoption of the system of coinage which we have also recommended -viz., the decimal subdivision of the sovereign, without altering the existing values of our gold and silver coins. The florin would be the standard coin, divided into 100 cents instead of 96 farthings. The bronze coinage would be depreciated 4 per cent., but, as we have pointed out, at a time when standards of value have been so violently disturbed, a reduction of 4 per cent. in the purchasing value of the penny would be unfelt, and the present is obviously a most opportune moment for revising our coinage. The Association emphasises the fact, on the importance of which we have laid stress, that according to the foregoing proposal the pound sterling is retained. The adoption of the metric system of weights and measures is similarly regarded as certain to bring benefits far outweighing any temporary difficulties and inconveniences met with during the period of transition, and the Association expresses the intention of urging the Government to take action on these lines at an early date. An appeal is made for support, the subscription for members being one guinea per annum and for associate members 5s. Mr. Fred Hilton, of 55, Market Street, Manchester, is acting secretary.

Volunteer Notes.—FIRST LONDON ENGINEER VOLUNTEERS.—Headquarters, Balderton, Oxford Street, W.—Orders for the week, by Lieut.-Col. C. B. Clay, V.D., Commanding :—

Monday, January 22nd.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.25—8.

Tuesday, January 23rd. School of Arms, 6—7. Lecture, 7.15, "Musketry," by the Instructor of Musketry.

Wednesday, January 24th.—Instructional Class, 6.15. Platoon Drill, Platoon No. 2.

Thursday, January 25th.—Platoon Drill, Platoon No. 7. Ambulance Class by M.O., 6.30.

Friday, January 26th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.25—8.25.

Saturday, January 27th.—N.C.O.'s Class, 2.30, by Company Commander E. C. Fleming.

Sunday, January 28th.—Entrenching at Otford. Parade Victoria (S.E. & C. Railway Booking Office), 8.45 a.m.

(By order), MACLEOD YEARSLEY, *Adjutant.*

Institution and Lecture Notes.—The Faraday Society.—At the annual general meeting of the Society, on December 18th, the following officers and Council were elected :

President.—Sir Robert Hadfield, F.R.S.

Vice-Presidents.—Prof. K. Birkeland, W. R. Bousfield, K.C., F.R.S., Prof. F. G. Donnan, F.R.S., Dr. Eugene Haanel, Prof. A. K. Huntington, Dr. T. Martin Lowry, F.R.S.

Treasurer.—F. Mollwo Perkin, Ph.D.

Council.—W. R. Cooper, Dr. C. H. Desch, Dr. J. A. Harker, F.R.S., Emil Hatschek, Cosmo Johns, Prof. Alfred W. Porter, F.R.S., E. H. Rayner, A. Gordon Salamon, Dr. George Senter, Cav. Magg. E. Stassano.

Birmingham and District Electric Club.—At the annual meeting the following officers were elected :—President, Mr. A. B. Mudie ; vice-presidents, Mr. H. Foulds and Mr. J. J. Richardson ; hon. secretary, Mr. N. Deykin ; hon. treasurer, Mr. W. H. Varnon. The report referred to the services rendered by Mr. W. G. L. Riddle, who had filled the office of president for two years and of hon. secretary for nine years. The financial statement showed a considerable balance in hand, and it was decided to invest part of the surplus funds in war certificates.—*Birmingham Daily Post.*

Bread and Butter Machine.—An electric machine of British manufacture, capable of cutting 3,000 slices of bread an hour, and buttering them, has just been produced and supplied to a number of shipbuilding works on the Clyde.—*Financial Times.*

Appointments Vacant.—Shift engineer (42s.), for the Queen Mary's Military Hospital, Whalley ; temporary assistant electrical engineer, for the Barking U.D.C. electricity works ; mains engineer, fitter drivers and engine drivers, wiremen, stokers and fitters for the War Department (hutted camps, electric power houses). See our advertisement pages to-day.

Fire.—The battery room and its equipment at the station of the Merthyr Electric Light and Traction Co., Ltd., was destroyed by fire on January 9th. The cause of the outbreak is unknown.

Electric Signalling on the G.W. Railway.—The installation of track signals, combined with electrically-worked distant signals at "slipping" stations, has been a feature of interest in connection with the work of the Signal Department of the Great Western Railway during the past year. Installations of this kind have been brought into use at Slough, Exeter, Taplow, and Wantage Road, while others are in progress at Reading, Newbury, Kingham and other places.

Workmen's Compensation.—At Blackburn County Court, his Honour Judge Sturges sanctioned a settlement of £200 in addition to £10 already paid, in a case in which Ellen Hunter claimed compensation from Messrs. Yates & Thom, Ltd., Canal Foundry, for the loss of her husband, who, in November, 1916, was following his occupation as an electric crane driver, when he was caught between the crane and a pillar, and crushed to death. Mr. Harry Backhouse appeared for the widow, and Mr. John Taylor for the employers.

Trench Foot and Electric Leakage.—In the *Lancet* of January 13th, Dr. C. N. Longridge discusses the cause and prevention of trench foot in the light of a theory of electro-pathology which he attributes to Mr. A. E. Baines, "a distinguished electrical engineer." The theory in question is that the brain, and possibly the spinal cord, is the seat of electrical generation, and that the current so generated is carried to the tissues by means of the nerves ; Dr. Longridge predicts that Mr. Baines will ultimately rank with Simpson, Lister, and Koch as a benefactor of the human race, but however that may be, the extent of his own electrical knowledge may be gathered from the following explanation of the origin of trench foot :—

"The dominating factor in the conditions under which trench foot occurs is wet. When a man is standing for days on end in water and liquid mud, his boots, socks, and the skin of his feet and legs become soaked. As is well known, the electrical resistance of the skin is enormously diminished when the skin is wet. Under these conditions a gradual leakage of electricity to earth takes place from the feet. Other things being equal, electricity will always leak from a point in preference to a plane surface, which accounts for the fact that the toes are most affected. This leakage deprives the cells of the foot tissues of their trophic influence, and they die. Hence the lesions of trench foot."

Dr. Longridge has carried out experiments with a view to testing his theory, and remarks that "before testing it is necessary to 'earth' the patient in order to dissipate any induced charge of electricity of which he may be the host. If this is not done, the patient's own intrinsic current may be swamped by charges he has picked up from trams, electric trains, or other sources. With both poles in contact with the body the galvanometer will give a deflection. When leakage is taking place from any particular area a high and rapid deflection is noted."

It will be observed that he makes no distinction between static charges and electric currents ; nor does he, apparently, allow for the fact that any circuit through the earth is liable to carry currents of voltaic or thermoelectric origin, or stray currents from other sources, or that a delicate galvanometer will register currents if the moistened figures are placed on the terminals—not "body currents" at all, but ordinary commonplace currents that would equally well be produced by a slice of beefsteak. Hence the experiments which he describes are wholly illusory. Naturally, as the result of misleading experiments and fanciful hypothesis, he comes to the appropriate conclusion that treatment of the feet with *dielectric oil* gives better results than any other method.

"The experience of officers at the front is that trench foot can be prevented. I am certain it can, but it can only be done, firstly, by keeping out the wet, and, secondly, by keeping up the electrical resistance of the skin of the feet. The feet should be thoroughly greased, and by far the best grease to use is the dielectric ointment which is now an article of commerce."

Certainly, keeping out the wet and anointing the feet are sure to be salutary and beneficial measures—but the electrical theory is all nonsense.

Tudor Accumulator Co., Ltd.—The Public Trustee is inviting tenders for the purchase of 3,579 "A" shares and 1,200 "B" shares, all of £10 each, in the above company. Particulars appear in our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The chief clerk in the Ealing electricity department is to be given a war bonus of £10 per annum. A similar war bonus is to be paid to the assistant engineer and the mains superintendent. Salaries of the clerical staff are to be increased by from 2s. 6d. to 3s. 6d. weekly.

The Sunderland T.C. has approved of the following changes of salary : Chief assistant electrical engineer and sales manager, £300 to £325 ; superintendent, Hylton Road electricity works, £275 to £300; chief clerk, £250 to £260; testing superintendent, £200 to £215; wages—cable jointers increased by 1s. 0½d. per week; junior cable jointers by 2s. 1d.; meter testers 2s.; installation and meter inspectors by 2s. The tramway traffic superintendent's wage was increased from £3 5s. to £3 10s. per week.

Major H. Grey, the electrical engineer to the Accrington Corporation, who is on active service, has tendered his resignation. The General Purposes Committee, however, have made arrangements by which he will continue in office until the end of the war.

Upon the recommendation of the electrical engineer at Barnes, Mr. Law and Mr. Cornet are to be granted, as recognition of their valuable services during the past year, honorariums of £30 and £20 respectively.

The Finance Committee of the Whitehaven T.C. has recommended that the salary of the acting electrical engineer, Mr. Gillitt, be increased to £250 a year, on the understanding that he is not paid any premiums in respect of pupils.

Colchester T.C. has appointed Mr. Sheppard, of the electricity works staff, to succeed Mr. Cottam as shift engineer.

Sapper A. Greed, R.E., Wireless Section, who has been discharged from the Army after an attack of malaria, has resumed his duties in the mains department of the Dewsbury Corporation electricity works.

The Leatherhead & District Electricity Co., Ltd., have granted their manager, Mr. H. Leslie Dixon, leave of absence to accept a commission in the Royal Flying Corps.

The Newcastle-under-Lyme Corporation has increased the salary of Mr. A. J. C. De Renzi, borough electrical engineer, to £250 per annum.

On the occasion of his marriage, Mr. J. H. Williams, of the Urban Electric Supply Co., Ltd., Grantham, was presented with a cruet by the members of the staff at Grantham. Mr. Edmundson, the manager, made the presentation.

General.—Mr. F. A. B. Lord, member of the London Chamber of Commerce, and of Messrs. W. F. Dennis & Co., has been nominated to the vacancy on the ward of Cordwainer for the City Corporation by the Common Councilmen of the ward.

Roll of Honour.—Flight Sub-Lieutenant Neville W. Frames, of the staff of the Port Elizabeth Municipal electricity department, South Africa, was killed on active service in November last.

Corporal A. V. Scholes, of the Royal Flying Corps, who was formerly telegraphist at the Huddersfield Post Office, has been awarded the Military Medal for efficiency and gallantry in maintaining communication with an aeroplane by wireless telegraphy while under heavy fire.

The following is a list of employés in the Oldham Corporation tramways department who have laid down their lives during the war:—Private J. W. Hopson, aged 25; Private T. H. Hilton, aged 24; Private Foster Irving, aged 26; Private Harry Slinger, aged 32; Private J. L. Taylor, aged 26; Sergeant J. Wright Wood, aged 40; Sergeant H. Shaw; Sergeant Major A. Dale; Private E. Custy; Private J. Cartledge; Corporal J. W. Rose; Private T. Winstanley, aged 35; Private S. Crawshaw, aged 20; Private J. Wilson, aged 24; Private S. Hallam, aged 21 (awarded Military Medal some time before his death).

Corporal R. E. Britton, No. 7,000, No. 1 Siege Company, Royal Monmouth R.E., who has been mentioned in Sir Douglas Haig's dispatch of November 13th, was an apprentice in the office of the electrical engineer to the Swansea Harbour Trust.

Sergeant James Smith, of the Scottish Rifles, and formerly employed on the Blackburn Corporation Tramways, has been awarded the Military Medal.

Quartermaster and Hon. Lieutenant Tutt, Welsh Regiment and Sergeant (Acting Company Sergeant-Major) D. A. Hopkins, Welsh Regiment, mentioned in dispatches, were employed in the Swansea Corporation electricity department.

Private E. Stewart, Seaforth Highlanders, and electrician, has died from wounds.

Private O. H. Davies, Canadian R.A.M.C., who was an electrician on the Canadian Pacific Railway, has been awarded the Military Medal for gallant conduct in his attention to wounded under heavy shell fire.

Corporal Edwards, V.C., has been presented with a gold watch and chain, subscribed for by his fellow-workers at the Western Electric Co., Ltd., Woolwich.

Sergeant Arthur Wandby, Rifle Brigade, has been awarded the D.C.M. He was employed by the Leeds Private Telephone Co.

Sergeant James Smith, of the Cameronians, formerly employed on Blackburn Corporation tramways, has been awarded the Military Medal.

Leslie Hulme, who is in the Flying Corps in France, and was previously employed by Messrs. Dick, Kerr & Co., Preston, has been promoted to first-class air mechanic in the wireless section.

Sapper John Wharton, R.E., has been awarded the D.C.M. for gallantry on the field. He was an articled apprentice to Mr. J. Morris, electrician, Bolton.

Acting-Corporal Harold Sharp, A.S.C., who has been mentioned in dispatches, was an employé in the Leeds Corporation electric lighting department.

Boy Telegraphist Ernest Kelly, R.N., who has won the D.S.M., after being previously recommended for it on three occasions, is only 17 years of age. He was with the British Westinghouse Co., at Manchester, until two years ago, when he entered the Navy. He is on a Dover patrol mine sweeper.

A. B. Woodhouse, of the R.N.D., only son of Mr. William Woodhouse, who is associated with the Yorkshire Electric Power Co., has been killed in action.

Private C. E. Palmer, Royal Fusiliers, Lewis Machine Gun Section, for 11 years on the staff of the L.C.C. tramway depôt at New Cross, has died of wounds received in action.

Private Leonard Blanks, Royal West Kent Regiment, who enlisted whilst with Messrs. S. W. Gibson & Co., electrical engineers, of Dartford, has died whilst a prisoner of war in Turkey.

Private A. Skirrow, of the West Riding Regiment, is in hospital wounded. He was employed in the Leeds Corporation electric lighting department.

Many of our readers will desire to join us in congratulations to Sergeant J. Conway Price, of the Welsh Guards, upon having been mentioned in Sir Douglas Haig's dispatch of November 13th, 1916, for distinguished and gallant service and devotion to duty.

Obituary.—Captain W. T. Le Feuvre.—The death has taken place in hospital, at Bangor, of Captain Walter T. Le Feuvre, R.E., the borough electrical engineer of Bexhill. Prior to the war the deceased had held a commission in the Territorial Army, and in 1914, having obtained leave from the Corporation, he took a commission in the Royal Engineers. He served in France for some months, but owing to an injury to the ankle he was returned for home service, and was acting as instructor when he was taken ill with pneumonia, which caused his death. Captain Le Feuvre held the post of electrical engineer to the Bexhill Corporation from the establishment of the undertaking 16 years ago. He was in his 43rd year, and leaves a widow and two daughters. During his absence on war service Mr. C. A. Frost, assistant engineer, has been in charge of the works.

NEW COMPANIES REGISTERED.

Pressparts, Ltd. (145,747).—Private company. This company was registered on January 11th, with a capital of £3,000 in £1 shares, to take over the business of an electrical and mechanical appliance manufacturer, sheet metal worker, stamper, piercer, solderer, welder, polisher, and plater carried on by Henry Justus Eck at Darwin Works, Salop Street, Birmingham, as Pressparts. The subscribers (each with one share) are: Edwin B. Alldridge, 354, Gillot Road, Edgbaston, Birmingham, coppersmith; Henry Justus Eck, 10, Priory Road, Chiswick, W., engineer; Alfred C. Lee, 107, Wake Green Road, Moseley, Birmingham, coppersmith. The first directors (to number not less than three or more than five) are: Edwin B. Alldridge, Henry Justus Eck, and Alfred C. Lee. Mr. E. H. Clutterbuck, solicitor, has filed the usual declaration that the company is not formed for the purpose or with the intention of acquiring all or any part of any business the books and documents of which are liable to inspection under the Trading with the Enemy Act, 1914. Solicitors: Lane, Clutterbuck & Co., Minories Chambers, Birmingham. Registered office: 8, Salop Street, Birmingham.

Ridout & Ratcliff, Ltd. (145,740).—Private company. This company was registered on January 10th, with a capital of £2,000 in £1 shares, to take over the business of an electrical contractor formerly carried on by G. F. Ratcliff, at 43, Baker Street, but now at 42, Upper Baker Street, W., and the business of an electrical engineer carried on by L. Ridout, at the last-named address. The subscribers (each with one share) are: L. Ridout, 42, Upper Baker Street, W., electrical contractor; G. F. Ratcliff, 42, Upper Baker Street, W., electrical contractor. The first directors are to be appointed by the subscribers. Solicitors: Turner & Co., 89, Chancery Lane, W.C. Registered office: 42, Upper Baker Street, W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

James Keith & Blackman Co., Ltd.—A memorandum of satisfaction in full on December 11th, 1916, of second debenture dated February 12th, 1913, securing £1,000, has been filed.

Northampton Electric Light & Power Co., Ltd.—Issue on January 2nd, 1917, of £1,835 debentures, part of a series of which particulars have already been filed.

Musselburgh and District Electric Light & Traction Co., Ltd.—A memorandum of satisfaction to the extent of £800 on December 27th, 1916, of charges dated November 13th, 1905, and May 11th, 1909, securing £90,000, has been filed.

Southern Brazil Electric Co., Ltd.—Loan contract with mortgage and pledge executed by way of local mortgage, executed abroad on October 17th, 1916, as collateral security for £750,000 debentures covered by trust deed of August 19th, 1914. Property charged: Certain concessions, lands, water rights, and immovable property in Brazil, and shares in other companies. Holders: Royal Exchange Assurance Co.

Delagoa Bay Development Corpn., Ltd. (76,099).—Capital, £166,300 in £10 shares. Return dated December 5th, 1916 (filed December 6th). 267,400 shares taken up; 10s. per share called up on 177,400: £88,700 paid; £45,000 considered as paid on 90,000 shares. Mortgages and charges: £188,900.

East India Tramways Co., Ltd. (74,457).—Capital, £100,000 in £1 shares (15,000 pref., 35,000 ord., and 50,000 def.). Return dated December 15th, 1916. 7,476 pref., 33,433 ord., and 50,000 def. shares taken up; £1 per share called up on 7,476 pref. and seven ord. shares; £7,489 paid, including £6 paid on 24 pref. shares forfeited; £83,426 considered as paid on 33,426 ord. and 50,000 def. Mortgages and charges: Nil.

Harold Wood Electrical & Engineering Supplies Co., Ltd. (93,423).—Capital, £1,000 in 950 pref. ord. shares of £1 each and 1,000 def. shares of 1s. each. Return dated December 8th, 1916. All shares taken up; £1,000 paid. Mortgages and charges: £600.

Hampshire Light Railways (Electric), Co., Ltd. (52,564).—Capital, £1,000 in £10 shares. Return dated December 7th, 1916. All shares taken up; £1,000 paid. Mortgages and charges: Nil

Blackpool & Garstang Electric Light Railway Co., Ltd. (62,150).—Capital, £10,000 in £5 shares. Return dated December 29th, 1916. 361 shares taken up; £4 per share called up; £1,707 paid (including £323 received on application for further shares not allotted), leaving £60 in arrears. Mortgages and charges. Nil.

Railway Finance & Construction Co., Ltd. (formerly known as Electrical Equipment & Securities, Ltd. Re-named 1909) (72,0[illegible]).—Capital, £100,000 in £1 shares. Return dated November 13th, 1916. 92,292 shares taken up; £1 per share called up on 657 and 4s. per share on 29,595, £6,576 paid; £85,716 considered as paid, being 16s. per share on 29,595 and £1 per share on 62,040. Mortgages and charges: Nil.

CITY NOTES.

Tata Hydro-Electric Power Supply Co., Ltd.

The annual meeting of this company was held in November, at Bombay, Sir DORAB J. TATA presiding. The president, referring to the present position of the company and its future prospects, said that the supply of power was generally satisfactory to their consumers. The equipment of all mills intended to be served with power from the first installation of generating plant was now nearly complete, and they were being regularly supplied. They were pushing forward as much as possible the equipment of those mills which were to receive power from the second installation, but some unavoidable delay was being experienced owing to certain restrictions now placed upon the manufacturers of the driving equipment by the British Munitions Department. On the completion of the equipment, the average consumption of electrical energy in Bombay supplied by the company would approximately be 40,000 electrical H.P. The fifth generating unit, with complete equipment, would soon be in service. The hydraulic works comprised in the first construction contract were practically completed. The work of building the Shirawta dam, which would take some time to complete, was in full progress. On its completion, their capacity to supply, so far as hydraulic development was concerned, would be considerably augmented, enabling the scheme to be gradually extended to its safe limit of output. The payment of interest out of capital had ceased from January 1st, 1916, from which date dividends and debenture interest would be paid from revenue. The concessions which this company had in the Andhra Valley had been transferred to a new company, which was established under the name of the Andhra Valley Power Supply Co., Ltd. An agreement was to be drawn up between the two companies in order to facilitate the co-operation of the two companies in fullest harmony.—The report and dividend recommendation given in the ELECTRICAL REVIEW for January 5th, 1917, were approved. The meeting subsequently confirmed the resolution passed at an earlier meeting increasing the capital to Rs. three crores by the creation of 10,000 new shares of Rs. 1,000 each.

Yorkshire (West Riding) Electric Tramways Co., Ltd.—The report for 1916 states that, after providing for all expenses, there is a net income of £26,188. A dividend of 6 per cent. per annum, less income-tax, on the 6 per cent. cumulative preference shares has been paid, £12,525 taken to depreciation, renewals and reserve, and £17,952 carried forward. The number of passengers carried during the year was 12,888,274, and the miles run 1,768,007, as against 11,602,483 and 1,763,702 respectively for the previous year.

Imperial Tramways Co., Ltd.—Mr. Samuel White, J.P., has been elected chairman of the company in the place of the late Sir George White, Bart.; Sir G. Stanley White, Bart., has been elected a director; Mr. W. G. Verdon Smith, the secretary of the company for the past 15 years, has been appointed managing director, and Mr. F. H. Withers secretary.

Edmundson's Electricity Corporation, Ltd.—The directors have decided to withhold payment of the six months' dividend on the cumulative preference shares payable January 15th until the accounts for the financial year ending March 31st are prepared.—*Financial Times*.

Bristol Tramways & Carriage Co., Ltd.—Mr. Samuel White, J.P., has been elected chairman of this company in the place of the late Sir George White, Bart., and Mr. S. E. Baker has been elected a director.

Nairobi Electric Power & Lighting Co., Ltd.—Interim dividend at the rate of 6 per cent. per annum on the preference and ordinary shares for the December half-year.

Rio de Janeiro Tramway, Light & Power Co., Ltd.—Dividend, 1¼ per cent. on the issued capital.

Sao Paulo Tram, Light & Power Co., Ltd.—Dividend, 2½ per cent. on the issued common stock.

Bank Rate.—Yesterday the Bank rate was reduced from 6 per cent. to 5½ per cent.

STOCKS AND SHARES.

TUESDAY EVENING.

THE present are War Loan markets. Everybody is trying to do his and her utmost to make the loan a success, and little else is talked about in the Stock Exchange to-day. With the loan itself there is general satisfaction. Hardly any points have cropped up which call for effective criticism; and an excellent feature is the fact that February 16th is definitely announced as the date for closing the subscription lists. One great point in favour of the loan is that it establishes a lower rate of interest than that which the Government was offering before it appeared.

In each of the preceding War Loans a higher rate was offered every time, with the result that people said they would take half the amount which they felt able to subscribe, and then wait for the next Government issue, to see whether better terms would not be given. Now, however, instead of the 6 per cent. provided by the recent Exchequer Bonds and the 6½ per cent. obtainable from Treasury Bills, the Government has stepped forward with its 5 per cent. at 95; while Mr. Bonar Law held out a very plain hint that if this did not produce sufficient money, other and less favourable terms were what the investor might expect.

As was inevitable, a good deal of nonsense has been written about the War Loan by those who ought to know better; and a little more restraint on the part of the halfpenny Press would stimulate, instead of prejudice, the newcomer. Far-fetched schemes of raising money with which to apply for the loan are being advocated by the noisy sensation-mongers, who ignore, either deliberately or without knowledge, the results that would accrue from the following out of their counsels. There is doubtful national advantage to be gained from the wholesale realisation of securities which make an appeal only to British purchasers. If stocks can be sold to foreign buyers, so much the better; but there is small sense in robbing Peter to pay Paul; and if any sales of stock were to be attempted on a large scale, they would damage credit generally, and contribute indirectly to a weakening of the new War Loan.

At the same time, we have no sympathy whatever with those extremely astute people who work out calculations into decimal points, with a view to seeing how they can obtain an interest in the new War Loan through the purchase of existing stocks which carry conversion rights. Possibly they may be able to save a few shillings, but whatever they gain is of advantage only to themselves, and probably deprives the country of the new money which would be afforded it by direct subscription to the present issue.

Holders of the securities with which we deal week by week will find no national benefit served by their endeavouring to sell the stock and shares in the British companies comprised in our lists. If a holder of Brazilian Tractions elects to pass on his shares to a Dutch buyer, or if Mexico Tramway bonds can be sold to American purchasers, and the money realised from these sales be utilised in the purchase of the new loan, so much the better for this country and the victorious conclusion of the war. But to turn out good-class stocks simply with the idea of getting them transferred into other British hands is of very hypothetical value; while as for some of the means suggested for the raising of money in other directions, the majority are as ill-conceived as they are likely to prove useless in the attainment of the main object.

That the markets for purely investment stocks should be dull and quiet is natural enough. Brokers and jobbers know perfectly well that most clients are bent upon subscribing their spare cash to the new loan. At the same time, the declines which have taken place during the past week are comparatively trifling in amount—comparatively, that is to say, if one remembers the effects produced by the issue of the 4½ per cent. War Loan in 1915, when values fell steeply, and when, for a time, hundreds of securities became practically unsaleable.

The Home Railway market feels a good deal the influence of the latest competitor. In this department there has been a fair amount of selling—or, rather, of attempting to sell, because the jobbers are not keen to take stock unless they know where to place it. Many of the lower-priced descriptions which were in speculative favour some six weeks ago have given way somewhat sharply, and the Undergrounds fall with the rest. Underground Electric incomes broke away to 90½, a fall of 3¼ points, certain of the recent buyers, who had picked up the stock lower down, electing to take their profits. A partial recovery has left the stock at 91, and the company's shares are both easier. Districts declined to 16¼, and Metropolitans are 1½ lower, although in all these cases it has to be remembered that there have been recently sharp rises.

Electricity supply shares are exceedingly quiet, the reason being, of course, the uncertainty felt in connection with the approaching dividends, coupled with the advent of the new loan. Prices on the whole are well held, and proprietors are making no effort to sell. No doubt their tenacity is fortified by the decision of the Board of Referees in regard to excess profits duty, reference to which was made here last week.

The telegraph market is quiet. Anglo-Americans have gone back a little. In this market, as in most of the others, a good deal of attention is bent on the problem as to what industrials ought to pay the investor, in the light of the 5¼ per cent. yield offered by a Government long-dated loan. The New York Stock Exchange has calmed down so considerably that from a daily turnover which reached over three million shares, dealings have dwindled to the neighbourhood of less than 200,000 in a day. The Globe Telegraph issues are both a little lower, Indo-Europeans fell 10s., and Marconis are quoted ex the dividend of 2s., allowing for which there is a trifling rise in the price.

News from Mexico is said to be worse this week, and most of the Mexican securities have gone back. Mexico Tramway Fives have fallen 5 points to 25. Nor are Brazilian things so good as they were last week. Brazil Tractions lost 1½ points. The various water and power companies connected with the Pearson group are inclined to be lower. Those undertakings concerned with munition-making in the United States and Canada are mostly dull. Dramatic breaks occurred in the shares of the Canadian Car & Foundry Co., the common losing 30 points in a day on account of an explosion which took place at the works.

Industrials followed the general trend of markets. British Westinghouse have weakened to 54s. 6d. Callenders ordinary and preference have both eased off; the preference, it may be worth pointing out, now return 6¼ per cent. on the money. Electric Constructions receded to 18s. 9d. British Insulated preference are lower at 5. The same tendency is noticeable amongst iron and steel shares. The rubber share market, however, keeps firm. There is not much business doing, naturally, on account of the attention absorbed by the War Loan; but the disposition is to look for higher prices amongst speculative shares generally as soon as the War Loan has settled down into permanent hands. Copper, the metal, shows no signs of improvement; and, consequently, most of the shares connected with the industry have lost small fractions on the week.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Jan. 16, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary ..	5	5	8⅜	—	7 8 2
do. do. do. 4½ Pref..	4½	4½	8¼	1/16	6 18 6
Chelsea	5	4	3	—	6 18 4
City of London	9	8	11¼	—	7 2 8
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10½	—	6 18 8
do. 6 per cent. Pref.	6	6	9⅞	—	6 1 6
Kensington Ordinary	9	7	6⅝	—	6 4 5
London Electric	4	3	1⅜	—	6 10 5
do. do. 6 per cent. Pref.	6	6	4 7/16	—	6 15 4
Metropolitan	8½	8	2¼	—	6 13 4
do. 4½ per cent. Pref.	4½	4½	8⅛	—	7 4 0
St. James' and Pall Mall ..	10	8	6	—	6 13 4
South London	5	5	2⅞	—	6 19 0
South Metropolitan Pref. ..	7	7	1 3/32	—	6 7 8
Westminster Ordinary	9	7	5⅝	—	6 4 5

TELEGRAPHS AND TELEPHONES.

	Dividend 1914.	Dividend 1915.	Price Jan. 16, 1917.	Rise or fall this week.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	93xd	— ¾	6 9 0
do. Def.	30/-	33/6	22½xd	—	6 18 4
Chile Telephone	8	8	7xd	—	5 14 8
Cuba Sub. Ord.	5	5	8¼	—	6 8 6
Eastern Extension	7	8	19⅞xd	—	*5 15 4
Eastern Tel. Ord.	7	8	138xd	—1	*5 16 0
Globe Tel. and T. Ord.	6	7	12¼	— ¼	*5 14 3
do. Pref. ..	6	6	9⅞	— ⅛	6 1 6
Great Northern Tel.	22	22	37	—	5 19 0
Indo-European	13	13	49	— ⅛	6 12 8
Marconi	10	10	2 1/16xd	+ 1/32	8 14 9
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord. ..	10	10	2¼	—	4 9 0
United R. Plate Tel.	8	8	6 1/16	—	*5 19 8
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13⅞	—	*5 15 4

HOME RAILS.

	Dividend 1914.	Dividend 1915.	Price Jan. 16, 1917.	Rise or fall this week.	Yield p.c.
Central London, Ord. Assented	4	4	65¼	—	6 2 2
Metropolitan	1½	1	23½	—1½	4 5 1
do. District	Nil	Nil	16½	— ¼	Nil
Underground Electric Ordinary	Nil	Nil	2	— ¼	Nil
do. do. "A" ..	Nil	Nil	6/6	—3d.	Nil
do. do. Income	6	6	91	—2¾	*6 11 10

FOREIGN TRAMS, &c.

	Dividend 1914.	Dividend 1915.	Price Jan. 16, 1917.	Rise or fall this week.	Yield p.c.
Adelaide Sup. 6 per cent. Pref.	6	6	4 15/16	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	8	—	9 4
do. 2nd Pref. ..	5½	5½	2¾	—	—
do. 5 Deb. ..	5	5	64½	—	7 15 0
Brazil Tractions	4	4	49	—1½	8 3 4
Bombay Electric Pref.	6	6	10½	—	5 17 8
British Columbia Elec. Rly. Pfce.	5	5	62xd	—	8 1 4
do. do. Preferred	—	Nil	44	+1½	Nil
do. do. Deferred	—	Nil	38½	—2	Nil
do. do. Deb.	4½	4½	64	+1½	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	25	—5	Nil
do. 6 per cent. Bonds	—	Nil	22½	—	Nil
Mexican Light Common ..	Nil	Nil	7¼	—	Nil
do. Pref.	Nil	Nil	15¼	—	Nil
do. 1st Bonds ..	Nil	Nil	27½	—	—

MANUFACTURING COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Jan. 16, 1917.	Rise or fall this week.	Yield p.c.
Babcock & Wilcox	14	15	2 13/16	—	5 6 9
British Aluminium Ord. ..	5	7	28/6	—	5 12 3
British Insulated Ord.	15	17½	11¾	—	7 5 10
British Westinghouse Pref. ..	7½	7½	2 9/32	— 3/32	6 11 4
Callenders	15	20	12⅞	— ⅛	7 15 4
do. 5 Pref.	5	5	4	— ¼	6 5 0
Castner-Kellner	20	22	8 5/16	—	6 12 7
Edison & Swan, £3 paid ..	Nil	—	7/16	—	Nil
do. do. fully paid ..	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	61½	—	6 10 1
Electric Construction	6	7½	15/16	— 1/16	8 0 0
Gen. Elec. Pref.	6	6	9¼	—	6 3 1
do. Ord.	10	10	13¼	—	7 5 6
Henley	20	25	16	—	7 13 10
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12½	—	*8 0 0
Telegraph Con.	20	20	88	—	*6 5 0

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, January 17th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	,,	£54	..
a Bisulphide of Carbon	,,	£23	..
a Borax	,,	£34	..
a Copper Sulphate	,,	£66	..
a Potash, Chlorate	per lb.	2/6	..
a ,, Perchlorate	,,	3/-	..
a Shellac	per cwt.	142/-	..
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers ..	,,	£19	..
a ,, Lump	,,	£16	..
a Soda, Chlorate	per lb.	1/-	..
a ,, Crystals	per ton	120/-	..
a Sodium Bichromate, casks ..	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c ,, Tubes (solid drawn) ..	,,	..	..
c ,, Wire, basis	,,	..	..
c Copper Tubes (solid drawn) ..	,,	1/8 to 1/8½	½d. dec.
g ,, Bars (best selected) ..	per ton	£166	£9 dec.
g ,, Sheet	,,	£166	£9 dec.
g ,, Rod	,,	£166	£9 dec.
d ,, (Electrolytic) Bars ..	,,	£141	..
d ,, ,, Sheets ..	,,	£161	..
d ,, ,, Rods ..	,,	£149	..
d ,, ,, H.C. Wire	per lb.	1/5¼	..
f Ebonite Rod	,,	3/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/3	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	3/3	..
i Iron Pig (Cleveland warrants) ..	per ton	Nom.	..
l ,, Wire, galv. No. 8, P.O. qual.	,,	£38	£2 inc.
g Lead, English Pig	,,	£32 5	..
g Mercury	per bot.	£18 15	..
e Mica (in original cases) small ..	per lb.	6d. to 3/-	..
e ,, ,, ,, medium	,,	3/6 to 6/-	..
e ,, ,, ,, large ..	,,	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/10¾	¼d. dec.
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	,,	..	..
n ,, Wire, Nos. 1 to 16	per lb.	2/11	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons
r W. F. Dennis & Co.

Official Price of Aluminium.—The selling price of aluminium ingots of ordinary commercial purity of 98/99 per cent. has been fixed by the Ministry of Munitions at £225 per ton, carriage paid to consumers' works. The maximum selling price of re-melted aluminium scrap and swarf ingots of 98/99 per cent. purity has been fixed at £210 per ton, carriage paid to consumers' works. The maximum price must not be exceeded, but a lower one may be fixed by agreement between the seller and the buyer, based upon the Metallic Aluminium content. These prices are to take effect as from January 1st, 1917, and permits, under Regulation 30 A of the Defence of the Realm Regulations, will be granted only for such dealings in the above-mentioned materials as are in accordance with the above prices. The above prices are subject to alteration, at any time, as may be directed by the Minister of Munitions.

Patents and Alien Enemies.—Messrs. Vickers, Ltd., have withdrawn their applications in respect of Patents Nos. 19,282/05 and 26,322/07. A licence has been granted to Messrs. E. R. & F. Turner, Ltd., in respect of Patent No. 27,548/12, granted to Amme Giesecke & Konegen Akt.-Ges. Applications have been made by Messrs. Benham & Sons, Ltd., in respect of Patent No. 26,347/12, granted to Albrecht for electric heating devices, and by Messrs. S. Dreyfus & L. Gaisman (Hooley Hill Rubber and Chemical Co.) in respect of Patents Nos. 11,530/13 and 11,615/13, granted to Farbenfabriken vorm. Friedrich Bayer & Co., and Nos. 12,777/13 and 12,661/14, granted to Newton for the same firm for the vulcanisation of caoutchouc.

Sterling Telephone and Electric Co., Ltd.—Mr. Guy Burney, managing director of this company, has issued, under date January 1st, 1917, the following circular:—

"We have the pleasure to announce that the enemy shares of this company have now been acquired from the Public Trustee by Sir John Bethell, Bart., M.P., and his friends. Sir John Bethell has consented to act as chairman of the company. Sir Thomas Bethell (brother of Sir John) and C. S. Syrett, Esq., have also been elected directors of the company. The whole of the shares are now entirely held by British-born subjects. The difficulties associated with the enemy share-holding having been removed, we trust we may confidently look forward to a continuance of your friendly relations and support."

COLONIAL TELEGRAPHS AND TELEPHONES.

By R. W. WEIGHTMAN, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

(*Concluded from page* 53.)

The local telephone development in some parts of South Africa has been quite phenomenal, especially in the mining districts of the Rand.

In Canada, the Bell Co. have central-battery manual systems in their larger exchanges, and in exchanges below 500 or 600 lines they use magneto boards. They have no automatic exchanges. The practice of the Manitoba Government Department is on similar lines.

In Alberta and Saskatchewan the Government exchanges at Calgary, Medicine Hat, Lethbridge, Regina, and Saskatoon are equipped with the Strowger automatic system, as is also the municipal exchange at Edmonton. This latter exchange was started in 1907 with a 500-line installation, but is now for 10,800 lines, of which 9,300 are connected. It is spread over four exchanges and an area of roughly 20 square miles. All other exchanges in these two provinces are magneto except two central-battery manual exchanges at Saskatchewan.

Dry cells are used on all subscribers' magneto instruments throughout Canada.

The block and alley system of distribution is generally followed.

Superimposed telegraph circuits, which are usually leased to the telegraph companies, are arranged on both "simplex" and "composite" systems. The "simplex" is the well-known system which gives one Morse circuit superimposed on one telephone pair by means of repeating coils. The "composite" gives two Morse earthed circuits, which can be worked either single or duplex, and one metallic telephone circuit on one pair of wires. The theoretical connections of a terminal composite set are given in fig. 4. The condensers and retardation coils on the Morse arms prevent the telephone currents from passing through these arms, and they also so flatten the telegraph currents that the "thump" which would otherwise be heard in the telephone is reduced to a minimum. The condensers and retardation coils connected in shunt with earth off the telephone circuit have the effect of reducing the momentary telegraph currents that pass from one Morse circuit to the other through the telephone circuit. These earthed branches have a high impedance to telephone currents and a low impedance to telegraph currents, so that the latter are largely shunted to earth. The condensers in these branches prevent the earths on the retardation coils from interfering with the local telephone calling-signals. The telephone transmission loss due to the introduction of a repeating coil at each end of a telephone circuit on the "simplex" system is equal to about one mile of standard cable, while the loss on a circuit equipped with a "composite" set at each end is equal to about ¾ mile of cable.

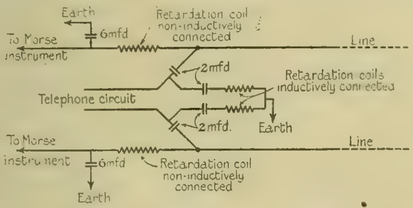

Earth
Retardation coil non-inductively connected
To Morse instrument
6mfd
Line
2mfd
Retardation coils inductively connected
Telephone circuit
2mfd.
Earth
To Morse instrument
Line
6mfd
Retardation coil non-inductively connected
Earth

Fig. 4.—"Composite" System of Superimposing Two Telegraph Circuits on Telephone Pair.

The minimum speech efficiency on the long-distance circuits varies under the different administrations, but it ranges from 30 to 36 miles of standard cable. The general dryness of the climate contributes to a high standard being attained.

Long-distance lines are equipped with lightning dischargers on the poles at suitable intervals, and where these wires are taken into an office or testing station it is a common practice to place the dischargers one or more poles away on each side of the office. The "Chapman" discharger shown in fig. 5 is a type much used for this purpose.

Branching joints on underground cables are of the lead Y-type, and all joints, both straight and branching, are treated with paraffin wax. In making a straight joint the lead sheath is removed from the ends of the cable for a distance equal to the length of the lead sleeve. The core is bound tightly with strips of muslin at the end of each cable sheath, the binding being packed close to the sheath so as to prevent the wires being cut by the edge of the sheath. The exposed conductors are thoroughly "boiled out" by pouring hot paraffin wax over them with a ladle until all traces of moisture are removed and the binding is thoroughly saturated with paraffin. Enough paraffin enters the sheath to form a seal, which protects the cable against moisture while the joint is being made. The temperature of the paraffin is above that of boiling water, but it must not be high enough to scorch or make brittle the paper insulation. In "boiling out" the cable it is the rule to work from the cable sheath towards the ends of the conductors. The jointing of the wires is done in the usual way, the joints being distributed along the whole length of the splice. The whole of the jointed wires are again "boiled out" until all traces of moisture have been removed. The splice is then wrapped with strips of muslin and compressed until the lead sleeve will just slip over the splice. The splice is again "boiled out," and this operation is again repeated after the final wrapping is completed, the drying out being continued until air bubbles cease to appear on the splice. The lead sleeve is slipped over before the splice has had time to cool and is wiped on to the cable sheath at each end.

The splice on a dry-core cable is undoubtedly its weakest point, but this form of joint when carefully made is so reliable that breakdowns are of very rare occurrence. It is in almost general use in the United States.

There is no through communication yet between the Eastern and Western shores of Canada. There is a break of 600 miles between Fort William and Kenora in which there is no telephone line at all, and the Rocky Mountains form another break between Alberta and British Columbia. The longest lines regularly in use in Canadian territory are those between Montreal and Windsor, and Montreal and North Bay, distances of about 600 miles. Loading coils are in use on both open-wire and underground sections of the long distance circuits. Communication is given with a large number of places in the United States through the trunk lines of that country, the longest distances being Montreal to San Francisco, 3,800 miles, and Toronto to San Francisco, 3,200 miles. (Communication has since been arranged between Montreal and Vancouver, *viâ* the American trans-Continental line, a distance of about 4,000 miles.)

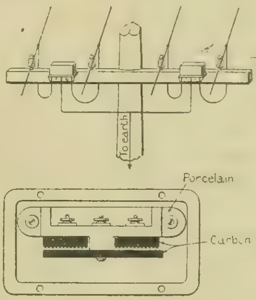


Fig. 5.—Chapman Lightning Arrester (Canada).

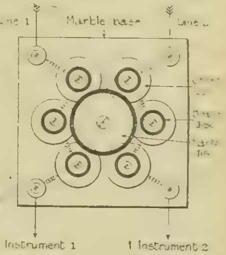


Fig. 6.—Lodge Discharger, Natal Pattern.

The telephone development of Canada is higher than that in any of the other Dominions or Colonies. For the whole of the country the average number of telephones per 100 of the population is 6.5. In British Columbia the average is as high as 11, while in Manitoba and Alberta the figures are 10 and 8 respectively.

Probably no country in the world has taken up automatic telephony so whole-heartedly as the Australian Commonwealth. In 1912 the chief electrical engineer personally investigated the systems then in use in America and Europe. His report, dated October 10th, 1912, deals in a very thorough manner with the comparison which may be made between manual and automatic systems. In comparing the semi-automatic with the full automatic he contended that the view that it is desirable to interpose an operator to control the series of operations that have to be made, and to check and correct failures when these occur, is wrong, and he declared himself emphatically in favour of the full-automatic for Australia. Since then important headway has been made; full-automatic equipment has been installed in 10 exchanges, the largest of which is Perth, with over 3,000 subscribers. Six other exchanges are in course of construction or approved, tenders have been invited for a further 18, and 14 others are under consideration. The exchanges so far opened are all equipped with the Strowger system, but both the Siemens and the Western Electric Co.'s systems are to be tried.

Both central-battery and magneto exchanges are in use. Distribution from all the larger exchanges is effected by means of underground cables. On very small exchanges open-wire distribution is adopted. Rubber-covered paper-core aerial cable has been used in certain of the States, but it has not proved satisfactory.

Selective 4-party line services are provided on the central-battery exchanges, and code-ringing party lines on the others, and on lines in country districts.

Both wet and dry cells are in use on subscribers' instruments, but the Post Office Leclanché cell with powdered depolariser is now being adopted.

There is a fairly extensive trunk system within the individual States, but the only capital cities as yet connected are Melbourne-Sydney (595 miles) and Melbourne-Adelaide (487½ miles). On both these circuits Morse duplex is superimposed and worked regularly. Loading coils have not yet been introduced into the Commonwealth. The percentage of telephones to the population at the end of last year was 2.721.

New Zealand was very early in the field in establishing telephone exchanges at its principal centres, and many of the exchanges installed between 20 and 30 years ago are still in operation. Many of the larger exchanges have become quite inadequate for present requirements, and the question of substituting more efficient systems has been before the authorities for some years past. The introduction of the central-battery manual system was contemplated, and three Western Electric central-battery exchanges were installed, but the administration hesitated to introduce this system generally in view of the development of automatic systems. In 1911 the chief electrician of the department was deputed to inquire into the various systems in use in America and Europe, and as a result of very exhaustive investigations he recommended the adoption of automatic exchanges for several of the principal towns. Experiments were carried out with several automatic systems available at the time, and the Western Electric Co.'s full-automatic system was decided upon as being the best calculated to meet the varied services of the Dominion. Contracts were entered into with this company for exchanges for the Wellington and Auckland telephone areas, and for separate single exchange installations for Masterton, Hamilton, Oamaru, and Blenheim. The ultimate capacity of each of these exchanges is the same, viz., 1,800 subscribers' lines, and 200 junction lines for special services.

At Wellington the system will have three main exchanges with immediate equipment for 4,000, 2,500, and 600 lines (ultimate capacities 8,000, 4,000, and 2,000 respectively). In addition, three sub, or "satellite" exchanges off the largest main exchange, with capacities from 200 to 600 lines, are contemplated, the ultimate capacity of the whole system being 20,000 lines, and accessory junction lines. Two of the main exchanges are now being installed, and but for delays caused by the war these would have been in operation by now. At Auckland the arrangements will be on similar lines with four main exchanges and two "satellite" exchanges, the total ultimate capacity being the same as at Wellington. It is not too much to say that before many years have passed all the important exchanges throughout the Dominion will be "automatic."

The longest speaking circuit is that between Wellington and Auckland, a distance of about 420 miles. This is obtained from two 400-lb. copper wires which are used for quadruplex telegraph purposes during the daytime. At night-time—after 6 p.m.—they are used as a telephone trunk circuit. In many cases telegraph circuits are superimposed on the telephone wires, and phantom telephone circuits are also obtained. Loading coils have not so far been installed. The standard of speech on trunk lines is the equivalent of 30 miles of standard cable. The number of telephones per 100 inhabitants is 4.6.

Lightning Dischargers and Protectors.

To-day it is generally, although by no means everywhere, recognised that the proper place for the lightning discharger is outside the building, or if inside, it should be placed as near the point of entrance of the wires as possible.

No form of lightning discharger known to the author will save wires if they are actually struck by lightning; they may be merely severed by the discharge, or short lengths of wire may actually disappear, deflagrated by the current, and such cases are not of rare occurrence on open country lines. The discharges the engineer has to protect himself against are those due to induction.

In Natal the author carried out a long series of experiments with the object of proving what types of protectors were best suited to the different working conditions there.

For protection at out-of-the-way offices where unreliable attendants are in charge, the carbon discharger is not always suitable. At a station of this class a discharger is wanted which will give protection without earthing the line. For this purpose the Wurts discharger was found to be most reliable. The type used had three cylindrical pillars of non-arcing metal with serrated surfaces, set in a porcelain base mounted on an iron bracket. The cover is of zinc. It will take one line wire on each outside pillar, the middle pillar being connected to earth. The connecting wires from the line wires were led as straight as possible, without spirals, twists, or sharp bends, and the earth was made as short and direct and as good as possible. With all types of dischargers it is essential that the greatest care be given to these points. The insulated wires running into the office were spiralled a few turns where they left the line wires, and the slight impedance thus introduced formed an effective choke to the discharge. Where dischargers of this type were employed and properly installed all other protective devices, such as fuses, spindles, and reels with fusible wires on them, were dispensed with.

This discharger is equally satisfactory on sections of line where lightning is specially troublesome, as on high, exposed tracts of country. Connected to the wires at suitable intervals they save them from damage due to heavy lightning charges flashing from the wires to the arms and poles, and they relieve the discharges at the terminal stations.

On railway signalling lines on which metallic circuits were used to minimise the effects of lightning, the discharger shown in fig. 6 was used. On these circuits working had to be carried on at all times, as any interruptions resulted in the disorganisation of railway traffic. This discharger is on the Lodge principle, and is the most effective discharger known to the author. It is, however, very expensive, and prohibitively so for a number of wires. The Wurts discharger might have been quite adequate, but it was introduced on other lines subsequently to the adoption of the Lodge discharger on these railway circuits, and the latter served the purpose so well that any risk there might have been in trying the other was never undertaken. This type of Lodge discharger is constructed with two separate series of three discharge disks and choke coils for the line wires. The central disk is earthed. The two line wires are connected to the two top disks, and below each disk there is a choke coil containing a number of turns of fairly heavy wire. The main discharges take place at these disks. The two succeeding disks on each side are similarly arranged with choke coils. With these dischargers in use the signalling instruments were operated in the heaviest lightning storms and not in a single instance during several years of operation did a discharger fail in its duty. As the edges of the line disks were burnt away by the discharges, they were turned slightly round to give fresh points for discharge, and it only rarely happened that a disk became so burnt as to require replacement.

NEW ZEALAND TRADE.

A careful analysis of New Zealand's import trade during 1915 by Mr. R. W. Dalton, H.M. Trade Commissioner in New Zealand, has been published by the Board of Trade (Cd. 8,415. Price 4½d. Wyman & Sons, Ltd.) Mr. Dalton remarks that the United Kingdom maintained its trade at a surprisingly high level, having in mind the difficulties under which manufacturers were working. While this fact is justifiable cause for gratification, it should be remembered that, though the results are not as yet remarkable, it is an undoubted fact that the manufacturers of certain countries not so much affected by the war have taken the opportunity of abnormal conditions to endeavour not only to capture trade which was formerly held by enemy countries, but also to establish themselves in face of competition, from whatever quarter. To this end they have been assiduously applying themselves to the appointment of agents and the organisation of selling campaigns.

The results of these activities may be more apparent in the statistics for the year 1916. Meanwhile, it may be regretted that, probably as a result of their being so hard pressed in other directions, manufacturers at home who are determined to appoint agents in this market show a disposition to put off doing so until after the war. The advisability of so doing must be very seriously questioned, for, with foreign manufacturers diligent in their search for good agents, and with agents doubtful as to what the after-war conditions may be—and, therefore, disposed now to take offers which may be made to them—it would seem to be a dangerous policy to defer until more normal times the first steps towards the preparation of a selling organisation.

While due credit must be given to the majority of New Zealand buyers for their loyalty to former suppliers, the fact that, in times such as those through which our manufacturers have passed, they should be able to maintain their trade at this high level in a market so far distant speaks very eloquently for their enterprise, for the efficiency of the shipping lines, and for the protection of the Navy.

It was only to be expected that suppliers nearer to the Dominion markets should be able under the circumstances to increase their trade with this market, for the time being, at any rate. Australia and Canada have increased their percentage shares of the competitive trade by 1.7 and 1.2 respectively, so that the share of the Empire in the trade of the Dominion is even greater than it was in the previous year. The percentage share of the United States in 1915 increased by 2.0, and that of Japan, though small, by 0.9.

The two latter countries in particular have been actively establishing organisations in this market on a more or less permanent basis. Nevertheless, bearing in mind what the manufacturers at home have been able to accomplish during the war, and the fact that productive methods have been very much improved, there seems ground for believing that, if during the war they do what they can to maintain their touch with the market, when the war is over they will be able to regain their former position, if not to strengthen it. There is also ground for presuming that a part, at least, of such success as foreign countries may have had in this market during the war is merely temporary, and will automatically disappear when manufacturers at home are again in a position to supply. For the rest, it has still to be seen how far the war has increased the competitive ability of British manufacturers; but it may be presumed that they will be on a more favourable basis than ever before. Added to this, there is the undoubted fact to be taken into account that the buyers of this Dominion are more than ever prepared to purchase British goods in preference to those of any country, and that this attitude, arising primarily from patriotism to the Mother Country, is strengthened by a realisation, as a result of the war, that the support of Empire undertakings is desirable, if not essential, in the best interests of the Dominion. If, in the meantime, manufacturers can spare the time, and will take the trouble, to explain to customers exactly what they are doing for the war, and how the war is interfering with their ordinary trade, the patriotism of the Dominion is such that a clear understanding will produce a marked effect on business.

Dealing particularly with machinery and machines, Mr. Dalton remarks that in this trade, production in which in the United Kingdom has probably been affected most of all industries by the war, the share of the United Kingdom in the total has declined from 59.0 per cent. to 55.4 per cent. It cannot be denied, however, that the United Kingdom's position in this trade before the war was not at all satisfactory. In relation to other trades, the percentage of the imports supplied by the United Kingdom was low, and there are certain important lines in which United Kingdom manufacturers are quite outclassed by their competitors. In consideration of the various items it will be noticed that, almost without exception, those lines are either lines which have been the subject of comparatively recent invention or development, or are such as are particularly adapted to Colonial conditions, and are in a great measure different from the articles required to serve similar purposes in the United Kingdom. The inferences to be drawn from these conditions would appear to be hardly complimentary to the ability and efficiency in designing and marketing of United Kingdom firms. As there can be no doubt that the manufacturers of the United Kingdom are second to none in manufacturing ability, it can only be supposed that their real fault has lain in failure to ascertain modern needs in such countries as New Zealand, and to manufacture to meet those needs, as well as in failure to organise an adequate selling campaign.

It is such conditions as these which have doubtless given rise to many of the criticisms of the efficiency of British manufacturers which one hears. Most of these criticisms are entirely unreasonable, and many are the product of hearsay or the outcome of a disposition, becoming all too popular, to imagine that the British manufacturer generally is effete as a serious competitor for the trade of the world. One cannot, however, consider the statistics under this class without concluding that in certain sections of this trade, at least, there is need for some further enterprise on the part of United Kingdom firms.

The leading competitor is the United States, but it may, perhaps, fairly be said that if the reason why British firms do not secure more of this trade is because they are not sufficiently enterprising, it is not equally true that the fact that American firms do secure it is a proof of their enterprise being greater. In many of the lines in which American firms are found to be predominant, the articles are of a nature which have had to be made in the United States to meet the needs of that country, and, as the conditions are much the same in this Dominion as they are in America, the same articles will suffice. The conclusions to be drawn from this are that such trade as the United Kingdom does secure in these lines is, and will be, the result of greater enterprise than that of their American competitor, and that the belief existing here that American firms are more enterprising than British is to this extent, at least, fallacious. The fact is that American production is so much standardised that in the majority of cases, perhaps, manufacturers in that country would be even less disposed to alter their patterns than British firms—the trouble is that they are not so frequently asked to do so, because, for the reasons already indicated above, there is not the same need.

The above remarks are made well understanding that conditions have changed in the United Kingdom since the war, and that there is reason to hope that when the war is over, manufacturers at home, having extended their plants, and finding that there is need of trade to keep them going, will turn their attention to many of these lines. If they do, there is no doubt that the trade in New Zealand in goods of the class now under consideration will experience a change.

PRINCIPLES INVOLVED IN COMPUTING THE DEPRECIATION OF PLANT.

By F. GILL and W. W. COOK, Members I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

It is not very satisfactory that engineers should hold such divergent views on so important a question as depreciation. Possibly this is due to the subject being regarded as one for the accountant alone, but in our view depreciation concerns the engineer, the financier, and the accountant, and no one of the three is competent to settle the question in any particular case, as, in order to obtain correct results, there must be co-operation between the three.

By the term "depreciation" is intended to be covered: (1) Provision for the diminution in value of plant in place and working (that is, its loss in value to the owner as a continuing plant), by reason of causes *outside* his control, such as age, wear, and accidents; this provision is hereinafter called "renewals." (2) Provision to enable the owner to take plant out of commission before its physical life is exhausted in cases where, from either progress of the art or growth of the business, it is economically advisable to do so (that is, by reason of causes *within* his control); this provision is hereinafter called "improvements."

It should be noted that the expression "renewals" denotes provision in respect of actual expired capital outlay, while the expression "improvements" denotes provision to enable plant to be destroyed while still valuable.

The function of the engineer in this matter is to provide the information necessary regarding the plant, such as first cost, residual value, and life.

The function of the financier is to provide information regarding the money, the amount available, the rate at which it can be borrowed, and the rate that can be obtained for the loan of it.

The function of the accountant is to provide accurate records based on the decisions arrived at, and to see that the real results are neither disguised nor hidden.

All three must come to a common decision, and each in any calculations he has to make must work to it, otherwise nothing but chaos can result.

When preparing a specification for plant to achieve certain definite results, there is usually more than one way of arriving at the desired end, and skilful judgment in the selection from among the alternatives must be exercised.

While the first cost of alternative plans is highly important, in most cases it is nothing like so important as the annual charges, and generally the decision as to which alternative to use can be made upon consideration of the annual charges alone.

Annual charges are composed of four principal parts:—

1. Return on capital outlay.
2. Depreciation—as already defined.
3. Maintenance, the cost of keeping the plant in as good condition as is desirable, but not of renewing it.
4. Operation—the cost of working the plant.

It is desirable to insist upon the importance of the utmost accuracy in the preparation of the annual charges. If the cost of any plant is to be judged by its annual charges, they must be the true annual charges, and one cannot express these by the single statement that they are, say, 14 per cent. per annum of first cost, unless either the cost is uniform each year, or the rate mentioned is an equated rate taken over the prospective life of the plant.

The sums required for return on capital and depreciation both depend upon the treatment of the capital account and the depreciation fund; in fact, these two are so intimately connected that their costs cannot be treated independently.

For the purpose of this paper there are two lives which must be defined:—

(*a*) Physical Life, that, is, the period during which the plant would continue to perform satisfactorily the service to which it is adapted, if allowed to do so, but subject to all causes *outside* the control of the owner, such as wear and tear or accidents.

(*b*) Economic Life, that is, the period of physical life shortened by causes *within* the owner's control, such as desire for economy, improvement of service, the taking out of plant because a greater capacity is required.

It is necessary to distinguish quite clearly between these two. The physical life affects the amount to be put aside each year for renewals, and since by definition the plant can perform its service satisfactorily during the whole time, there is no compulsion to renew before the conclusion of the physical life.

The renewals fund thus ensures that the money invested in plant is always represented by the assets, provided that none of it is voluntarily destroyed.

In order that the owner of the plant may be always in a position to take advantage of developments and still be in a sound position, it is necessary to have a special fund available for the purpose, and such a fund is referred to in this paper as the improvements fund.

As such a fund is necessary for the successful conduct and progress of the business, the annual contributions are, in a continuing business, part of the annual charges against the plant.

The distinction between the renewals fund and the improvements fund must constantly be borne in mind.

The charges to the renewals fund represent actual expired capital outlay each year, and consequently are the measure of the diminution of the value of the plant in place considered as a structure, whilst the improvements fund enables plant to be superseded before its physical life is ended, and ensures that when this is done the value of the assets shall always represent the invested capital.

The methods of arriving at the deduction to be made for any plant which has already been in existence some time may be divided into two classes:—

(*a*) Based on a detailed examination of the plant and an individual assessment of values for each item.

(*b*) Based on an estimated life which the various classes of plant will have under a given standard of maintenance, and providing for the diminution in value by writing off or setting aside a proper sum in respect of each expired year (or other portion) of life.

When carefully examined there is really no sharp dividing line between these two methods.

In the case of detailed examination (*a*), proper weight can be given to condition, but physical examination alone will not enable a proper deduction to be made for the depreciated state of the plant. In some cases, for some years, the plant shows no sign of wear or decay, yet obviously some provision ought to be made for the expired life during these years. It is usual, therefore, and necessary, to estimate the first cost, life, age, and residual value.

If, as in method (*b*), the bulk is considered instead of the individual items, the life and age can be estimated with much greater certainty, while consideration of the amount spent on repairs and upkeep, supplemented by inspection, will give the condition.

The measurement of the effects of wear and tear and the passage of time is essentially a financial operation, and no satisfactory solution can be found without going through the steps of establishing the first cost, residual value, life, and age.

It is often said that one cannot say how long a certain plant will last; but this is not a sufficient answer. One must estimate the life if there is to be any attempt towards scientific treatment in planning.

One cannot neglect capital charges, *i.e.*, return on capital and provision for depreciation; and the latter depends very largely upon life.

Those who say the life cannot be estimated, and take, say, 10 per cent. as capital charges, do, in fact, estimate the life, though they do not state the period, and they do so without taking the necessary precautions to estimate it correctly, because for any particular rate of return on money, and with a given residual value, 10 per cent. per annum can only be arrived at by one definite life.

Further, without estimates of lives one cannot logically arrive at one common rate for capital charges for various classes of plant capable of living for various periods. It follows, therefore, that of necessity estimates of life must be made.

Most of the examples in the paper, which concern economic life have been worked out on a basis of :—

First cost	£100
Residual value	13 per cent.
Economic life	19 years.

and the examples which concern physical life on a basis of :—

First cost	£100
Residual value	2 per cent.
Physical life	25 years.

In both cases interest where taken is at 5 per cent. per annum.

Let the essential conditions be that the plant shall be charged with a yearly sum sufficient to :—

(1) Pay for all maintenance.

(2) Pay all operating expenses.

(3) At the end of the physical life, renew the capital outlay on it.

(4) Provide sufficient money to enable the company to take advantage of improvements in the art, and take out of commission, when desirable, plant which still has some years of life left in it.

(5) Pay the company an agreed return on the money invested, say, 5 per cent. per annum.

(6) Let it be also assumed that the capital is £100, and that it and the plant do not increase during the whole time.

Maintenance and operating costs are assumed to remain constant and can be neglected.

The money received each year in advance for renewals and improvements cannot remain idle; it must be used to repay the capital gradually, or be lent at interest to someone outside the business.

Since the matter can be treated in different ways, it is necessary to consider what tests shall be required of the various methods. There are two: (1) The total cost of all the annual charges for the economic life of the plant shall not exceed the real cost; and (2) the incidence of the annual charges shall not be such as to cause anomalies in the conduct of the business in different years or periods, unless such incidence is due to some plant condition.

In the typical methods to be examined, it is assumed that the first cost is £100, the residual value at the end of the economic life £13, and the economic life 19 years.

The present value of all payments, £94.86, is the total cost, independent of any method, to be used in the first test of any method.

There are various methods of treating the provision for depreciation, but substantially they reduce to the following :—

(1) Maintenance Method, wherein no regular sum is put aside, the plant being maintained and renewed out of revenue expenditure.

(2) Reducing-Balance Method, wherein a uniform percentage is deducted each year off the reduced capital cost.

(3) That usually called the Straight-Line Method, wherein the annual charge is the ratio of one year to the total time or life.

(4) Sinking-Fund or Annuity Method, wherein value is given to the interest the fund will earn until it is wanted.

(1) The Maintenance Method affords no means of calculation; it is bound to be irregular, and since no charge can be made until a renewal actually takes place, the method is always in arrear unless and until a complete renewal is effected.

(2) The Reducing-Balance Method is very frequently employed to ascertain the amount to be allocated for depreciation at the end of a year. The first cost being assumed at £100, the residual value 13 per cent., the economic life at 19 years, it will be necessary to apply a rate of 10.18 per cent. per annum to the reduced balance to extinguish the £87 during the life, and the costs for return and depreciation are shown in fig. 1.

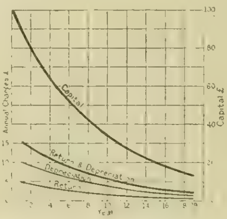


FIG. 1. ANNUAL CHARGES. REDUCING BALANCE METHOD.

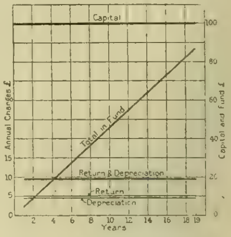


FIG. 2.—ANNUAL CHARGES. STRAIGHT-LINE METHOD AS FREQUENTLY POSED.

This method results in a relatively heavy charge in the early years, and a very light one in the last years. The present value of the whole series of payments is £94.86, and so this method satisfies the check as to total cost; there only remains the check on incidence.

(3) The Straight-Line Method has been strongly advocated and requires extended consideration.

As usually posed, it is simplicity itself. £87 is to be found in 19 years; therefore, all that is required is £4.58 per annum for depreciation and, with £5 for return, the total charges for these two heads are £9.58 per annum, as shown in fig. 2.

This table does not, however, pass the test of total cost; the present value of 19 annual payments of £9.58 each at 5 per cent. is £115.77, instead of £94.86, an excess of £20.91.

If £4.58 be set aside annually, there will, of course, be £87 accumulated at the end of the 19 years; but since it is not prudent to leave money idle, it is plain that interest ought to be, and will be, earned by the money so set aside annually.

If interest is taken at 5 per cent. per annum and added to the growing fund, there will be at the end of the 19 years not the £87 required, but £139.84, so the yearly payments must be reduced below £4.58 per annum until the amount is just sufficient to accumulate only the £87 required, and this needs a yearly payment of £2.85 for the 19 years.

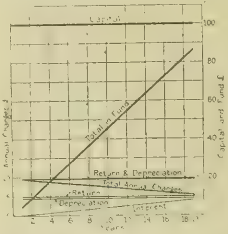


FIG. 3. ANNUAL CHARGES. STRAIGHT-LINE METHOD IN PRACTICE.

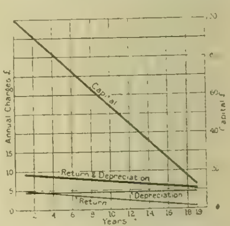


FIG. 4.—ANNUAL CHARGES. STRAIGHT-LINE METHOD. PART OF CAPITAL REPAID EACH YEAR.

If the earned interest be not added to the fund, but credited to the general revenue account, as is generally the practice of those who uphold the straight-line method, the effect is that the revenue is increased thereby, with the result that a higher return on the capital is obtained, the interest earned by the depreciation fund not being required for the plant. But this is a violation of the hypothesis, because a stated return on capital was to be earned, no more and no less.

This case is shown in fig. 3. Here, again, the present value of all the payments exacted for the plant is too great, being £115.77.

If the straight-line law is followed, but instead of accumulating a fund the capital is partly repaid each year, the present value is seen to be correct at £94.86, and there remains the question of incidence. Fig. 4 shows this.

(4) Annuity Method. Fig. 5 shows the case treated as an annuity, by which each year a part of the capital is repaid and a return is paid on the capital outstanding. Here the total annual charge is uniform at £7.85 per annum, made up of the decreasing return component and an increasing depreciation component. At the end of the life all the capital has been repaid, except £13, which will be found by the sale of the plant. The plant gets the benefit of interest, because as capital is repaid the return thereon ceases. The present value of the series of payments is £94.86.

(4) Sinking-Fund Method. Fig. 6 shows the case treated by a sinking fund; in this instance the capital remains fixed at £100, and a fund is built up gradually against the end of life, at which time, and not until then, the money will be required either to repay the capital or to replace the plant.

Here the total charge is uniform at £7.85 per annum, made up of uniform charges each year both for return and for depreciation. The present value of the series of payments is £94.86.

The depreciation fund is not required until the end of the life, and, of course, earns interest in the meanwhile; in this instance the interest is added to the fund, and because of that addition the annual charges are reduced.

The advocates of the straight-line method have to choose between figs. 2, 3, and 4.

They cannot adopt fig. 2, because that requires either that no interest is earned by the money paid annually in advance, or that interest is earned but not disclosed, each being an untenable position.

They cannot adopt fig. 3, because that requires the plant to pay an enhanced annual charge under the plea of its being required to provide for depreciation, although, as a matter of fact, the enhancement is used to give the owner a greater return.

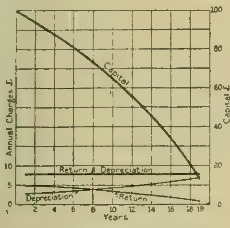


Fig. 5.—Annual Charges. Annuity Method.

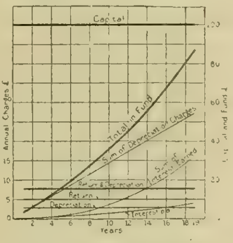


Fig. 6.—Annual Charges. Sinking Fund Method.

They are not likely to adopt fig. 4, because that requires a charge which reduces each year till the end of the life of each portion of plant, and then increases and again commences to fall. It would be impracticable to base any rates on this table.

TABLE I.—Present Value of the Annual Charges for 19 Years by the Various Methods Shown.

Method.	Figure No.	Annual charges.	Present value.
		£	£
Real requirements	—	—	94·86
Reducing balance	1	15·18 to 2·19	94·86
Straight line as frequently posed ...	2	9·58	115·77
Straight line in practice	3	9·58	115·77
Straight line if proportion of capital is repaid each year	4	9·58 to 5·46	94·86
Annuity	5	7·85	94·86
Sinking fund	6	7·85	94·86

Tabulating the present values of the whole transaction by the various methods, we have Table I.

Now, it is obvious that each method produces exactly the required present value, except that which takes up the position that interest will not be earned on the money received each year and in advance of being required, or while admitting that interest will be earned does not credit it to its source.

Examining the methods shown in Nos. 4, 5, and 6, each of which has a present value of £94.86, for the test of incidence, Nos. 1 and 4 require an annual charge which varies each year, while Nos. 5 and 6 have charges wihch are steady each year.

There is no condition as regards the plant which requires this varying annual charge, and certainly no plant condition which would enable one to distinguish between the varying annual charges in Nos. 1 and 4.

If there is some real reason for varying annual charges, of course they must be faced; but if they are untrue, it is foolish to cumber a forecast of annual charges with a varying scale.

The reducing balance method (No. 1) is seen to be one of convenience, and not of fact, because if it were really correct that the annual charges vary in such a marked fashion, *e.g.*, 1st year 15.18 per cent., 6th year 8.87 per cent., 12th year 4.66 per cent., then either there must be some counterbalancing increasing cost, or the charge to a consumer for the use of the plant would require to be a reducing one.

There is no such reducing charge in practice; consequently, if the steady charge to the consumer is sufficient to give a return of 5 per cent. in the first year, then the same charge will give 15.8 per cent. return in the 6th year, 39.3 per cent. in the 12th year, and 94.8 per cent. in the 19th year.

The same reasoning applies to the method shown in No. 4; in ordinary practice there is no such reducing charge, except in book-keeping, and that has its foundation in convenience or prudence, and not in the actual requirements of the plant.

On the other hand, both the annuity and sinking-fund methods are correct in amount, satisfy all real requirements demanded by the plant, and, being uniform, can be easily handled.

In practice it is not usual to repay the capital fractionally each year; the money set aside for depreciation is generally accumulated until wanted, and the sinking fund method satisfies all conditions of the problem so far.

(*To be continued.*)

LEGAL.

Secret Process in Rubber Manufacture.

In the Chancery Division on Thursday, January 11th, Mr. Justice Peterson continued the hearing of the action brought by the Alperton Rubber Co. against Manning and the Belgium Tire Co. to restrain the disclosure of a secret process for the hardening of rubber, so as to render it suitable for electric insulation and other purposes. The allegation was that the defendant Manning, while in the plaintiffs' employ, obtained their formula for a hardened rubber called Alperlite, which they had introduced as a substitute for the German Stabilit, and had disclosed it to the Belgium Tire Co., who were now manufacturing a similar substance.

Mr. Hughes, K.C., and Mr. Hodge appeared for the plaintiffs, Mr. Herbert, K.C., and Mr. Manning for the defendant Manning, and Mr. Tomlin, K.C., and Mr. Deighton Pollock for the Tire Co.

Opening the case for the defence, **Mr. Herbert** said that a winding-up order had been made against the plaintiff, and the Official Receiver, who was acting as liquidator, after considering the matter, did not feel in a position to go on with the action, which was being continued by the debenture-holders. Mr. Herbert also pointed out that Mr. Hughes had not thought it worth his while to go on with the claim against the Tire Co. for inducing the defendant Manning to leave plaintiffs' employ. His submission was that on the evidence already given, and the evidence he should call, there was no justification for the claim in the action against Manning. His case was that Manning had acted in a perfectly *bona fide* manner. The formulæ he had been using while with the plaintiffs were part of his technical equipment, and he was entitled to use them wherever he might go. Really the only important formula was that which related to Stabilit, and the question turned upon whether Manning had taken that formula and communicated it to the defendant company, and that company was manufacturing something from a formula supplied by Manning, which he had obtained in confidence from the plaintiffs. He understood that the Belgium company were not only not using that formula, but were going to prove that they were using quite a different formula. However that might be, the plaintiffs' evidence had not connected Mr. Manning with communicating any process to the Belgium Co. The action was brought entirely under a misapprehension. The plaintiffs thought that Manning was in the employ of the Belgium Tire Co., and had taken this formula to them, whereas he was acting as a commission agent, and had merely placed orders with them.

Mr. Tomlin said that his case was that the Belgium company never had any information from Mr. Manning. They had been experimenting with a view to finding a substitute for Stabilit, and had found one. The case made against them was that they had received information from Mr. Manning, but there was no evidence as to that of any sort or kind. The case made against them was one of suspicion, and nothing else. Mr. Manning denied in the witness box that he had communicated any information obtained while in the plaintiffs' employ. He was a costs clerk with the plaintiff company, and had nothing to do with the technical part of their business. Nothing whatever was said about secrecy when he was engaged.

Evidence was called on behalf of the Belgium company to show that the formula used by them was not the same as that used by the plaintiffs.

The case is proceeding.

Petition for Revocation of Patent.

In the Chancery Division, on January 11th, Mr. Justice Sargant again heard an application on behalf of the respondent, Mr. Ralph Hancock, to a petition by The James Keith & Blackman Co., Ltd., for the revocation of his patent relating to centrifugal fans.

Mr. J. H. Gray applied to have the petition held over, so that it should not come on for trial before the June (Trinity) sittings of the Court. He said the patentee was at present in America upon

Government business, and there was no probability of his being able to return soon, but his solicitors were prepared to give an undertaking that if he returned before the time indicated for the hearing, they would notify the petitioners to that effect.

His Lordship granted the application on the respondent's solicitors undertaking that if they knew of their client's intended return, they would let the other side know.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

UNITED STATES OF AMERICA.—A recent decision by the Board of General Appraisers entitles crude india-rubber in sheets—imported in the form of sheets about 12 in. wide, 20 in. long, and ¼ in. thick—to entry free of Customs duty under the Tariff Act of 1913.

ARGENTINE REPUBLIC.—A Presidential Decree, dated October 17th, regulates the Customs procedure in connection with the clearance of samples at Argentine ports. Parcels of samples may not exceed 10 kilogs. (22 lb.) in weight, otherwise they will be regarded as "cargo," and placed in warehouse at the port of entry. Only parcels containing articles which have been so defaced, &c., that they are useless for trade purposes may be cleared as "samples without value." When such samples are imported in trunks or other containers subject to duty, the importer must pay or enter into a bond for the amount of duty leviable.

Parcels containing samples of kinds not included in the preceding paragraph, or which may be classified under any heading of the Valuation Tariff, are to be regarded as "samples of (commercial) value," and, as such, shall pay duty in accordance with the values established by the Appraisers, *provided that the samples consist of separate pieces of goods which are commonly imported in sets*, and *that there are only one or two pieces of each class of article*; or—if the samples consist of articles of miscellaneous kinds, classes, or qualities in the form of one or two pieces to illustrate each kind or quality—provided that such samples are those of goods which are of kinds commonly imported in larger quantities and in parcels containing only one kind or quality. In this case, the interested party must declare in detail the pieces or objects which he wishes to import, and he may apply for permission to examine the contents of the parcel if such examination is necessary in order that he may make a correct declaration.

When samples consist of single articles illustrating goods which are sold in pairs, the interested party must annex to his declaration a statement, in triplicate, specifying the "manufacturing number" of each article and the material of which made, the dimensions, and any other details which serve to distinguish one object from the others of the same general category comprised in the importation.

Parcels of samples must bear, on the outside, in addition to any marks, numbers, and addresses, the word "muestras," or its equivalent in a foreign language.

Customs officers are forbidden to permit importers to alter the condition of objects imported from foreign countries and documented as "samples," either by stamping such objects or perforating them with a view to depriving them of their quality as saleable merchandise. All parcels containing goods not defined as samples in these Regulations, but which, nevertheless, may be sought to be cleared through the Customs as samples, shall render the importer liable to the penalties provided by the Tariff Law.

The complete text of the Regulations may be consulted at the Department of Commercial Intelligence, 73, Basinghall Street, E.C.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Published expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

10. "Adjustable shade for gas and electric light." H. Ashton. January 2nd.

16. "Electric starters for combustion engines." D. C. S. Sandeman. January 2nd.

18. "Electric cables." British Insulated & Helsby Cables, Ltd., and J. Brotherton. January 2nd.

38 "Automatic electric control of petrol-electric, &c., vehicles." V. S. Robinson & P. F. Smith. January 2nd.

41. "Electric ignition for internal-combustion engines." B. T. Lang. January 2nd.

51. "Transmission dynamometer." F D. Everett. January 2nd.

81. "Control of electric motors." J. M. L. Slater. January 2nd.

90. "Electric lamp or other vacuum tube having a copper leading wire." G. Ohtani, S. Yago & T. Yamai. January 2nd. (Japan, January 26th, 1916.)

97. "Electric treatment of reaction substances." F. H. A. Wielgolaski. January 2nd.

117. "Electrolytic apparatus" I. H Levin. January 3rd. (U.S.A., June 3rd, 1916.)

131. "Electric incandescent arc lamps." British Thomson-Houston Co. (General Electric Co., U.S.A.). January 3rd.

139. "Combined starting and lighting dynamos for motors cars, &c." E. C. R. Marks (Soc. Anon. des Etablissements L. Blériot). January 3rd.

153. "Electro-magnetic switches." Electric & Ordnance Accessories Co. and J. Etchells. January 3rd.

155. "Electro-magnetic regulating and switching devices." Electric and Ordnance Accessories Co. & J. Etchells. January 3rd.

177. "Ignition systems." W. J. Mellersh-Jackson (Philips-Brinton Co.). January 4th.

180. "Magneto-electric machines." G. A. Lister, M-L Magneto & E. A. Watson. January 4th.

196. "Shock-resisting winding for rotating magnet coils." Vulcan Maschinenfabriks Akt. Ges. January 4th. (Austria, May 24th, 1916.)

216. "Locking device for electric lamp globes." W. C. Ellis (A. Ellis and E. Ambrose). January 4th.

220. "Apparatus for electric welding." T. E. Murray & H. R. Woodrow. January 4th. (U.S.A., January 12th, 1916.)

249. "Apparatus for automatically retransmitting through successive lines telegraphic messages received from a distant station." S. E. Appleton, Eastern Telegraph Co. & A. Fraser. January 5th.

253, 254, 255. "Process of electric welding." T. E. Murray. January 5th. (U.S.A., February 18th, 1916.)

264. "Electric ignition of gas, petrol, &c., internal-combustion engines." W. S. Frost. January 5th.

282. "Alternating-current dynamo-electric machines." Lancashire Dynamo and Motor Co. & W. Stansfield. January 6th.

306. "Electric signalling systems." F. G. Bell, W. C. Davey, and The Sterling Telephone & Electric Co. January 6th.

313. "Telephone system." Aktieselskabet Elektrisk Bureau. January 6th (Norway, January 15th, 1916.)

314, 315. "Ignition dynamos." C. T. Mason. January 6th. (U.S.A., March 15th, 1915.)

PUBLISHED SPECIFICATIONS.

1915.

13,176. Power Transmission Systems. W. Morrison. September 15th. (September 15th, 1914.)

15,886. Apparatus for Closing the Doors of Railway and like Vehicles. Knorr-Bremse Akt. Ges. November 10th.

16,113. Wattmeters and like Instruments for the Measurement of Electric Power. H. E. Trent. November 15th. (November 11th, 1914.)

17,247. Talking Machines and Driving Mechanism therefor. British Thomson-Houston Co (General Electric Co., U.S.A.). December 8th.

17,393. Lighting Arrangement for Ophthalmic and Therapeutic Work. W. J. Harvey. December 11th.

17,399. Marine Depth Sounding. Sir R. A. S. Paget and Duddell. December 11th.

17,557. Apparatus for Compiling Statistics Mechanically by the Aid of Perforated Bands. C. Haggenmiller. December 15th.

17,600. Automatic Weighing Apparatus, more especially for Liquids. E. C. R. Marks (Adam). December 16th.

17,662. Signalling Lamp. A. A. Lyon. December 17th.

17,691. Electric Signalling. International Electric Co., H. E. R. Roose and R. G. le Noir. December 17th. (Addition to 3,520/15.)

17,736. Magnetic Compasses. Creagh-Osborne, A. J. Hughes and Henry Hughes & Son, Ltd. December 18th.

17,753. Control of Electrical Measuring Instruments. M. J. E. Tilney and N. C. F Jensen. December 20th.

17,895. Gyroscopically-controlled Torpedoes and Launching Tubes therefor. Crucible Steel Co. of America. December 22nd. (April 3rd, 1915.)

17,897. Automobile Torpedoes and Launching Tubes for use therewith. Crucible Steel Co. of America. December 22nd. (April 3rd, 1915.)

17,923. Automatic Train-stopping Devices. A. L. Lyttle & G. I. Costello. December 22nd.

17,954. Means for Controlling the Speed of a Machine. Marconi's Wireless Telegraph Co. & C. S. Franklin. December 23rd.

1916.

The numbers in brackets are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

9. Railway Signalling. H. W. Firth & F. W. Leake. January 3rd, 1916 [102,509.]

385. Electric Indicators. R. E. H. Lovelace and Ediswan & Swan United Electric Light Co. January 8th, 1916. [102,629.]

956. Process for obtaining Solid Products of Condensation from Phenols, Formaldehyde, and Salts of Sulpho-acids. K. Tarassoff & P. Schestakoff. January 20th, 1916. [102,635.]

1,597. Radio-telegraphy. J. Bethenod & E. Girardeau. February 2nd, 1915. [100,058.]

1,920. Thermostats. C. E. Hearson. February 9th, 1916. [102,538.]

2,541. Arc Light Carbons and methods of manufacturing the same. R. D. Pike. February 21st, 1916. [102,645.]

2,641. Projector Arc Lamp. J. Brockie and Johnson & Phillips. February 22nd, 1916. [102,647.]

2,697. Automatic Electric for Signals. W. A. Jeboult & H. S. Stobart. February 23rd, 1916. [102,649.]

3,922. Automatically-operating and Switch for Machine Switching Telephone Systems and the like. Western Electric Co. & J. G. Hackley. March 16th, 1916. [102,655.]

4,683. Quick-break Electric Coupling Members. W. T. Henley's Telegraph Works Co. & E. E. Judge. March 30th, 1916. [102,662.]

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THE
ELECTRICAL REVIEW.

Vol. LXXX. JANUARY 26, 1917. No. 2,044.

ELECTRICAL REVIEW.

Vol. LXXX.] **CONTENTS**: January 26, 1917. [No. 2,044.

Page
Trade Organisation... 85
British Electrical Exports and Imports during 1916 87
The Rating of an Electric Lighting Station 87
The Education of Engineers 87
Some Considerations Affecting the Use of Electricity in Agriculture (*illus.*) (*continued*) 88
The Faraday Society (*illus.*) 89
Principles Involved in Computing the Depreciation of Plant, by F. Gill and W. W. Cook (*concluded*) 91
New Electrical Devices, Fittings and Plant (*illus.*) 94
Correspondence—
  The Position of Shift Engineers after the War 95
  Source of Error in Thermometry 95
  Localising a Fault 96
  City and Guilds Examinations 96
Legal 96
War Items 97
Business Notes 98
Notes... 102
City Notes 105
Stocks and Shares 106
Exports and Imports of Electrical Goods during Dec., 1916 ... 107
Electrical Exports and Imports during 1916 and Previous Years (*illus.*) 108
Trade after the War 111
Import Trade of Ceylon 112
New Patents Applied for, 1917 112
Abstracts of Published Specifications 112
Contractors' Column ... ... Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. *Established 1872.*

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE 1—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "Agbekay, London." Code, A B C.
Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 6d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

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Wellington, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to The Electrical Review, and crossed "London City and Midland Bank, Newgate Street Branch."

THE "ELECTRICAL REVIEW'S"
ELECTRICAL & ALLIED TRADES DIRECTORY
(THE RED BOOK),

1917 EDITION,

IN PREPARATION.

H. ALABASTER, GATEHOUSE & CO.,
4, Ludgate Hill, London, E.C.

TRADE ORGANISATION.

During the past two years a vast amount of attention has been devoted to the question of national industrial organisation. There have been luncheons and conferences, lectures and negotiations, all designed to further movements in that connection. How far have all these efforts been successful in bringing the industries of the country into one fully representative body armed with authority and information to enable it to speak on behalf of industry as a whole? There is a feeling that, notwithstanding all that has been done, there is still something wanting.

As we have ventured to suggest for a long time past, strong trade associations are necessary to which the Government can turn for information regarding particular trades, but we should like to feel that our negotiations and conferences gave better promise of an actual Parliament of Industry in which all our national industries had their seats occupied by duly accredited representatives of Capital, Labour, and Industry. It would be so much more satisfactory for the Government to be able to turn with confidence to a truly national and representative body when it needed guidance in regard to large industrial policy. We are sure that Mr. Neville Chamberlain must have thought so in the course of his National Service investigation and preparation. At present the Government is able in some cases to depend upon the co-operation of a number of specialised and more or less representative trade associations, but some of the industries have not one coherent body qualified to speak on their behalf, and only a comparatively few of the associations which are in existence are co-ordinated in their operations. The war has demonstrated the need for trade associations to foster and develop particular departments of industry, and as was shown in our pages at the time, Mr. Asquith last year gave Governmental approval to this aspect of the organisation idea. We may be pretty confident that the Lloyd George Government will not be less in favour of our industrial house being set in order along these lines, for between now and the end of the war, as well as in the years following, all sorts of questions will be bound to arise in connection with which it will be necessary for the State to consult those responsible for the conduct of our great industries, whether as capitalists or as workers.

The call for organisation of trades, or, more properly, industries, was voiced once more last week in a lecture at the London School of Economics. The audience was not one of manufacturers, so the treatment of the subject necessarily had to follow more or less general lines which to us and our readers would not be at all unfamiliar. One of the ways in which the lecturer (Mr. E. J. P. Benn) seems to us to differ from other speakers when dealing with this matter is in his discounting all efforts that have been made during the last two years. We confess to feeling a little disappointment that the comprehensive super-organisation of all great industries has not emerged by now, but we are not inclined to agree with him that "Chambers of Commerce, federations of industry, and other similar bodies . . . . live almost entirely upon politics," nor can we quite agree that "their existence depends upon the tariff agitation," though in some cases we know that it does do so. Yet we cannot see why, even if they do so depend, they should have "no place in the serious study of the development of trade efficiency or the increase of national output." In other places at least one of the federated organisations (which was represented at Mr. Chamberlain's Birmingham meeting last Saturday) has been attacked because it is *not* outspokenly protectionist. We do not believe that either Mr. Benn on the one hand, or the daily Press on the other, assists the organisation movement by dragging in fiscal controversies. It seems to us that Mr. Benn wants us to start *de novo*, as though all the great industrial negotiations of the past two years were so much serious effort thrown away, and he would have us face the fiscal question as though there had been no war with Germany, in which connection we have no fears whatever that he will be able to carry the nation with him. Not only does it seem to us that Mr. Benn wants us to start *de novo* in regard to our organisation efforts, but he expresses views which might be more in keeping with a state of things which would exist if we were at the *beginning of industry* instead of having reached the advanced and complex industrial position in which we stand to-day. His desire is that every workman and workwoman should be a member of a trade union; that every manufacturer should be a member of a trade association; that from the trade unions and trade associations in a given industry there should be elected representatives to sit in a Trade Council; that from these Trade Councils there should be elected a National Trades Council with a member of the Government at its head, whose duty it would be to promote the trading interests of the country, and that in this way the Government should recognise and control both parties in industry. The Government must demand of the unions that they abandon their independent and irresponsible attitude, and it must demand of the masters' associations that they give up those elements which are contrary to the public interests.

The trade association idea is preferred to the trust or amalgamation tendency, because it would keep the little man in being. The little man is described as a "tremendous" asset in trade, for, somehow or other not explained, he is "essentially British." His only trouble as seen by Mr. Benn is that he *will* devote his energies to fighting other little men "instead of joining with them in an effort to fight the battles of the nation, and to improve himself and his industry." In passing, we may say that we were not aware that it was only the *little* man who fought his competitors, but we fully agree that "if we can get the advantages of amalgamation or united action without destroying the little man we shall be better off." How are we to proceed in order to reach this very desirable end when the "little men" have to meet in competition Teutonic trusts with anywhere between £10,000,000 and £15,000,000 capital? Here by a stroke of the pen we have it. Let us, he says, organise our little man, let us arrange his work for him, "force" him to specialise on some one little part of the trade in which he is engaged, then we shall "secure the advantages of economical production, which is the main asset of the trust or combine." Now this is essentially a matter for manufacturers, and for those who have built up our industries with individual enterprise and capital; it is certainly not a new one for discussion among electrical manufacturers. Would newcomers ever be admitted to an industry? If so, would they be told what they must manufacture? Could we call this freedom from restraint of trade or of industrial enterprise? We hardly know which idea we prefer—that of the trust or that of the trade association in which cooperation *cum* compulsion is the ruling principle. Can it be supposed that the latter is an attractive policy wherewith to induce every manufacturer to become a member of a trade organisation? To effect it would certainly call for a Government which was prepared to impose compulsion upon industry all round, and with an iron hand. How can it be effected otherwise in this very human world—except at a School of Economics? Its only chance of succeeding is through negotiation, and, if you will, "peaceful suasion" within the ranks of an industry itself. Mr. Benn's ideas may sound attractive enough at a homely gathering at the London School of Economics where there is a lecture but no following discussion: they may be applicable, too, in respect of bedsteads or of boots, but our concern is more with the electrical and engineering industries, and the possible application of those ideas thereto in this year of grace nineteen hundred and seventeen. When the lecturer refers to the iniquities of the "stupid competitive system" which forces every manufacturer to attempt to cover the whole of his trade, and thus waste half of his energies, we incline to the view that he over-states his case—unless he has boots and bedsteads in his mind. The application of the principle of co-operation is already at work in some trades, among them the electrical, and we believe it will grow spontaneously or by judicious fostering rather than by *forcing*.

We are sorry that the space at our disposal prevents us from following Mr. Benn through many other parts of his lecture. The whole discourse is a very interesting, though ambitious, one, for we agree with him that "trade is a very large subject, far too complex for any one mind to grasp properly," "one can very easily become lost in detail." After all, the specialists in each trade must know their own problems best, wherever the State comes in to promote their organisation under its protection.

We confess to a little confusion arising in our minds as we consider some of the lecturer's remarks. For example, we cannot quite see what sewers and cemeteries have to do with "trade," at any rate, in the way he uses them. That they are essential, as trade is, for our well-being, goes without saying, but is it suggested that we now give less attention to trade than we do to local government because there are thousands of local authorities? If so, then surely he means that in the multitude of organisations there must be strength and wisdom! He says: "There are 28,678 local authorities in the United Kingdom to attend to sewers, cemeteries, street lights, and other such details. Surely trade is worth at least as much attention." But, surely, we have more than 28,678 factories, works, firms, associations, and organisations looking after trade!

We are entirely at one with Mr. Benn when he argues in favour of more enterprising and cooperative effort on the part of traders in the capturing of trade abroad; but this is an old story in the electrical and engineering world. "Every trade must present a united front to foreign competition," and the "small man" who cannot afford to cover the markets with business-getting men of the right type on his own account knows quite well that if he have the mind to do so he can secure his share in competition with the foreigner by acting in cooperative groups, whether consisting of half-a-dozen different sections of his particular industry or of half-a-dozen individual firms in his own particular section. It is partly because the Teutonic trusts have been so wealthy that they have been able to cover the world markets so efficiently with capable representatives, and have been able to secure the spoils. In some of the coming markets of the world they may repeat their performances if we are content to act in such matters individually as "small men," however much the latter may be "forced" to alter their lines of manufacture in the interests of economical production.

Dr. Heath, of the Advisory Council, in congratulating Mr. Benn on the plainness with which he had expressed his opinions, told us that for the securing of Government grants for industrial research representative trade associations were essential, and that associations which desired to secure these grants would have to be representative of the employers, of the workers, and of men of science. It is along these lines, then, that we must proceed to develop and adapt our associations, though, of course, there are many other things besides research grants—important as these are—for which they exist.

British Electrical Exports and Imports during 1916.

Readers who are interested in trade statistics will view with interest the graphic summary of our electrical export and import business during the last few years, which we publish elsewhere in this issue. Attention may be drawn, amongst other things, to the gratifying improvement in export values during the past year, despite the many obvious difficulties of overseas trade; to the important position now occupied by France as a purchaser of British electrical goods; to the growth of Dutch lamp imports into this country, the value of such imports during the year having considerably exceeded £300,000; and to the growing activity of the Japanese electrical industry, as represented by the rising values of Japanese material imported into this country, and the competitive power which this portends in other more accessible directions.

Although the importation of American electrical goods continued on a large scale, comparable with German business before the war, yet there appears to be a tendency to a falling-off in values, which we hope may be due to other causes than merely official restrictions. On the whole, we have good reason to be proud of the result of our efforts during the year, which, in addition to rendering material assistance to allied and more nearly related countries at a critical time, have no doubt helped to augment the "silver bullets" which represent victory in the field.

The Rating of an Electric Lighting Station.

In the recent case of the Clones Electric Lighting Co. *v.* Commissioner of Valuation, which was heard at Monaghan on January 18th, Judge Johnston, sitting as Recorder at Quarter Sessions, heard an appeal from the Commissioner of Valuation. The case related to the valuation of the Clones electric lighting undertaking, and his Honour, in his judgment, considers some points which are of general interest. As those who have been concerned with the law of rating are aware, the assessment depends upon what an individual known to lawyers as the "hypothetical tenant" would pay for the property as a going concern. In the case of a house, the hypothetical rent is comparatively easy to determine; but who can say off-hand, or even after much computation, what any individual might pay as rent for the property of an electric lighting company? The rateable value of the property of the company in question was recently fixed (for 1915) at £100. In 1914 it had been £25, and the company appealed.

The first question for decision was whether a 112-H.P. gas engine and a 40-H.P. oil engine should be included as part of the rateable property. In England, such machinery would be rateable on the principle laid down in the Tyne Boiler Case, but in Ireland the matter is virtually decided by statute, the Valuation Act, 1860, providing that "motive power . . . shall be valued with the buildings," but that "no machinery shall be taken into account other than that used for the production of motive power." Judge Johnston decided that the engines were rateable; but he also decided—and with his decision we venture respectfully to agree—that the accumulators, dynamos, switchboard, and belting, being mere tenant's fixtures, were not rateable.

Passing on to other questions, he held (applying certain well-known principles) that the rateable value must depend on revenue. It was contended on the part of the appellants that inasmuch as the year 1914 meant a loss to the company, that year should be taken into account when arriving at the profit. The learned judge, however, declined to accept this view, saying that the letting value of the hereditament as it stood was the figure to be ascertained. It was not for him to look back to previous years. He did, however, allow regard to be had to the meter readings of 1916, which made it plain that, as the career of the company was one of increasing prosperity, they were favoured by his having regard only to the revenue of 1915. In the event, he reduced the rateable value from £100 to £75, after pointing out that the "revenue" in contradistinction to the "constructional cost" method of valuation was the right one to adopt in the case of electric lighting companies. Incidentally, it may be mentioned that, in arriving at the gross profits, the appellants sought to be allowed to deduct the rent which they had to pay for the land on which the power station stood. But this was not permitted, because if they had redeemed the rent by an expenditure on capital account that would be treated, for rating purposes, as landlord's capital, and would not carry with it any allowance.

The Education of Engineers.

The Committee appointed by the Manchester Association of Engineers in November, 1914, to consider this subject, recently issued a valuable report, which ought to be in the hands of all employers and educational authorities. Proposals are put forward to bring about closer cooperation between these parties, by the election of representatives of the former by the large technical societies, to form, with an equal number of technical representatives of the local educational authorities, an advisory body to deal with all questions (other than finance) arising in connection with the education of engineering apprentices. The Committee takes the view that in all cases the school or university training must be supplemented by adequate shop training, which cannot be given at a technical school, and must be continuous throughout a definite period. Too early specialisation is deprecated, 14 years being suggested as a suitable age at which to decide upon a boy's future vocation.

Referring particularly to engineering apprentices, the Committee recommends the raising of the minimum age for leaving school to 15 or 16 years, the attainment of a satisfactory standard of education before apprenticeship, and continuity in education by part-time attendance at school up to the age of 17; after attaining that age those who are capable of assimilating advanced technical training should be admitted to a day course (one day per week), the remainder being encouraged to attend evening classes. An important feature of the recommendations is that scholarships should be provided to enable deserving youths in the works, whose behaviour and progress are satisfactory, to obtain further education.

For brevity and lucidity the report is unexcelled, and the recommendations will, we believe, meet with the approval of the vast majority of those who have studied this important subject. The only uncertain element is the attitude of employers towards the proposal that apprentices shall spend two half-days a week at school, with wages, up to the age of 17; but some of our best firms are already working on similar lines, and we believe that the concession would be amply repaid within a short time. Hearty co-operation is again the key to the position.

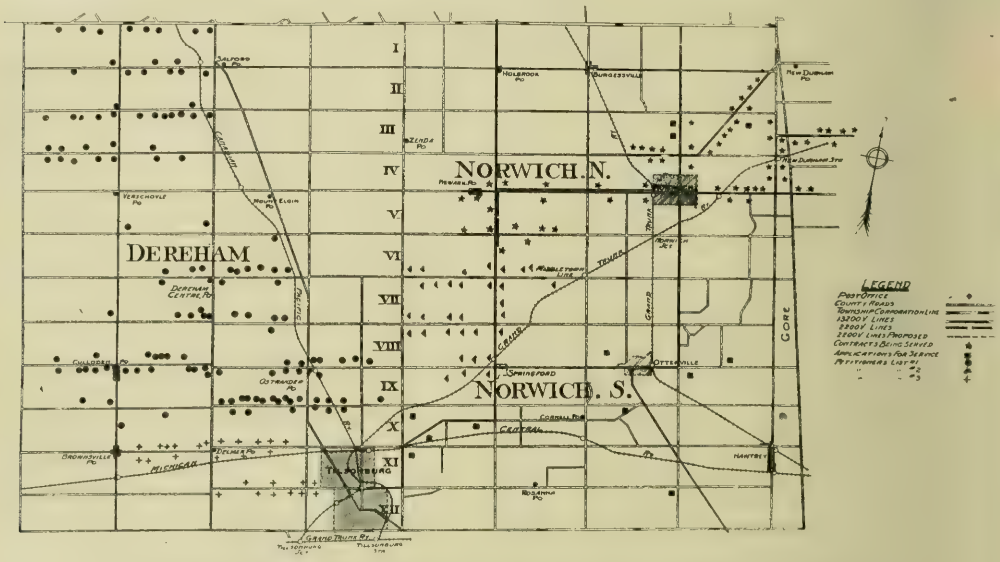
SOME CONSIDERATIONS AFFECTING THE USE OF ELECTRICITY IN AGRICULTURE.

(*Continued from page* 64.)

A QUESTION which will naturally occur to any engineer who studies the broad question of agricultural electrical supply, is as to the possible scope of such business.

Unfortunately, detailed statistical information bearing on farm power does not appear to exist in this country, and in regard to this and other matters it is only possible to make certain deductions from published data.

In our issue of December 3rd, 1915,[*] we published a rough map of the agricultural portions of England, showing the existing supply undertakings which might be utilised in initial attempts to supply the farmers in the area shown. About 160 such generating stations were shown as being in touch with agricultural country; for electrical supply purposes each of these stations can be assumed—as a basis of estimate—to deal with an area 10 miles in diameter, equal to 78½ sq. miles, or, deducting 1½ sq. miles for the built-up area of the town, which is usually not a large one, there is left 77 sq. miles of agricultural country per station. According to the 1906 Census of Production, the number of holdings or farms per 1,000 acres varies from 12 to 14 as between the Eastern and Western English agricultural areas, representing, roughly, 70 to 80 acres per farm, a figure which is probably a fair average, bearing in mind that the small holdings are more numerous in the vicinity of towns. On this basis it will be seen that each of the assumed station areas would contain from 600 to 700 potential farm consumers, in addition to village and private house consumers, possible industrial users and public lighting. Averaged over 160 stations, this represents, roughly, 100,000 potential farm consumers for a small portion only of the country, and, if we can judge by published data regarding farm business here and abroad, each farm would, on the average, be worth at least 30 lamps and 5 H.P. of power to the electric supplier, representing a total of three million lamps and half a million H.P. in the initial stages for the 160 undertakings referred to.



MAP SHOWING PROGRESS IN ELECTRIC SUPPLY TO FARMS IN PART OF OXFORD COUNTY, ONTARIO.

Published data in regard to power actually used on farms are very meagre and, no doubt, misleading at the present time.

For instance, in 1906 it would appear that for the whole of Great Britain some 218,000 H.P. of steam, gas, oil, and other engines was employed, steam, the most wasteful form of power on a farm, accounting for 106,000 H.P., or nearly one-half. The figures do not include temporarily hired engines, which would, no doubt, have greatly increased the total, and it is obvious that in the intervening, and particularly the last two, years a great increase must have occurred in the total.

An interesting feature of the 1906 figures is that only ·4 H.P. was used, on the average, per holding (of 1 acre and above), while in the case of the holdings of 1 to 50-acre size, an average of only ·06 H.P. was used per holding.

It cannot be contended that these figures are any guide to the farmers' possible power requirements, if electrical power were available, as will be gathered from Mr. Kerr's paper[*] on the subject last year; if anything, they are significant of the backward state of the agricultural industry.

In the discussion following the reading of that paper, it was pointed out that Hereford farm consumers paid an average of £25 each for electricity, and on this basis some 2½ millions per annum of additional revenue from farms alone is awaiting the efforts of supply authorities in the 160 central-station areas referred to.

As touching on the traction problem and the possibilities of employing electric tractors, vehicles, and ploughs, it may be noted that there were in 1906 about a million and a-half horses on farms in Great Britain, at least half of which were, no doubt, used for traction purposes.

The work carried out by Mr. Kerr at Hereford demonstrates the feasibility of supplying farms in the vicinity of a country town, but it leaves us to surmise as to the position which might arise if the farm load greatly preponderated over that of the town.

No reliable data, so far as we know, has appeared in reference to a considerable rural supply system, which is strictly applicable to English conditions, and an investigation of the probable load characteristics, and other features of such a system, would be of considerable assistance in connection with the movement for agricultural supply.

An American writer[†] who recently investigated this aspect of the question as regards the Pacific North-Western area of the U.S., pointed out that in the particular undertaking investigated, 37 per cent. of the population served was outside the city limits; this 37 per cent. furnished 38 per cent. of the company's revenue, but required 51 per cent. of the operating expense and gave only 10 per cent. of the operating revenue and about one-third of 1 per cent. of the net operating income. However, it appears that though each class of business is credited with its own operating and financial expense, the rural business is catered for by a cut rate, because it is argued that were it not for the 37 per cent. of rural business the city business would show a less net revenue than it now does, and the rates on the city business would have to be materially increased. It is further argued that such rural business might be justified even if carried on at an apparent loss. The limiting factor is the quantity of rural business which a given city business can profitably support. In this particular case the rural business gave 38 per cent. of the gross revenue, but required 47 per cent. of the total investment, or 9 per cent. more than its share, and incurred additional financial charges to that extent, and the writer in question addresses himself to the problem of overcoming this handicap, believing that the solution will be found in the adoption of new and cheaper standards of construction for such work; wider limits of variation of supply voltage; specially adapted rural rates; and the joint use of pole lines by electric supply and telephone lines—a joint service being practicable in cases where a single service is not on the ground of cost.

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[*] "Electricity in Agriculture; its National Aspects."

[*] "Application of Electricity to Agricultural Purposes"; I.M.E.A. *Proceedings*, 1916.

[†] N.E.L.A. Paper on "Rural Transmission Lines," by A. S. Hall.

In this country, so far as can be judged from experience in farm supply, such consumers would find it profitable to pay a higher rate for energy than the usual town rate, which is often based on the competition of a cheap gas supply which does not extend into the farm areas.

The experience of the Ontario Hydro-Electric Commission in rural supply is important. There are approximately 1,000 rural services on the Ontario system, and of these about 60 per cent. are farms. In the Toronto suburban district there are 200 rural services; in Grantham township, a fruit-growing district, there are 100 rural services; and in North Norwich township, a dairy district, there are over a 100 such services connected and applied for.

Probably due to labour shortage, the Commission had many more inquiries in 1916 for farm power than in previous years, and amongst the large petitions received was one containing 476 names from a particular district.

The Commission will give a service where there are only three consumers per mile; the usual procedure is for the Council of the township to present a petition, signed by would-be consumers, and accompanied by a map showing the location of their farms, to the Commission, which prepares an estimate of cost of lines, and supply, and submits a definite tariff to the Council.

The tariff is then submitted to a meeting of the petitioners, who, if they accept it, must sign the contracts before any construction work is commenced.

The contracts are between consumer and township, and, assuming that sufficient consumers have been secured to warrant the building of a line, the township then contracts with the Commission for a supply of energy.

All primary lines are constructed by the Commission at its own cost, and all secondary construction, including transformers, lines, services of not more than 120 ft. from the main line, meters and cost of installing them, are paid for by the township, whose share of the cost is covered by a debenture issue. The township may operate its own system, but the cheaper way is for the supply station authority to undertake the work, in which case it would collect all consumers' accounts, meet operating expenses, pay to the Commission the amount due for power used, for the annual fixed charges on the township's debentures, and similar charges on the cost of the primary lines.

It should be noted that under this arrangement the farm supply business appears to be on a self-supporting basis, the tariff being based on the cost*, which the Hydro-Electric Commission's extensive experience in this connection should enable it to estimate with considerable accuracy. Actually the rural rate consists of a "service charge" of $3 per month for three consumers per mile; $2·50 for four consumers; or $2 for five consumers, plus a KW.-hour rate for all consumption up to the first 60 hours' use per month of the contract amount, and a charge of one-half this rate for all remaining consumption during the month, the secondary KW.-hour rate being based on the cost of power in the district.

Many consumers wish to install a 5-H.P. motor, but generally use only a 2-H.P. demand, and to meet such cases a consumer with a 2-H.P. contract is allowed to install and operate a 5-H.P. motor with the understanding that the township can install a special meter to indicate excess demand, and charge for it at $1\frac{1}{2}$ times the initial KW.-hour rate.

The following is the approximate cost of farm construction work on the Commission's system:—

Assuming that a three-phase service is carried 600 ft. from the pole-line on the road to the farmer's barn, where the transformers would be located to be near the power site, and that a single-phase lighting service were carried back 300 ft. to the house, the cost would be, roughly, $46. Interior concealed wiring would cost, per outlet (knob and tube), $2-2·5; conduit, $3·5-5; and open wiring, 90 c.-$1·5. The wiring for a house and barn would cost:—

House.—	10 lights on 2 switches, at $2·5 per outlet ...	$30·0
Barn.—	6 lights and 3 switches, at $4·5 per outlet ...	40·5
	Outside light for yard	3·0
	Service entrance	5·0
	17 lamps, at 25 c. each	4·25
	Lines into premises	46·0
	Total	$128·75

The above figures are approximate, and only of interest as showing what the Commission considers should be the cost of this class of work in Ontario.

It should be noted that the Ontario Power Commission Act, 1911, was introduced to facilitate the distribution of electrical energy in rural districts, and the Fifth Annual Report of the Hydro-Electric Power Commission (for 1912) mentions that the response to this in the form of inquiries and petitions was so great, that the Commission carried out a series of demonstrations at exhibitions, fairs, farms, &c., in accessible districts, with a view to educating the farmers.

In addition, several demonstration farms were completely equipped with electric power and lighting. One of the important factors behind this instructional campaign was the desire to improve the load characteristics of this class of business by inducing farmers to so rearrange their work as to improve the electrical load factor, and thus facilitate cheap supply. The absence of a steady flexible supply of power resulted in the farmer reserving all the heavy operations until such time as a steam engine could be hired to do this work in the shortest possible time—a system which can obviously be modified if electric power is continuously available.

(To be continued.)

THE FARADAY SOCIETY.

An Electric Furnace for Testing Firebricks.

At the December meeting of the Faraday Society, Mr. B. A. Griffiths and Mr. Edgar A. Griffiths, of the National Physical Laboratory, exhibited and described a carbon tube furnace which they have recently been using for carrying out a series of tests on the softening points of refractories, and their compressive strengths at furnace temperatures exceeding 1,800 deg. C., properties obviously of the greatest importance in considering the practical value of a new refractory.

A sectional view of the furnace is shown in fig. 1. The $\frac{1}{4}$-in. carbon tube C is of 2 in. outside diameter, and is 11 in. long. A $\frac{1}{4}$-in. slot extends down almost its entire length, to permit of observations of the heated specimen. The tube is encased in a sheet iron casing A, 12 in. diameter, the ends of which are closed with asbestos slate board B B. The thermal insulator consists of crude zirconia powder—an excellent insulator—surrounded by a 3-in. layer of magnesia-asbestos lagging.

A most important feature of a carbon tube furnace is the construction of the electrodes, for any heating caused by the passage of large currents across the metal-carbon junction is fatal. Fig. 2 shows how the electrodes are formed in the present furnace. A copper tube, through which the water for cooling passes, is bent into a zigzag form and white bearing metal cast around it, the mould being formed of strip iron with the carbon tube as core. In this way a perfect fit between metal and carbon is ensured, and with a current of 400 amperes the drop of potential across the contact was barely detectable.

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* We do not know on what basis the power cost is determined in individual cases, but it is obvious that a "cut" rate could be offered, if thought desirable, for development purposes.—Eds. E.R.

Another type of electrode designed for a large 5½-in. crucible furnace is also of sufficient interest to describe here. This is shown in fig. 3. L L are graphite blocks bored to the diameter of the furnace tube. The copper leads M are hollow, and water-cooled. A further contact with the graphite blocks is through the flexible conductor O.

To preserve a neutral atmosphere a stream of nitrogen is passed through the tube, otherwise the carbon is rapidly oxidised. Up to 1,700 deg. C. the furnace is free from volatile carbon compounds. It is of interest to note that the atmosphere in the tube is highly ionised; in fact, currents of several amperes will pass between insulated electrodes having only a few volts potential difference between them. The current is accompanied by the transport of material particles, probably molecular aggregates.

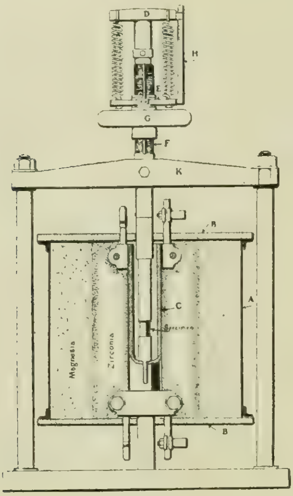


Fig. 1.

Pressure is applied to the specimens under test, which are small cylinders of the refractory material about ⅝ in. diameter and 1 in. long, by means of the plunger arrangement above the furnace, the action of which will be clear from fig. 1. The magnitude of the pressure is read off on the scale H. In the furnace shown, pressures up to 150 lb. per square inch could be applied. The specimen is supported in the furnace on a carbon rod, from which it may be separated if contamination is feared, and a similar rod on top transmits the pressure. Usually three test pieces were taken from a brick, and the results only accepted if concordant. A test took about two and a half hours with a 10 deg. C. increase of temperature per minute.

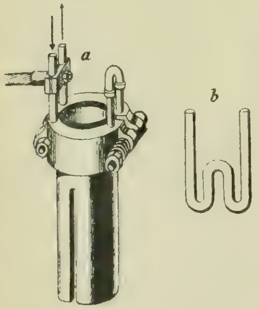


Fig. 2.

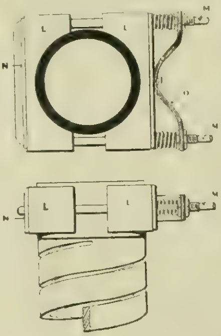


Fig. 3.

Temperatures are measured in this furnace with an optical pyrometer, which sights the specimen through the slot in the furnace tube. Observations are effected by comparison with the field of illumination due to an electric lamp, the instrument being directly calibrated by comparison with a thermocouple under "black-body" conditions. It is possible to attain a temperature of 3,000 deg. C. with the furnace for short periods, but all commercial refractory bricks soften under loads below 1,700 deg.

The tests that have so far been made with the furnace cannot be published at present, but it may be stated that a magnesite brick normally breaks down at 1,500 deg. C. under a pressure of about 30 lb. per sq. in. The authors have placed in the hands of makers and users of refractories an instrument of considerable value.

A Method of Uniting Optical Glass by Heat.

Mr. R. G. Parker and Mr. A. J. Dalladay described a very ingenious method they have devised for uniting together glass surfaces polished plane, or to the same curvature, to a high degree of accuracy. The existing method, that of cementing, has obvious disadvantages, both mechanically and optically, and to do away with the necessity of cement is, as Dr. Rosenheim characterised it, a remarkable achievement. The method, once it is known, is the quintessence of simplicity. The finished surfaces are merely placed together and subjected to carefully-controlled heating, some 80-90 deg. C. below the annealing temperature, when, under slight pressure, complete union takes place, the two pieces become absolutely one, and it is impossible to separate them along the surface of juncture. The possibility of the process probably arises from the fact that glass under slow stresses acts as a highly-viscous liquid, which becomes fairly mobile as the temperature is raised, even very far below the melting range.

The operation is carried out in a platinum-wound electric oval tube furnace, 3½ in. by 2½ in. by 14 in. long, fitted with double silica windows at each end. Two resistances permit of a very close control of temperature, down to ¼ deg. C. per minute, which is measured on a Callendar recorder. An arrangement by which polarised light can be passed through the furnace, so as to examine the effect on the glass or silica under operation of unequal heating, completes the apparatus. The method has been used successfully to construct such apparatus as the cell for a Rayleigh interference refractometer or a polarimeter tube. Up to the present it has, unfortunately, not been found possible to unite two different kinds of glasses, such as the flint and crown used in object glasses, owing to their differences in annealing temperature. Fused silica can, however, be welded by this method.

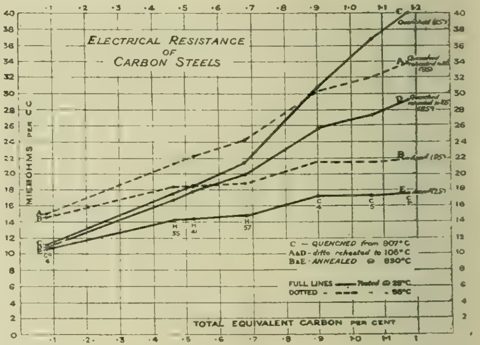


Fig. 4.

The Resistance of Iron and its Chemical Composition.

Prof. E. D. Campbell, of the University of Michigan, presented a paper, which was read by Sir Robert Hadfield, entitled "Do Equiatomic Solutions in Iron Possess Equal Resistances?" The conception of steel as a solid solution long ago suggested a relationship between its chemical composition and its resistance, and Benedicks, in 1902, put forward his well-known rule that equiatomic solid solutions in iron possess equal resistances. This relation was based on certain assumptions, which need not detain us now, that the experimental work of Arnold has shown to be untenable, and the object of the experiments described by Prof. Campbell was to see whether it might not be possible to suggest a more satisfactory hypothesis to explain the relation between carbon-concentration and resistance of heat-treated steels. The experiments were made on seven steels of various compositions in both the hardened and annealed states, the heat treatment being carried out in a small electrically-heated furnace on bars 6 mm. square and 15 cm. long. The specific resistances were measured at 25 deg. C. and at 95 deg. C., maintained by means of an oil bath, and were determined by measuring the fall of potential between knife edges clamped to the bar 10 cm. apart, a constant current flowing through the bar. The experimental results are embodied in the accompanying curves (fig. 4). It is at once obvious that different amounts of influence are produced in the specific resistance by equiatomic concentrations of carbon. On taking into consideration, however, the amount of iron carbide present, Prof. Campbell concludes that what determines the deviation of resistance from that of pure iron is the *molecular* concentration of the *carbides* in solid solution, and not the *atomic* concentration of the *carbon*, and he puts forward this hypothesis for consideration and experimental confirmation. One striking point to be noted in these results is the almost constant value of the absolute increase in specific resistance with increased temperature, at which the specific resistance is measured, this increase differing very slightly from that of pure iron. These results would indicate that this increase in specific resistance with increased temperature is wholly due to the increase in specific resistance of the solvent, while that component of the total specific resistance due to the solutes in solid solution is very slightly, if at all, affected by the temperature at which the specific measurements are made.

The following papers were also read:—"Grain Growth in Deformed and Annealed Low-carbon Steel," sent in by Mr. **Ralph H. Sherry**, of Detroit, who explains in it the conditions under which this undesirable grain growth occurs; and "The Effect of Pressure on the Equilibrium Constant of a Reaction in a Dilute Solution," presented by Prof. W. C. McCullagh Lewis, of the University of Liverpool. This paper indicates a simple mode of deducing the effect of external pressure on the equilibrium constant of a reaction in dilute solution.

It was announced that general discussion on the following subjects were in course of arrangement:—"The Training and Work of the Chemical Engineer," "Osmotic Pressure," and "The Physical Chemistry of the Setting of Cements and Plasters." The first of these will be held in February, and will be opened by Sir George Beilby, F.R.S.

PRINCIPLES INVOLVED IN COMPUTING THE DEPRECIATION OF PLANT.

By F. GILL and W. W. COOK, Members I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

(*Concluded from page* 83.)

Value of Plant in Place at any Time.

The engineer controlling a system must be able not only to know the annual charges on each kind of plant, but also to estimate the value remaining in the plant at any time.

In considering extensions of plant, or the adoption of improved plant, it frequently happens that the question arises whether it is economical to take out certain plant still performing satisfactorily the service it is adapted to, and replace it by new plant of a more economical nature. If the existing plant is taken out, there will be a wastage of its then value in place, plus the cost of taking it out and less the amount received for the recovered materials, the net result of this being a present loss when the change is made. Against this loss there is to be set any economy in annual charges that may be gained by the new plant during the period which would have remained of the displaced plant's life. Further, since the wastage must be incurred when the change is made, while the prospective savings are in the future, the two sums must be brought to a common time for comparison; in fact, the problem is to find out if it is worth while to incur a present loss to achieve a future gain.

Unless the new plant will thus pay for the wastage, or unless there are compelling reasons which require the change irrespective of economy, the change should not be made.

If the first cost and the annual charges have been rightly estimated, the diminution in value is the amount which should be in the renewals fund, for that was the very purpose of the fund. That is, the first cost less the amount which should be in the fund is the measure of the remaining value.

One easy way to test the equity of the value in place produced by the alternative methods used in treating depreciation is to examine how each would result if an undertaking passed successively to several owners, on the basis of the remaining value being the first cost less the amount which should be in the renewals fund.

In this case, as already shown, the life concerned is not the economic life, but the physical life, so that in calculating the following tables we must take the physical life of 25 years, and the residual value, at the end of life, at £2.

Assume that an original owner whose conditions are set out in Table II (5 per cent. sinking fund), to whom the user of the plant pays £7.05 per annum, sells at the end of the eighth year on the basis of this table. He will then sell for £100 less £19.61 (the amount in the fund). = £80.39.

This second owner's conditions will then be: Capital £80.39, remaining life 17 years, residual value £2, other conditions as before, and the table shows these figures for the next eight years.

If the second owner transfers to a third owner at the end of the 16th year, on the same basis, he will then sell for £80.39 less £28.97 = £51.42.

The third owner's conditions will then be: Capital £51.42, remaining life nine years, residual value £2, other conditions as before, and the financial result is shown in the table.

If the third owner transfers to a fourth at the end of the 24th year, on the same basis, he will sell for £51.42 less £42.8 = £8.62.

This last owner's conditions will then be: Capital £8.62, remaining life one year, residual value £2, other conditions as before, and the table shows his position.

This last owner finds £2 from sale of materials and £6.62 from his renewals, and thus gets back the money he had invested.

TABLE II (Abbreviated).—Value of Plant in Place.

Sinking-Fund Method.

A End of year In different ownerships.	In plant's life.	B Capital.	C Return on capital 5 % p.a.	D Renewals fund.	E Total C + D.	G Total in renewals fund.	H Value of plant, in place, B G.	L Per cent. return on capital.
First owner.		£	£	£	£	£	£	
1	1	100·00	5·00	2·05	7·05	2·05	97·95	5
8	8	100·00	5·00	2·05	7·05	19·61	80·39	5
Second owner.								
1	9	80·39	4·02	3·03	7·05	3·03	77·36	5
8	16	80·39	4·02	3·03	7·05	28·97	51·42	5
Third owner.								
1	17	51·42	2·57	4·48	7·05	4·48	46·94	5
8	24	51·42	2·57	4·48	7·05	42·80	8·62	5
Fourth owner.								
1	25	8·62	0·43	6·62	7·05	6·62	2·00	5

TABLE III (Abbreviated).—Value of Plant in Place.

Straight-Line Method.

A End of year In different ownerships.	In plant's life.	B Capital.	C Return on capital 5% p.a.	D Renewals fund.	E Total C + D.	F Balance to equalise 1st owner's annual charge of £8·92 p.a.	G Total in renewals fund.	H Value of plant in place, B − G.	J Interest on fund.	K Total return C+F+J.	L Per cent. return on capital.	M Average per cent. return on capital.
First owner.		£	£	£	£	£	£	£	£	£		
1	1	100·00	5·00	3·92	8·92	—	3·92	96·08	—	5·00	5·00	5·69
8	8	100·00	5·00	3·92	8·92		31·36	68·64	1·37	6·37	6·37	
Second owner.												
1	9	68·64	3·43	3·92	7·35	1·57	3·92	64·72	—	5·00	7·28	8·28
8	16	68·64	3·43	3·92	7·35	1·57	31·36	37·28	1·37	6·37	9·28	
Third owner.												
1	17	37·28	1·86	3·92	5·78	3·14	3·92	33·36	—	5·00	13·41	15·26
8	24	37·28	1·86	3·92	5·78	3·14	31·36	5·92	1·37	6·37	17·09	
Fourth owner.												
1	25	5·92	0·30	3·92	4·22	4·70	3·92	2·00	—	5·00	84·46	84·46

It is true that the portion of the annual charge allocated in this example to renewals becomes larger each year, being for the case under consideration, £2.05, £3.03, £4.48, and £6.62; but that is only one part of the transaction, and the increase is exactly counterbalanced by the reduction of the charge in respect of return on capital, in this case, £5, £4 02, £2.57, and £0.43. It will be observed that each successive owner has taken over the plant at what it would have stood at, had part of the capital been paid back each year on the annuity method.

Thus each successive owner has had the same plant, the same annual charge, and has got back all his capital at the end of his term.

Now contrast what happens under the straight-line law, the annual rental remaining constant at the amount fixed by the first year's annual charge. The figures used are shown in Table III.

The first owner's conditions are: First cost £100, life 25 years, residual value £2. He charges the plant with £8.92 per annum, and has the plant for eight years. During that time the money he receives, together with the interest earned by the renewals fund, which is not credited to its source, *i.e.*, the plant account, is sufficient to enable him to pay a return on his capital increasing from 5 to 6.37 per cent.

He then sells on the basis of this table at £100 less £31.36 = £68.64, and thus, with what is in his renewals funds, his capital is repaid.

The second owner's conditions are: First cost £68.64, residual value £2, remaining life 17 years, and the table shows the figures for the next eight years.

Here it is seen that the annual charges for the second owner consisting of the Return, column C, plus the Renewals, column D, fall short of the total for the original owner by £1.57, and this is available with the interest earned by the fund to give a total return on the capital increasing from 7.28 per cent. per annum in the ninth year to £9.28 per cent. per annum in the 16th year.

If the second owner transfers to a third at the end of the 16th year, he will sell for £37.28 (£68.64 − £31.36), and the conditions for this owner will be: First cost £37.28, residual value £2, remaining life nine years, and the result is shown in the table.

The balance here, column E, is greater than before, and the total return on the capital increases from 13.41 per cent. to 17.09 per cent. per annum.

If the third owner transfers to a fourth at the end of the 24th year, he will sell for £5.92 (= £37.28 − £31.36), and the last owner's conditions will be: First cost £5.92, residual value £2, remaining life one year, and his position is shown in the table.

This last owner gets £2 for the residual value, which with £3.92 in the renewals fund repays his capital, and the total return on his capital is 84.64 per cent. per annum.

Thus each successive owner has had the same plant, and has got back all the capital invested, but each successive owner has received a higher percentage return on the capital invested than any of the previous owners.

It may be argued that the amount of profit an owner can make has nothing to do with the value of the plant, and this is true. In the above cases the relative profits under the same conditions have merely been used to test whether the price at which the plant is valued seems a fair one or not.

When one finds that, on the one hand, when interest is brought into the transaction, there is absolute equality as between various years or various owners, and, on the other hand, when interest is not brought in, the successive year or successive owner is always progressively favoured, one has good ground for the conclusion that all is not right with the method of valuation which neglects interest on the renewals fund payments.

Equated Lives for Plant.

In treating a case in which there are various lives, it does not appear to be well known that the average life obtained in the usual manner of getting a weighted average is an erroneous figure to use in calculations for redemption of money. The late Mr. Robert Hammond referred to this in his paper on "Depreciation."

If we take a plant consisting of three classes of articles having different first costs and lives as shown below, we find that the average life is seven years, obtained as follows:—

	Amount. £	Life in years.	£ × years.
Class A … … …	300	10	3,000
Class B … … …	200	5	1,000
Class C … … …	100	2	200
	600		4,200

Total average life 4,200/600 7 years.

But in the complete cycle of 10 years the money actually involved will be:—

	£	£
Class A, one renewal … …	= 300 × 1 =	300
Class B, two renewals … …	= 200 × 2 =	400
Class C, five renewals … …	= 100 × 5 =	500
		1,200

and therefore the figures should be, if interest be not added to the fund:—

	Amount. £	Life in years.	£ × years.
Class A … … …	300	10	3,000
Class B … … …	400	5	2,000
Class C … … …	500	2	1,000
	1,200		6,000

Equated life = 6,000/1,200 = 5 years.

One usual way of calculating this equated life, *i.e.*, without interest, is to divide the first cost by the sum of the annual instalments.

If, on the other hand, interest (say 5 per cent. per annum) is added to the renewals fund, the calculation will give 4.95 years as the equated life.

If an average life of seven years is taken for calculating the provision, the actual deficit will be £1,200 − 857 = £343 in the 10 years.

From this example it will be seen that there is a great danger if the difference between average and equated lives is not appreciated. The equated life is always shorter than the average life. Provision for a complex plant can only be made either by providing separately for each part and summating the annual payments, or by using the correct equated life and treating the plant as a whole.

When, however, a sub-division of plant having the same general characteristics is considered, the average lives or ages may safely be used.

In some cases the life of plant is limited by the units of work performed rather than by time. One example of this is a tool such as a lathe or press; another is a locomotive. Such things do not wear out by the passage of time, but by the work which is done by them, and it would be wrong to estimate the life of such a thing merely in years irrespective of work.

The question arises, how the proper charge per unit of work is to be arrived at, since in some cases there must be found the correct amount to be charged to each job for the use of a tool or machine.

In such a case, time, *i.e.*, the physical and economic lives, must be brought into the calculation, and one is bound to estimate a period during which the units of work will be performed in order not to ignore the fact that the payment for depreciation is made in advance of the money being actually required, and therefore interest must accrue.

Constant Maintenance Cost.

It was assumed above that the maintenance cost would be constant throughout the life of the plant, and it is necessary to return to this question.

The renewal of each part, as it is required in its turn, is provided for by the fund established on the basis of the equated physical life. The cost of maintenance is the cost of looking after the plant, keeping it in running order, repairs, keeping records and inspections, but not of making renewals.

Sometimes in practice it is found more convenient to charge small renewals to maintenance rather than to renewals account, but that convenience does not affect the question of fact.

We believe that constant maintenance cost, if full provision is made for renewals, is a tenable assumption.

In the case of telephone plant, careful investigation failed altogether to detect any increase in the cost of maintenance with advancing age, and so far we know of no data showing increasing cost apart from renewals.

Some advocates of the straight-line method say that the interest on the depreciation fund is required to offset this alleged increasing charge.

If there are cases of maintenance cost increasing with age, this increasing cost must, of course, be met, and any such cases will doubtless have well determined cost data, but the provision should be made directly, and not indirectly. It would be curious indeed if on all classes of plant the increasing cost of maintenance were just the amount provided by interest at varying rates, compounded over various periods.

Assessment of Profits.

The amount to be charged to depreciation, or, as we prefer to put it, to renewals fund and to improvements fund, before assessing the profits of an undertaking, is the total amount indicated by the portion of the annual charges allotted to those costs. The correctness of the annual charges has already been discussed, and when these have been settled, then the charge against the year's income for renewals and improvements must follow in principle that settlement, subject to any alteration of fact which later knowledge may have brought to light. But this does not permit of any change in the method.

If the sinking fund method is correct for the annual charges, it must also be correct for the year's accounts; otherwise, the annual charges are not true, and if they are not true, the primary object of ascertaining the annual charges—to select plant wisely—is vitiated.

The accountant cannot logically at this stage question the correctness of the charge; he may honour the bill or not, may put away more or less than the correct sum as given by the annual charges, but this sum remains the true measure of the year's debit against the undertaking.

Reserves Invested in the Business.

Up to the present one assumption has been that the capital account was closed and, therefore, the reserve funds could only be lent outside. But for many purposes it is more convenient to invest these reserves in the business itself rather than to lend them outside and raise fresh capital for the extension of the business. There is no difference in principle whether the reserve be lent outside or invested in the business; in either case the money must earn interest, and the interest must be credited to its real source.

Conclusions.

There is only one common method for the financier, the accountant, and the engineer. This common method is best studied in the annual charges for plant, determined in advance of construction.

To determine the amount in the annual charges for depreciation it is necessary to estimate the first cost, residual values, and the physical and economic lives of the various classes of plant. It is also necessary to fix the treatment of the capital account and to estimate the charge for return on capital.

The interest to be earned by the reserve funds must be credited to its source.

The reserves are preferably handled by means of two funds, as follows:—

(*a*) A renewals fund for providing the necessary money at the end of the physical life, that is, the end of the period during which the plant will give its service satisfactorily under all conditions *outside* the owner's control.

(*b*) An improvements fund for providing sufficient additional money to enable the plant to be taken out of commission for reasons *within* the owner's control, and while it is still giving its service satisfactorily.

The calculation of the amounts to be contributed to these two funds must include the interest which should be earned by the money before it is required at the end of the life.

The amount, calculated as above, which should be in the renewals fund gives the correct diminution in value, when considering the value to the owner, of the plant in place and working, at any period in its history.

The amounts, calculated as above, which should annually be put to the two funds, renewals and improvements, determine the correct depreciation charge against the undertaking for the purpose of assessing profits, fixing rates, and, under certain conditions, assessing the value of an undertaking as a going concern.

The sinking-fund method fulfils all the requirements.

The straight-line method does not.

All estimates, such as first cost, physical and economic lives, and interest earned by funds, will require revision from time to time either as a result of experience or of changes in conditions.

Discussion in Yorkshire.

The paper was read by Mr. Cook and discussed at a meeting of the Yorkshire Section of the I.E.E. on Wednesday, January 10th.

Mr. Stansfield (Yorkshire Electric Power Co.) said he feared that the authors had not taken into account the difficulties which the accountant must meet and overcome, and those which had to be encountered and overcome by the business-man, who had to make the undertaking a success. Accountants had particular opportunities of observing the methods of those in authority, and appreciating the reasons for the somewhat rough-and-ready methods adopted. In considering depreciation, they must remember that the primary necessity was to obtain business, and that they were forced to deal with depreciation according to the year's working. Directors, shareholders, and councillors did not concern themselves very much with rates and methods of depreciation, and engineers and accountants alike had in the end to adopt methods as little complicated as possible. Competition had to be faced. The maintenance method, the first one to be thrown overboard by the authors, was the policy pursued by railway companies with enormous capital and plant, and though this was, perhaps, not theoretically sound, there must be something in it, because the railway companies had not gone into liquidation. He agreed with the authors' objection to the reducing method, because during the earlier years the plant would not earn so much as in later years, and profits would not be such as to provide a sufficient surplus for depreciation. In regard to the straight-line method, it must be assumed that its advocates had thought it out, even if the advantages of the system did not seem to be capable of demonstration. It appeared to him that the sinking-fund method required very elaborate book-keeping. If it was to be consistently adhered to, the life of each important piece of plant would have to be dealt with separately. That was an important point when the supreme powers came to have their say in the matter. He agreed with the authors that the objection to the sinking-fund method on the ground that it must be unfair either to the buyer or the seller was absurd. Undertakings were not run for the purpose of being sold. It could safely be employed on the repayment of money either by equated or regular payments. Then there was a time period within which it must be repaid. It could be used for life assurance, because the period of life could be averaged, but it was a very different matter to deal with plants whose life could only be estimated, and where they could only depreciate in accordance with the amount of profit which had been made.

Mr. Whittaker (Borough Treasurer of Wakefield) said he had been struck with the fact that the authors appeared to regard maintenance as a standing charge; however the plant might be depreciated in the future, the same amount of maintenance was to be charged to revenue each year. He had found that the maintenance charges on the Halifax plant had increased year by year, and he had, to a large extent, adopted the straight-line method. The paper had opened his eyes in the matter of the improvements fund. He had not heard that side of the matter raised before, and it seemed to him there was something in it. At the same time, it was very largely a matter of having the ratepayers to consider.

Mr. Mitchell (Deputy City Treasurer of Leeds) said it appeared to him that if the sinking-fund period, as determined by authority, was the correct one, nothing more need be done in the way of providing for depreciation than providing for the reduction of the debt within the period. If it were proved that any other sums were necessary in order to provide for improvement, it was proof positive that the sinking-fund period had been too long, and if that were proved, local authorities would be well advised to shorten the loan period and set up a sinking fund.

Mr. W. Lang thought Mr. Cook would be disappointed to find that the matter was discussed so largely from the point of view of expediency, because it should not end with that. There were, however, many factors to be taken into account which were not mentioned in the paper at all. There was, for example, the rise and fall of the bank-rate. That was quite a material item in relation to depreciation of very large undertakings, where money was put in a sinking fund, and was not available for very urgent repair work, or renewals or extension work which could not be delayed.

Mr. J. E. Storr said he disagreed with the authors' statement that depreciation should be included in the annual charges of all plant, seeing that depreciation was defined as including the improvement or replacement of obsolete plant. That conclusion should be modified, because at least a third of the electrical plant assets were not subject to obsolescence.

Mr. Walton (accountant, of Leeds) objected to the sinking-fund method on the ground of the difficulty in getting business men to give attention to anything so complicated. It was only by the straight-line method and the reducing method that business men could be got to appreciate the true effect of depreciation. He always recommended the reducing balances method.

Mr. W. M. Selvey said it appeared to him that in the case of a company whose stock or shares were equivalent to a gilt-edged security every method, however theoretical, which could be adopted to define accurately the exact financial position of a concern should be adopted. But the bulk of businesses could not be so described, and what the man in a speculative kind of business wanted to know was not what his capital was, but what he turned over, and what he made on it. He did not want to know what he was worth until he wanted to turn it into a limited liability company, and then he found he was worth a great deal more than he had ever imagined! As to a company that was in the stage of developing, there was a certain sort of value called goodwill, which could not be called capital, and in regard to which the argument was that it was not only legitimate, but necessary to draw on that goodwill in a sense by not placing to depreciation a certain amount of the gross profits in any particular year, because of the necessity of keeping up the face value of the actual shareholders' capital. The goodwill in a long-established company was practically written off, inasmuch as it appeared as a reserve fund, which was drawn on in case of necessity in order to keep up the perfectly steady depreciation which must be set aside if the actual financial position of a company was to be accurately ascertained. When the company reached that stage the most perfect theoretical method available must be applied.

The Chairman (Mr. T. Roles) said the paper had been a most useful one to engineers. In Bradford, the Corporation paid back an equal amount of capital yearly, so that the interest on capital should be a varying amount. The loan terms were shorter than they had been in many other places, and, whatever the earlier engineers might have thought about it, that had proved fortunate for those who had followed. In the early stages, in addition to the sinking fund, a certain amount was set aside for depreciation, and after about 15 years that amounted to a considerable sum. It was then decided that the whole of the books should be handed over to the city treasurer, and he took the whole of the depreciation from the various assets, and made an appropriation fund. The fund had largely been used as an improvement fund, and the present consumers were very much indebted to the original consumers for providing this money, because it had enabled the Electricity Committee to effect very considerable improvements in plant, and to scrap plant which would otherwise have had to be used because additional money could not be borrowed. It appeared to him that the great point brought out by the authors was that depreciation should be divided into two parts, to provide for the diminution in value of plant in place, and the taking of plant out of commission before its physical life had been exhausted. Although the periods of the loans might reasonably be assumed to be the life of the assets, it was often found economically advisable to throw out old generating sets before they had actually come to the end of their physical lives, and considerable economies had been effected in the Bradford experience by so doing. With regard to the authors' two alternative ways of commencing an installation, it was not always recognised that it was often better to spend more in connection with the first cost of plant than to spend less. Results were in favour of the more expensive plant. He believed that municipal electrical committees had a very bad name in this connection. They almost invariably went for the lowest tender, and what happened was that they had to pay much more in the way of maintenance, and they should pay very much more in depreciation, though whether the depreciation was allowed for was a question.

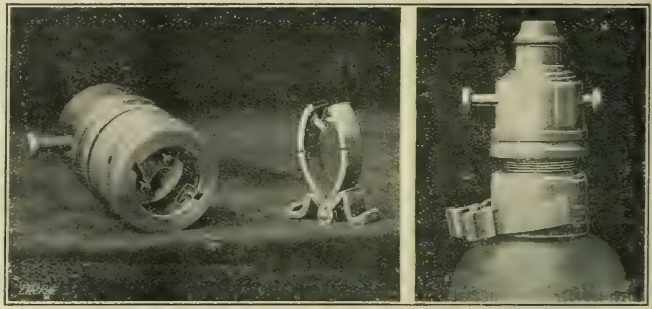
Mr. Cook, in replying on the discussion, said that if what the accountants had said really represented their attitude, he and his colleague had failed in what they had been trying to do. They had tried to set out the principles for computing the depreciation of plant chiefly from the engineer's point of view, and before anything could be done in that way the accountant must understand the engineer's point of view. It was equally true, of course, that the engineer must understand the point of view of the accountants. Someone must make a start towards that mutual understanding, and that was why they had done it. Some of the difficulties of the owner or employer were undoubtedly due to the fact that the accountant was pulling one way and the engineer the other. If these two could agree upon principles and act together they would have more influence on the owner. One of the ways in which an agreement on a method would be helpful would be by getting agreement between the Local Government Board and the income-tax authorities. At present they could not reconcile the methods of the two authorities with each other, and probably not either of them to the facts. To express it roughly, the difference between the two authorities was very largely a question of one acting on the physical life and the other upon the economic. He could not agree for a moment with what had been said about the difference between good and bad years in reference to depreciation. Whether the year was good or bad, depreciation charge was a working cost, and if they were not able to meet it in one year they must carry it forward in some shape or other. A good deal had been made of the extra labour involved in book-keeping by the sinking-fund method. There were generally such objections to new methods, but he had not found this one to be substantial in actual practice. Mr. Selvey's contribution to the debate was a very valuable one which would take some thinking about, and he would defer his reply.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

The "Thab" Patent Lamp-Lock.

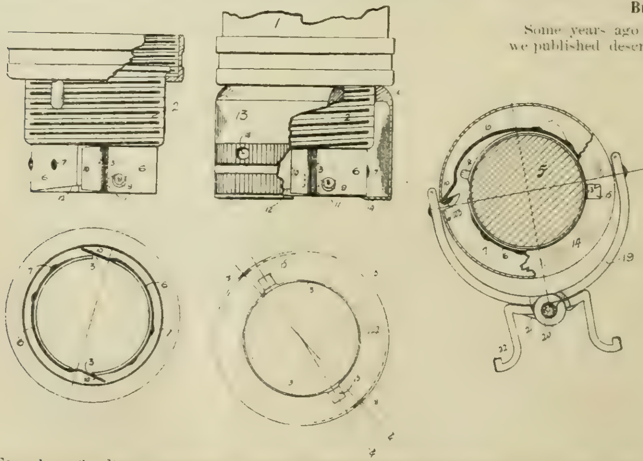
Mr. T. H. Alex. Brown, of the Heidelberg Municipal Electricity Works, Transvaal, South Africa, has developed an ingenious and effective type of combined shade carrier and lamp-lock, which is illustrated herewith. The necessity of a locking device for tungsten lamps is keenly felt in South Africa, and we are informed that there is a wide open market for a lock which can be depended upon to retain the lamp securely in its socket.

The device consists essentially of an ordinary bayonet-socket holder provided with two spring latches, which allow the lamp to be inserted in the socket and then snap upon the pins, so that the lamp cannot be moved in any direction. To remove the lamp a special key is necessary, with which the latches are lifted out of the way while the lamp is withdrawn. Combined with the lock is a shade carrier which forms an essential part of the device. The details are shown in figs. 1–3, and views of the parts are given in figs. 4 and 5. In the lampholder 1 the lamp socket 2 has an external thread and bayonet slots 3, engaging the pins 4 of the lamp cap 5. Flat spring latches 6 are riveted to the socket at the end 7, and are provided with holes 8 opposite the inner ends 9 of the bayonet slots; the free ends 10 of the springs are bent outwards, so as to be lifted by the entering pins, and the edges 11 of the springs with the socket are tapered away as shown at 12, to ensure that the pins will fairly pass under the springs when the lamp cap is inserted and turned round in the socket. The barrel 13 screwed on the socket has a flange 14 at the lower end, which covers the springs 7, the flange being provided with slots 15 to admit the pins; the upper end 16 of the barrel is curved to suit the usual patterns of lamp shade, and holes 18 are provided in the barrel for the insertion of the releasing key. The key consists of two arms 19, hinged together at 20, with a spring 21 which tends to close the arms; grips 22, when held between the finger and thumb, enable the key to be held open while inserting the pegs 23 in the holes in the barrel. The manner in which the pegs lift the latches is shown in fig. 3, the lamps and socket being rotated with one hand, whilst the barrel and key are rotated with the other until the pins are released and the lamps can be removed, the slots 15 being then opposite the open ends of the bayonet slots. Usually the shade is carried above the lamp lock and barrel; on the other hand, some shades closely embracing the lamps cannot be fixed in this way. A lamp cap ring is then slipped over the cap, and rests on the shoulder of the cap, the shade is placed on the ring, and, after the lamp has been inserted in the socket, the barrel is screwed down to grip the shade securely, as in fig. 5.



Figs. 4 and 5. The "Thab" Lamp-Lock and Key.

The inventor has kindly sent us a model of the device, which we find bears out his claims, and it appears that it would take a very clever thief to detect the method of locking and succeed in removing the lamp.



Figs. 1 to 3.—Details of the "Thab" Combined Shade Carrier and Lamp Lock.

Burleigh Dynamos and Motors.

Some years ago (November 26th, 1909, and January 5th, 1912) we published descriptions of D.C. motors with commutating poles

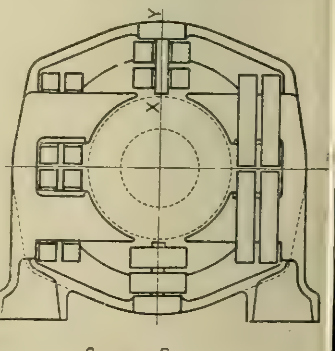


Fig. 6.—Diagrammatic Section of Burleigh Field-Magnet System.

and cast-iron magnets, in which the field-magnet system was designed on a novel principle, for which many advantages were claimed. These machines are being made by **Messrs. Newtons, Ltd.**, of Taunton, under Mr. J. W. Burleigh's patent, and particulars of them are embodied in a list recently issued by the firm. The essential feature of the design is the special arrangement of the four-pole field, as shown diagrammatically in fig. 6; it will be seen that the poles are arranged in pairs connected by stout yokes, while the interpoles are carried on much lighter yokes, which also form part of the magnetic circuit, the whole of the carcass being of cast-iron. By this construction, while the weight of the machine differs little from that of an all-steel magnet system, less machining is required and the cost is reduced, while equal efficiency and excellent commutating properties are obtained. The magnetic leakage is reduced, and the ventilation is greatly improved, owing to the large spaces provided in the interpole yoke, as shown in fig. 7, which represents an "open protected" motor. Machines built on these lines have been tested at the Faraday House Testing Laboratories, which report that the interpole flux is closely proportional to the armature current, and shows little sign of saturation up to loads of 50 per cent. in excess of the normal output, so that the machine could carry larger overloads than one of the ordinary type. The heat-dissipating properties of the machine are described as excellent, and the weight is not greater than that of steel-frame machines of the best manufacture. In a report on an adjustable-speed 8-H.P. motor of the same type, it is stated that the machine worked sparklessly at all speeds and loads up to 50 per cent. overload, had no tendency to hunt, even with a field of half the minimum strength for which it was designed, and ran silently under all conditions. It also started satisfactorily against full load with minimum field strength as a shunt machine, and gave its normal output continuously at the lowest speed without overheating, with an efficiency of 84 per cent.

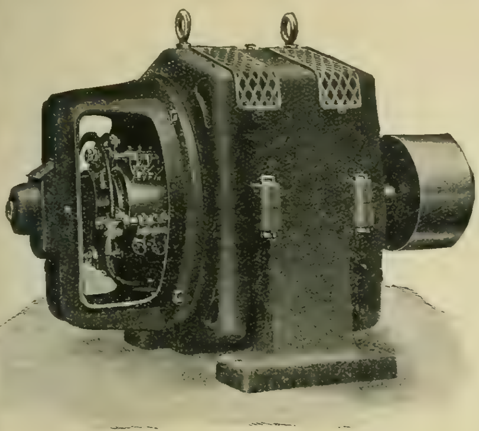


Fig. 7. Newton's Open Protected Motor.

The list gives the H.P. and speeds of each size of motor at six different voltages, and also states the efficiency at each speed and loads up to 1¼ full load, an unusual and valuable feature. The outputs run from 1½ to 100 B.H.P., the largest size having an efficiency of 91·5 per cent. at full load. In the case of the variable-speed motors, in view of the unlimited variety of combinations of pressures, powers, and speeds that may be asked for, a simple table has been devised which enables the reader to find with ease the suitable size of frame for any voltage between 110 and 550, with a speed variation of 4 : 1 : a range of 6 : 1 can be provided in many cases. In these and other respects the list is exceptionally informative and useful to the engineer.

Pocket-Lamp Extension.

A convenient improvement on the ordinary pocket lamp has been devised and prov. protected by **Messrs. W. R. Curtis** (13, Coniston Road, Muswell Hill, N.) and **E. Bigmore**. It consists of a miniature lamp of the usual pattern, provided with a spring clip for attachment to the user's clothing, and connected with a flexible cord, the other end of which is wound on a spring cord-absorber; the case of the latter is furnished with a screw adapter so that it can be attached to the case of the ordinary pocket lamp or torch in place of the lamp. Thus the battery can be carried in the pocket, and the lamp clipped on to the coat-collar or used as a torch to find the kerb, and so on; when not required for use, the cord is automatically coiled up and the lamp is clipped on to the case, which can then be used as a hand lamp in the usual way.

A New Swiss Company.—A new company, under the title of the Elektrotechnische Werke Lauffen, has been formed at Laufenburg, in the canton of Aargau, for the manufacture of electrochemical and electrometallurgical products. The share capital is £30,000, of which one-half has been paid.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Position of Shift Engineers After the War.

The position of shift engineers is only a part of a very large question. It is not only shift engineers who are affected, but it is everyone from chief downwards.

The central-station profession is suffering from a very bad disease, and, unless it can be cured, there is no doubt about the advisability of the first-class men clearing out; they have been doing it for some time now, and the emigration increases every year.

With very few exceptions, every position in central stations is underpaid, but in many cases the men holding these positions are overpaid, and unless the second-rate men are removed by offering a better salary and attracting the first-class man, it is only a question of time before the central-station profession is in the hands of the second-class man altogether.

If the emigration of the best men is going to be stopped, it is up to the first-class chief engineers to do it by offering better salaries for their assistants; the results would be better, and their own salaries would increase in proportion. Of course, you cannot expect the second-class chief to assist in this work, because, if the first-class man stopped, he would have to go.

This question is more than a professional one, it is a national one, because it is necessary for the manufacturers of this country to be supplied with power at a minimum rate, and it can only be done by first-class men from chief downwards.

Suum Cuique.

As a shift engineer of many years' service in different public supply undertakings, both company and municipally controlled, I heartily endorse the greater part of the clear and concise exposition of the state of affairs presented by Mr. John Marks in his article on this subject. As for the great majority never reaching "the lower figure, £250," as their annual salary, I think £200 would be a nearer estimate: the number of shift engineers getting £225 or more might be reckoned on the fingers of one's hands. The article, however, true to life though it is, has dealt with the darker side of the picture, and there is a lighter side, even for an intelligent man with a good education, if he can exercise discretion. For example, the tedium of long hours of light load and uniform running of the plant may be largely dispelled by undertaking literary work of a technical character, which may prove both educative to the writer and others, and remunerative to his bank account. Books, articles of an up-to-date character for the Press, scientific literature, &c., offer considerable scope. Another advantage is that if one wants a day off, it is easily arranged with one's colleagues, and no questions asked, the equivalent of work done by them being repaid at a convenient season, whereas in an ordinary business office to get a day off means an interview with the "chief," with explanations, and then having to ask a favour, for the work of one day cannot, as a rule, be made up on another. When all is said and done, however, in the duties of a shift engineer there is not sufficient scope to satisfy a progressive mind, and in that case the best policy is to

Get Out.

Sources of Error in Thermometry.

I was much interested in the notes by Mr. E. B. Pausey in your issue of December 29th last, as one who has had to battle, often with no very great success, against the prevailing methods of applying thermometers and pyrometers to pipe lines and similar apparatus, and I welcome his very practical remarks on the subject.

The errors which are incurred by the use of a thermometer pocket which has only shallow insertion into the heated zone, and which is of large cross section, may be very large indeed. They are, further, quite incalculable, as they depend upon a number of variables, as pointed out by Mr. Pausey. A case which I have had to meet in which these errors appeared very largely was in connection with electrical pyrometers for use on running locomotives, the temperature being that of the superheated steam. As the case is one illustrating just this class of error, it may be of interest to your readers.

The primary measurement was made by an electrical pyrometer of the thermo-couple type, this being installed with the hot junction actually exposed to the superheated steam in the header of the locomotive. With the special design of thermo-couple employed the conduction effect was practically negligible, and the thermal capacity of the actual thermo-couple junction was very small, therefore the accuracy of the indication of this pyrometer was high, and its speed in following temperature variations quite in advance of anything which could be achieved with a mercury thermometer.

The consulting engineers, however, having that touching faith in the mercury thermometer with a pocket, referred to by Mr. E. B. Pausey, specified that alongside the thermo-couple there should be provided a steel pocket available for use with a mercury thermometer. As the pressure was high, and the consulting engineers were cautious, the thickness of this steel pocket, bored from the solid, was considerable, hence the conduction error was very large. It was really rather amusing to use a mercury thermometer installed under these conditions as a check upon an electric pyrometer of much higher intrinsic accuracy. The result in practice was that we had to put a caution on the test certificate issued with the electrical pyrometer, that, owing to this conduction effect, the temperature, as shown upon the mercury thermometer, might easily be lower than that of the electrical pyrometer by as much as 10 per cent.

Of course, this error was not only very large, but quite incalculable, because it depended upon three variables—namely, (*a*) the actual temperature of the steel; (*b*) the rate of flow of the steam past the pocket; and (*c*) the temperature of the flange in which the pocket was mounted.

The mercury thermometer is, of course, an extremely convenient instrument for measuring temperature, but the user should realise very clearly that, at the best, it can only indicate the temperature of its own bulb; whether that is the temperature of the material under measurement depends, to a very large extent, upon the conditions in which it is used.

The present tendency in high-temperature operations is very strong towards the use of some electrical method such as the thermo-couple, in which the installation can be made with the least danger of conduction errors, and also with less danger of permanent error resulting from temporary overheating.

Chas. E. Foster,

January 17th, 1917.
Proprietor, Foster Instrument Co., Letchworth.

Localising a Fault.

Can any of your readers engaged on central-station mains work suggest a simple method of localising a fault as detailed below, somewhere on a length of just about a mile of triple-concentric L.S. and S.T. armoured cable? The system of supply is D.C. three-wire, and the cable in question acts as a feeder and runs from the station switchboard bus-bars to a feeder pillar a mile away, there being en route three S.T. boxes and half-a-dozen T boxes (for house services of two-core cable—no other cable being in the roads this feeder is laid in, some premises have been connected direct from the feeder), but there are no inspection boxes of any kind between the station and the feeder pillar, and the cable is laid from 1 to 3 ft. deep in very hard soil.

Tests proved all the three conductors to be shorted, and each showed a dead earth, but the cable was not burnt completely through. A loop test was impossible, as there was no sound conductor (all three being shorted), and it was also impossible, for many reasons, to drop a length of cable on the surface and so try a loop test.

"Burning out" was, for various reasons, not practicable.

With a search coil and telephone, notes could be heard distinctly over the whole length, though the conductors at one end were entirely disconnected.

The compass method of Mr. R. C. Quin was tried, but proved deceptive, the needle indicating the direction of the flow of current from each end to points a few yards apart, but the fault was not between the two points.

Current for testing purposes was, of course, available at both ends of the cable, but the only instruments available were a general combined house-testing generator set, an insulation testing set, and volt and ampere meters.

The fault, fortunately, was found by chance, but the writer would be glad of advice *re* the best and simplest method to proceed in such a case in future.

Mr. F. C. Raphael's book on localisation of faults does not clearly show how to proceed in cases of burn-outs on triple-concentric or three or four-core L.S. and S.T. armoured cable where "all conductors are shorted and earthed" and where "no spare cable is available to make the loop."

Mains Assistant.

City and Guilds' Examinations.

Your comments on our two previous letters, if you will permit us to say so, afford an excellent example of how the initial scope of a subject can be extended to confusion point.

Our first letter dealt with the two City Guilds' subjects—Electrical Installation Work (late Electric Wiremen's Work) and Electrical Engineering, and compared the treatment meted out to each in technical colleges, &c., and the results obtained.

In your footnote on this letter you brought in references to manufacture, &c., which appeared to us quite beside our point, and we wrote to say as much.

In your footnote to our second letter (see your last issue), you begin by digressing still further, and launch into general remarks about the "respective functions of the technical college and the trade school," "electrical manufacturing as a handicraft," &c. Your mention of "trade schools" (how many are there?) and "handicraft" reminds us of our letters in your columns in November and December last anent final-grade classes in Electrical Installation Work.

You return to the point towards the end of your note, when you place another construction on the percentage results. Some may consider your interpretation correct.

Next you disagree with our original contention that the subject of Electrical Installation Work is grossly neglected. In regard to this, may we tender the same suggestion as we made to Mr. A. P. Trotter in the above-mentioned previous correspondence—viz., that you should peruse the syllabus of the subject, and then walk into the nearest polytechnic and see what they do with it.

Your final remark that "Grades I and II in Electrical Engineering have a direct bearing on wiremen's work" reopens such a field for strong disagreement, that we do not feel equal to the task. You might compare the respective syllabuses.

We regret exceedingly that no teacher of the subject has had the energy to join in this correspondence, as we feel sure that we should have received a good deal of support from that quarter. There are obvious reasons, of course, why men in that position should hesitate to state their views publicly.

A. P. Lundberg & Sons.

London, N., *January 22nd*, 1917.

[We fail to see what bearing this letter has upon the subject.—Eds. Elec. Rev.]

Several other letters are unavoidably held over to a later issue.—Eds. Elec. Rev.

LEGAL.

Secret Process in Rubber Manufacture.

(*Continued from page* 83).

Mr. Ballantyne was called by the Belgium company to prove, as an expert chemist, that the formula used in the manufacture of their hardened rubber was not the same as that which was alleged to have been taken away from the plaintiff company by Manning. He produced 18 formulæ for the purpose of obtaining insulating hard rubber.

Cross-examined by Mr. Hughes, K.C., he said he could not say whether they were formulæ for goods that had been supplied, but he thought so. The least variation in the ingredients might be of great importance. Materials produced from two different formulæ might have the same specific gravity, whilst in materials produced from the same formula one might get considerable difference in specific gravity.

Mr. Hughes said that was not the experience of rubber manufacturers, and Witness said he had had no experience in rubber manufacture, but had considerable experience of rubber as a chemist. He had no doubt that the first test between rubber manufacturers and their customers was specific gravity.

Further evidence was called for the defence, and, counsel having addressed the Court on behalf of their respective clients, his Lordship reserved judgment.

Liability of Tramway Authorities.

At the Newcastle-on-Tyne County Court, on the 19th inst., a typist sued the Corporation, as owners of the tramway undertaking, claiming damages for the loss of a suit case, valued at £9 15s., which she handed to the conductress, who placed it at the back of the car. The plaintiff paid 1d. in respect of the parcel and received a ticket for it. When she alighted from the car the case could not be found, having probably been removed by another passenger. For the plaintiff it was submitted that the Corporation, by accepting the luggage, became common carriers, and it was contended that they had broken their obligations as common carriers. For the Corporation it was argued that they were not common carriers; the only obligation upon them was that a passenger could carry with him 28 lb. of luggage. The plaintiff had failed to prove any negligence. His Honour asked why the charge of 1d. was made; why should they make a charge and accept no responsibility? For the Corporation it was replied that the charge was for the carriage and not for insurance. His Honour reserved judgment.

Moraine *v.* The United Electrical Manufacturing Co.

In the Lord Mayor's Court, on Monday and Tuesday, this case was heard before the Recorder (Sir Forrest Fulton, K.C.) and a jury. The plaintiff, Mr. M. N. Moraine, commission agent, residing at Berkhampstead, and now in Government service, sued the defendants, manufacturers of electric pocket lamps, torches, and batteries, of Moor Lane, E.C., for 10 per cent. commission upon orders for electric pocket lamps and batteries procured by him for the defendants.

Mr. W. Eddy was counsel for the plaintiff and Mr. A. Morley for the defendants.

According to the plaintiff's case, in November, 1914, the outbreak of war having put an end to his business, he discovered there was a demand for electric pocket lamps and batteries, and became acquainted with Mr. Pordes, of the defendant company. In June, 1915, Mr. Pordes entered into a verbal agreement whereby plaintiff was to receive 10 per cent. commission on all orders introduced by him to the defendant company. The plaintiff had a list of 250 customers given him, and a private connection of his own. The plaintiff was successful in obtaining orders, and worked up the business for four months. He then received a letter from the defendants stating that no more orders could be received through him for the Solar electric pocket lamp, and that if there was any money due to him, they would be pleased to let him have it. Upon the orders received by the defendants, as a result of plaintiff's efforts during the short interval of time, there was due from them 10 per cent. commission. At the time of the commencement of the proceedings, as a result of the inspection of the defendant company's books, there was found to be due a sum of £50, and that was the sum the plaintiff now sought to recover. The plaintiff had been prepared to have the matter dealt with by the Registrar of the Court at a reference where an inquiry into various items could be better proceeded with, but to this course the defendants objected.

Counsel for the defendants said that the reason for the objection to having the matter referred to the Registrar of the Court was that there was a dispute between the parties as to the terms of the verbal agreement, and there were items in the plaintiff's claim for commission which had reference to orders executed long before the agreement relied upon by the plaintiff was entered into. The defence was that up to the time of the proceedings the plaintiff had been paid all that was due to him. A sum of £25 was paid into Court to satisfy the plaintiff's demands.

The jury found a verdict for the plaintiff for £48 15s. 2d., an order being made for the money in Court to be paid out to the plaintiff.

WAR ITEMS.

War Trade Department.—After Monday next, all communications for the War Trade Intelligence Department should be sent to the new address, 1, Lake Buildings, St. James's Park, near Storey's Gate, Westminster, S.W.

Badged Electricity Workers.—A correspondent says that electricity authorities have been notified by the Ministry of Munitions that all war service badges and certificates held by men of military age, and graded as unskilled or semi-skilled, are to be withdrawn.

Trading With the Enemy.—The "London Gazette" for January 19th contains further lists of firms and bodies in the following countries with whom trading is prohibited:—Argentine, Brazil, Denmark, Ecuador, Greece, Netherlands, Norway, Spain, Sweden, &c.

Manchester War Bonus.—The Manchester Corporation, in refusing the application of the Corporation officials for a war bonus of 10s. a week, has resolved that each Committee will reserve its own judgment as to the necessity for raising salaries or not.

Raw Materials and Men in Germany.—Addressing the shareholders, at the recent annual meeting in Berlin, of the Siemens & Halske Co., Arnold von Siemens is reported to have stated that all the company's works were in full operation, and there was no lack of orders. The prospects were dependent upon the extent to which raw materials and labour were available. As the company had important duties to fulfil, it was probable that raw materials would be placed at its disposal to the desired amount. The course of conditions after the war would chiefly be characterised by the paths assumed by statesmanlike administration.

At the meeting of the Schuckert Electricity Co., of Nuremberg, the chairman announced that a large stock of orders was brought over into the new financial year, and further orders had since been received, which were greater than in the corresponding period of 1915. As a consequence, the company could again reckon on obtaining satisfactory results insofar as men and raw materials were rendered available to an adequate extent.

Carlisle Electricity Department.—We have before us two lists showing the part that is being performed by the staff of the Carlisle electricity department with the Forces and with the Volunteers. Twenty-two names are given in the first list, which includes the station superintendent, Mr. H. P. Baynham, who is Company Sergeant-Major in the Royal Marine S.M., the chief clerk, and other members of the office and station and outside staff, also five apprentices. The second list, which contains 24 names of men in the Volunteers, is headed by Captain F. W. Purse, the city electrical engineer, followed by his chief assistant, Corporal J. H. Thompson, and members of the office, station, and outside staff.

Tramways and Substitution.—The Secretary of the Tramways & Light Railways Association wrote to members of that body, under date December 27th, 1916, as follows:—"I beg to inform you that the following arrangement has been come come to between the War Office and this Association, on behalf of its members. I am authorised to say that if you will supply the War Office with a list of all your employés who are now in the Army (at home or abroad), steps will be taken to ascertain if they are in a low medical category, and if this is the case, arrangements will be made to exchange them for general service men to be released by you. The list should contain the man's name and initials, his regimental number, rank, unit, and, wherever possible, where he is stationed. You are also requested to give the names, &c., of men now in your employ who will be available as substitutes for the men released from the Army. The lists should be sent at the earliest possible moment direct to the Secretary, The War Office, S.W., D.R., 4 Department."

Dr. Walter Rathenau Again.—We reproduce from the American *Literary Digest* for January 13th, just to hand, the following article on "Germany and the Next War."—"No lasting peace appears, whatever may be the official views of the Government, to enter into the calculations of some of the captains of industry in Germany, at least, if the views of Dr. Walter Rathenau are typical. As the head of one of the greatest electrical industries in the world, the Allgemeine Elektricitäts Gesellschaft, popularly known as the 'A.E.G.,' Dr. Rathenau occupies high rank among the commercial magnates of the Fatherland, while his genius for organisation is such that, since the war began, the task of mobilising industry has been committed to his charge by the Government. Under these circumstances, Dr. Rathenau's utterances acquire special significance, and it is somewhat of a shock to find an article from his pen in the Berlin *Lokal Anzeiger*, in which he discusses the need of industrial preparation for a future war, which he apparently regards as inevitable. He says:—

"'We began the war a year too soon. When we have secured a German peace we must begin at once a reorganisation upon a broader and firmer basis than ever before. Establishments that produce raw materials essential to the Army must not only continue their work, but enter into it upon lines of increased energy, forming thus the kernel of economic Germany in preparing in the economic sense for the next war. We must carefully calculate in advance, in view of lessons learned in this war, what our country lacks in raw material or essentials of raw material, and secure immense reserves to remain unused until a day in the future. We must organise as genuine an industrial mobilisation as we had a military mobilisation. Every technician or semi-technician, enrolled or not in the list of mobilised, must be empowered through official credentials to take charge and direction of a given establishment upon the second day following a new declaration of war. Every establishment manufacturing for commercial purposes must be mobilised also, and understand officially that upon the third day after declaration of war its entire abilities are to be devoted to serving the Army upon demand.'

"'It must also be determined in advance just what quantities and sort of essentials such establishment can furnish the Army in a given time. Each establishment also should be required to furnish a detailed list of workmen who can be dispensed with, these alone to be mobilised in the military sense.'

"While preparations must be made at home, Dr. Rathenau would have the diplomats of the Fatherland busy abroad in order that some of the experiences of this war may be obviated in the future. He writes:—

"'We must finally establish some definite commercial understanding with nations outside Europe that will offer them advantages, to be duly specified in detail, whereby these nations, as neutrals, will find it to their direct disadvantage commercially to trade or sell munitions during war to either ourselves or our enemies. We can afford to offer such conditions. And, finally, when the next war comes, it must not be a year too soon.'

"These frank utterances from one of the leading capitalists of Germany have produced in France a marked reaction against peace, and we find that brilliant French author and academician, Mr. René Bazin, using Dr. Rathenau's article as a text for an impassioned appeal to the United States not to insist too strongly on peace proposals at the present time."

Exemption Applications.—At Pontefract, exemption was claimed by Mr. J. L. Brown (25), who asserted that he was the only electrician in the town. In reply to a question, Major Renny said that he did not think that applicant would be able to enter the Navy, but he might enter the Engineers as a linesman. The appeal was dismissed, applicant not to be called up until April 1st.

At Bromley (Kent), Mr. May, secretary to the local Electric Light & Power Co., applied for exemption, and said that he was in the Naval Air Service. The Tribunal decided that they had no jurisdiction, and dismissed the application.

At a sitting of the Canterbury Tribunal, on January 15th, an appeal was made by Mr. Sidney Terry (29), electrical engineer, for himself and an employé named Reginald A. Elliott. Mr. Terry stated that he had charge of all the electrical plant, dynamos, and lighting at a local munitions works and at the premises of the Motor Co. The Advisory Committee recommended three months to Mr. Terry, and no time to the employé beyond a month's grace before the calling-up. Mr. S. Shea, for Mr. Terry, asked if the three months could be extended, as there was such a scarcity of skilled electricians. Mr. Terry was given the three months, and the case of Elliott was put back for medical classification.

At Woking, the Electric Supply Co. appealed for the retention of S. C. Bicknell (38), electric wireman and repairer. It was stated that Bicknell was one of only two men left to maintain the repairs over the company's area, and before the war they had 10 men doing similar work. It was impossible to obtain an experienced man in his place. Six months granted. The Military Representative suggested that efforts should be made to replace Bicknell, who is in Class A, by a substitute out of the Army before the six months expired.

At Whitehaven, on January 17th, an electrician appealed for the retention of his son, aged 31, the only experienced man left to undertake electrical work at collieries, &c. The Advisory Committee recommended conditional exemption, and this was agreed to.

At Chatham, 10 employés were appealed for by the Tramway Co., their exemption certificates having been withdrawn. With the consent of the Military, two were again given conditional exemption, and the rest were temporarily exempted, pending substitution.

The South Staffs. Appeals Court has given conditional exemption to an electrician in charge of a generating station at Rowley Regis under the Government, who intimated that they required appellant's services.

The Isle of Thanet Electric Tramways & Lighting Co. appealed at Broadstairs, on January 16th, for conditional exemption for an employé, aged 36, engaged as a wireman and driver, repairer of trucks, &c. Conditional exemption until the company finds an efficient substitute.

On the appeal of the Electric Traction Co., Ltd., the Peterborough Tribunal have granted the following exemptions:—J. Culshaw (34), chief traffic inspector, in B 1, conditional exemption; J. G. Manning (28), electrician, Class A, one month for substitution; C. W. Armitage (29), tramway foreman, Class A, a month for substitution; G. A. Maywood (33), fitter and mechanic, a month for substitution; F. G. Jessop (29), mechanic and driver, B 2, conditional exemption; E. A. Sewter (30), electric fitter, &c., B 2, three months.

At Taunton, the Corporation electricity department appealed for W. P. Short (28), ledger clerk, book-keeper, and relief switchboard attendant, in Class B 1. The electrical engineer (Mr. Howard) said that the man was indispensable to the supply of current for power and light to munition and other works. Six months' exemption was granted.

At Eastbourne, an electrical engineer appealed for the retention until the end of March of an apprentice, aged 19, and passed for general service. The employer said that by the time stated he hoped to get three boys efficient in the work. The appeal was rejected.

At Farsley (Yorks.) Tribunal, the Morley Electrical Engineering Co. claimed for six men, all of whom, except one, came under the "Trade Card" category. The one, H. Moore, armature winder, was 26 years of age, and it was suggested that he would have to be refused owing to his age, though the firm might claim him under their engineering scheme. The Tribunal could not agree to him being in a certified occupation. Mr. W. Summerscales (the manager of the company) said it was singular that when the Government made the arrangement with the Trade Union no provision was made for foremen, but the Employers' Federation were considering the question. Moore had charge of the department which made motors for driving machinery for Russia, France, Italy, and Australia. All the hands under him were only about 17 years of age, and if he were taken the department would have to be closed. He was a highly skilled man. The Clerk having given it as his opinion that Moore's age did not now debar him from conditional exemption, this ruling was accepted, and he, with the other five men, was conditionally exempted to March 31st. The other men were F. L. Bell (34), draughtsman and designer; J Hartley (36), turner; L. Magson (30), engineer's blacksmith; W. Pearson (40), pattern maker; and F. H. Platts (37), electrical fitter.

At Northampton, Henry Sale, a cartage contractor, appealed for the exemption of his son Harry, aged 30, married, with three children. He said that he and his son were in partnership, and they both worked in the business, and employed two other men. They had a contract running for the carting of the whole of the coal used by the Northampton Electric Light & Power Co., and that occupied the whole of their time. They had that day carted 74 tons. It was suggested that the man appealed for could be replaced, but Sale said that was impossible; there was no labour available. Ald. F. H Thornton, the chairman of the Electric Light Co., pointed out that the company was an important branch of the public service, and said it would be very difficult to find a substitute. Three months' final was given.

Before the Henley Rural Tribunal, Mr. R. C. H. Harrison, of Shiplake Court, appealed for the retention of R. A. Pride, engineer in charge of the electric light installation. Conditional exemption was granted until May 1st, subject to substitution.

At Bexhill-on-Sea, Mr. R. W. Waine appealed for J. Bloor (35), electrician, classified for labour duty abroad. The Military agreed that he was of more use in civil life, and did not oppose temporary exemption. Three months were conceded.

At Oxford, the Military Representative asked for a review of the case of W. T. Cooke (28), electrical fitter and mechanical lead burner, with Messrs. Hill, Upton & Co., electrical engineers, granted conditional exemption to June 26th. On behalf of the firm it was stated that Cooke was the only one now left to do his work, three others having left for the Army. The firm were engaged in considerable munition work, and Cooke was chiefly engaged putting in machinery at munition works. He had sole charge of the installation of machinery, and had to go all over the country. It was mentioned that the firm had a trained lady electrician, the only firm, it was believed, in the country who had one, and that 90 per cent. of the firm's work was indirect war work. Captain Fox said that there was a great demand for men of Cooke's stamp in munition works, and in the Royal Flying Corps. The Tribunal held that Cooke was engaged on work of national importance, and they confirmed the conditional exemption.

At Oxford, the Electric Light Co. asked for exemption for Mr. J. F. Pierce (39), chief assistant engineer, two fitters and turners, a shift foreman, three switchmen, an improver, a motor mechanic and tester, an electrician, and a stoker. Mr. F. Gray, for the company, said that they had 14 men of military age, but they had to supply current for power to munition works in the district. Of the 14 men, 10 were passed for general service, and four had been rejected. He suggested that one should go at once, two should be released if efficient substitutes were found, and seven exempted for three months on condition that during that period every effort would be made to find substitutes. It transpired that the improver had joined up, and Mr. Gray's suggestion as to the rest was agreed to, Mr. Pierce being with those exempted for three months.

BUSINESS NOTES.

Australian Contracts.—The Victorian Railways Department has agreed to include in all contracts accepted the name of the country where any such articles or goods or material are manufactured.—*Tenders.*

British Industries Fair, 1917.—Manufacturers who are exhibiting at the British Industries Fair have received their allotments of space from the Board of Trade during the last few days, and the work of erecting stands has already begun. The total amount of space applied for has again largely exceeded the space at the Board's disposal, with the result that exhibitors have found their allotments considerably reduced. In some cases it has even been found necessary to reduce the applications by half. The space covered by the Fair will be considerably larger than last year, and the number of exhibitors will also be greater.

The Fair will open on the last Monday in February (February 26th), and will remain open till March 9th.

The London Fair, like all such undertakings, comes under the restrictions imposed by the Ministry of Munitions, and, consequently, certain trades, which would otherwise be included, cannot participate. As before, the direct interest of the electrical trade, as exhibitors, is naturally very limited, for in London the trades included will be toys and games, earthenware and china, glass, fancy goods, stationery and printing.

The Glasgow British Industries Fair will cover textiles, ready-made clothing, boots and shoes, foodstuffs, and domestic chemicals.

At the London Fair the charges for space will be 2s. a sq. ft., and exhibitors have no other expense except the cost of the erection of their stands. At last year's Fair many exhibitors had stands as small as 6 ft. × 6 ft., and their total expenses, including the erection of their stands, probably did not exceed £7. None the less, many of them booked orders for several thousand pounds.

Bankruptcy Proceedings.—Christian Evan Evans, 93, Cannon Street, E.C., financial agent.—An application for an order of discharge was made on January 17th to Mr. Registrar Linklater at the London Bankruptcy Court. Mr. Daniel Williams, Official Receiver, reported that the bankrupt failed in August, 1914, with provable debts £2,034 and assets expected to eventually realise £170. In December, 1912, the bankrupt, in consideration of shares valued at £300 (borrowed from a creditor) and £50 cash, acquired an interest in a patent for the Boran electric lamp, which was then being exploited by third parties. The lamp was to be manufactured by a company, but the latter went into liquidation and the lamp was never placed on the market. The bankrupt estimated his loss on the venture at £350, and the creditor from whom he borrowed the shares had proved against the estate for £500. The application was opposed by the Official Receiver on the grounds (1) insufficiency of assets to equal 10s. in the £ on the amount of the unsecured liabilities; (2) omission to keep proper books of accounts; (3) contracting debts provable in bankruptcy without having at the time any reasonable or probable ground or expectation of being able to pay them; and (4) rash and hazardous speculation. His Honour upheld the report, and imposed a further suspension of two years. Order entered accordingly.

J. R. Whitehouse, managing director of an electrical company, 43, St. Andrew's Road, Golder's Green, Middlesex.—This debtor applied to the Judge sitting at Barnet, on January 23rd, for his discharge. The Official Receiver stated that the liabilities were £630, and the assets, which were estimated at £385, had only realised £31. Debtor was now in employment, and receiving £125 a year. His conduct during the bankruptcy proceedings had been unsatisfactory. The solicitor appearing for the debtor said that the failure had been brought about owing to the war, and asked his Honour to treat his client leniently. His Honour, however, said it was a very bad case, and he refused the application.

Calendars and Diaries.—From Mr. George Ellison, of Birmingham, we have received a small desk calendar on metal base, with daily turn-over date-slips. Rather a large proportion of the space is occupied with the various addresses of the firm, but a small memoranda space is left, in addition to which one has before one each day a calendar for a complete three months.

The S.R.O. Ball Bearing Co., of 115, Southwark Street, London, S.E., have sent us a clearly dated calendar for 1917, with monthly sheets, at the right-hand side of which is a daily memoranda space. Copies may be obtained on application.

The London Association of Foremen Engineers has sent us a copy of its diary, containing particulars regarding the Association, list of members, engineering data, &c. Referring to the tables of metrical equivalents, which are carried to the millionth of a centimetre, the 10-millionth of a ton, and the 100-millionth of an inch, we would suggest that these figures are enough to frighten anybody; all that is necessary in practice is four or five significant figures. The diary is neat and handy, and contains an insurance coupon.

Swiss Trade in 1916.—According to information collected and published by Swiss financial institutions, the iron and steel and engineering industries in Switzerland had an abundance of orders during the whole of 1916. Considerable difficulties, however, were experienced in obtaining raw materials; the prices reached an exceptionally high level, and this fact and the advance in wages, caused a large increase in the cost of production. The electrical industry was characterised by an active course of business at good selling prices, and the prospects are declared to be decidedly satisfactory.

Catalogues and Lists. — British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park.—Fourteen illustrated leaflets, containing particulars, and in some cases prices, of the following manufactures: Contactor control gear, ironclad switchgear, electric motors, heating apparatus, wire-drawn lamps, rotor starters, reversing controllers, motor-control panels, and lightning arresters and multi-gap surge dischargers.

British Thomson-Houston Co., Ltd., Rugby.—Descriptive List No. 2,269 (eight pages), containing illustrated particulars, with fully-tabulated dimensions, of their crane and hoist motors.

Spray Engineering Co., Boston. U.S.A.—Bulletin No. 250 (16 pages), containing a fully-illustrated description of their "Spraco" equipment for washing and cooling air, especially applicable to steam turbo-generators and other electrical machinery.

Electrical Supplies Co., 233, Tottenham Court Road, London, W.—Folder, giving prices of "Lighthouse" cinematograph carbons.

Messrs. E. Bennis & Co., Ltd., of Little Hulton, have issued No. 3 (December) of their journal "Cheap Steam."

Liquidations.—Immisch Launch & Boat Co., Ltd. – A meeting of creditors is called for January 26th at Electrical Federation Offices, London.

Stentorphone Syndicate, Ltd.—Creditors are to send particulars of debts, &c., to Mr. A. A. Baster, Whitgift Chambers, North End, Croydon (the liquidator), by February 20th.

Kilowatt Publishing Co., Ltd.—Creditors must send particulars of debts, &c., to the liquidators, Messrs. A. Webster and E. A. Burnie, by February 16th.

Trade with Canada.—H.M. Trade Commissioner in Canada and Newfoundland (Mr. C. Hamilton Wickes) is to pay a further official visit to this country. He is expected to arrive early in March, and will be prepared to interview (by appointment) representatives of firms who may be able to see him in London at the Offices of the Department of Commercial Intelligence of the Board of Trade for several weeks before Easter. Immediately after Easter he will visit certain trade and industrial centres in the United Kingdom. Firms who may desire to have an interview with Mr. Hamilton Wickes are requested to make their application not later than February 19th in the case of London and March 5th in the case of the Provinces. Applications should be addressed to the Comptroller-General, Department of Commercial Intelligence, 73, Basinghall Street, London, E.C.

For Sale.—The Llandudno U.D.C. invites offers for 1,325 yards of lead-covered insulated cable; the Erith U.D.C. is inviting offers for the sale of a Bettington boiler, and several A.C. generating sets (125 KW. and 50 KW.). Full particulars are given in our advertisement pages to-day.

Trade Announcements.—Messrs. J. Halliwell & Sons, electrical and mechanical engineers and contractors, having opened new premises at 7, Church Road, Seacombe, Cheshire, desire to receive catalogues, &c., of electrical and mechanical machinery, tools, and accessories; also samples of cables, wires, &c.

Mr. Charles Haswell, of Sherbrooke Chambers, 8, Norfolk Row, Sheffield, has been appointed the agent of Messrs. Crompton and Co., Ltd., London and Chelmsford, for Sheffield and the surrounding district.

Exhibition.—According to the *Financier*, it has been decided that the Shipping, Engineering, and Machinery Exhibition, which it was originally intended to hold in September and October, 1914, but which was postponed owing to the outbreak of war, is to be held at Olympia after the conclusion of the war.

Book Notices.—The *Journal* of the Tramways and Light Railways Association for January contains a full list of members of the Association.

"Willing's Press Guide for 1917." London: Jas. Willing, Ltd. Price 1s.

"L'Entente": Revue Politique, Economique et Financière. No. 1. January 15th, 1917. Paris: A. Pamaron, G. Prade. Price 3 fr.

LIGHTING AND POWER NOTES.

Aldershot.—The U.D.C. has acceded to the application of the postal authorities to give a supply of current to the new post office premises, and to supply other premises en route when the extension of the mains is carried out.

Australia.—According to the *West Australian*, the new East Perth (W.A.) power station has now been brought into use for both tramway and general supply.

Bandon (Co. Cork).—The Town Commissioners are considering a scheme for electric lighting.

Banbridge (Co. Down).—E.L. Proposal.—At the last meeting of the U.D.C. it was resolved to ask for tenders for the lighting of the town, either by gas or electricity. Banbridge is a steadily-improving town with mills, factories, &c., situated on the Upper Bann.

Continental.—Spain.—A new hydro-electric generating station established by the Compania Mengemor, near Mengibar (Province of Jaen), has lately been completed and put into operation. The plant, which utilises the power of the Escalas Falls on the River Guadalquivir, will supply current for lighting and power purposes in the district.

Russia.—In a study of the resources of the Caucasus in connection with the development of industries in Russia, it is stated that the hydro-electric installations in the cities of Hagri, Suchum, Novycaphon, Batoum, Artvis, and Borzham have a total capacity of 15,000 H.P. Hitherto this has been utilised locally, but a portion might be diverted to chemical purposes. The Commission which carried on the investigation has opened up negotiations with important firms for the installation of electric furnaces for the production of nitrates in the Caucasus.

Caucasian newspapers report that the employment of water-generated energy from the Rivers Kaban and Maloi-hata is under investigation. The Council of the Viceroy of the Caucasus has approved the chief heads of a contract with J. Nikolenku for a period of 75 years, ceding sites on these rivers, but with a Government right of purchase within 30 years. The capacity of the central station is estimated at 45,000 KW., and exceeds that of all the other installations in the Caucasus combined, their total being 30,000 KW., without reckoning the plants employed in the mining industry.

Dartford.—The electrical engineer has forwarded the following particulars to the I.M.E.A. on the effect of the working of the Summer Time Act on the quarter's revenue ending September, 1916, as compared with the previous year. The reduction in sales for lighting purposes only was 30 per cent. (cinemas, &c., not included); saving in coal for quarter, 13 tons (estimated); saving to lighting consumers, £120. The charges for electricity were not raised in anticipation of a loss in revenue due to the Act.

Dublin.—The various reports arising from the Special Inquiry were on the Corporation agenda for a special meeting last Friday, but, owing to the length of time occupied by other business, it was decided to postpone the discussion until the February meeting.

The Electricity Supply Committee has submitted to the T.C. a further report protesting against the procedure adopted by the Special Committee of Inquiry, urging that the expert engaged to advise it should have been the chief engineer of a British central station, and pointing out that the expenditure of large sums of money at the present time on extensions and alterations at the power station is impracticable. The Electricity Committee also claims to have made arrangements which guarantee the maintenance of an undiminished supply of electricity, and again asks that the report of the Special Inquiry Committee shall be referred to it for investigation and report.

At the final meeting for the year of the Electricity Supply Committee, the outgoing chairman (Mr. J. J. O'Neill) said it was a matter for congratulation that they were able, during the last completed financial year, to pay off just over £32,000 of capital raised, and, in addition, to pay £24,000 in interest and make a profit of nearly £9,000.

The Corporation has decided to borrow, for the extensions of the electric lighting system, sums of £28,000, £60,000, and £12,000, and, under sanction of the L.G.B., has authorised the borrowing, for the purpose of the utilisation of the electric tramway system for the conveyance of refuse, and the provision of a depot, the sums of £7,700 and £4,500.

According to Mr. P. J. McAndrew, a local consulting engineer, arrangements are now being made to proceed with the scheme for the utilisation of water power in Ireland for electrical purposes.

Dundalk.—Inquiry.—This week a L.G.B. inquiry will be held into an application by the Council for a loan of £5,000 to carry out extensions to the electric lighting system of the town and district.

Ewell.—Prov. Order.—The P.C. has appointed a Committee to interview the South Metropolitan Electric Tramways and Lighting Co. regarding its application for a prov. order for the area.

Gillingham (Kent).—The T.C. has entered into a further contract with Recess Screws, Ltd., for a supply of current on the basis rate of 1¼d. per unit, subject to a sliding scale.

London.—Poplar.—Owing to the growing difficulty in obtaining carts, the Electricity Committee has decided to purchase out of the profits of the current year a second Foden steam wagon, at a cost of £744 (Electric Vehicle Committee please note). The surveyor of taxes made an assessment of the electricity undertaking of £4,201 in respect of excess-profits tax for the year ended March 31st, 1915. Objection was successfully taken on behalf of the Council to the assessment, which has been discharged.

Fulham.—The Electricity Committee reports that difficulties have been experienced with the economisers at the electricity works, due to tube failures under pressure, and it is proposed to work the economisers at atmospheric pressure, involving the installation of a centrifugal pump to pass the water through the economisers to a galvanised hot well. The cost will be about £100, and will obviate an immediate expenditure of some £2,000 for renewals. The Committee has received the certificate of the Ministry of Munitions in respect of the borough electricity works, and has adjusted the wages of the employés in accordance with the scale approved by the Islington B.C. in connection with the certification of its electricity undertaking.

L.C.C. The Finance Committee recommends the Council's sanction to the borrowing by the Woolwich B.C. of £2,442 for electricity purposes.

The Committee, with the consent of the Treasury, has granted a loan of £3,000 to the Hackney B.C. for mains and switchgear.

St. Pancras. The Electricity Committee has decided in favour of an offer by the Brush Co. to remodel the 1,000-kw. Ljungstrom turbine, which the Council has had in satisfactory use for some time on hire, pending the installation of a 5,000-kw. set of the same type. It is proposed to alter it so that it will develop 1,500 kw. continuously and have an overload capacity of 20 per cent. for two hours, at a cost of £6,500, less £1,500 paid for hire.

A deputation of cinema proprietors has interviewed the Committee with a view to obtaining power rates for projector use. At present a special flat rate of 3d. per unit is given, and the Committee considers that such energy should be charged for at lighting, not power, rates.

Manchester.—A deputation appointed to consider the possibilities of increased street lighting, after visiting a number of other towns, has come to the conclusion that Manchester already has a larger proportion of lamps lighted than the towns visited.

Stafford.—Loan Sanction.—The T.C. has received sanction to a loan of £1,000 for the provision of new cable.

Stowmarket.—According to the *Bury and Norwich Post*, the Suffolk Electric Supply and Power Co. does not intend to increase the price of electricity for lighting and power, although the six months' working, April to September, showed a loss; the returns for the past three months, however, are satisfactory, and there is every prospect of this improvement continuing. The Summer Time Act accounts for the adverse balance during the spring and summer quarters.

Tonbridge.—At a meeting of the U.D.C., strong objection was taken to the application of the local gas company for a prov. order to supply gas for the purpose of generating electricity, in rivalry to the Council's electricity undertaking. A letter from the manager of the company expressed the opinion that they would be able to meet the Council on the matter, and the subject was deferred.

U.S.A.—According to the *Electrical World*, the Secretary of War, on the ground that he lacks legal authority, has refused to take action in regard to authorising additional water diversion at Niagara, but recommends that temporary permits be given to generate more power, and that this should be decided by Congress.

Willesden.—Proposed Extensions.—A report from the electrical engineer shows that, owing to the growth of the undertaking, the demand leaves no margin of safety or capacity in either cables or machinery, and extensions must be made before next winter. Application is to be made to the L.G.B. to sanction the borrowing of £10,110, made up as follows: New 500-kw. rotary converter with transformers, switchgear, foundations, and connections at Salusbury Road and Acton Lane sub-stations, £3,600; new 1,000-kw. cable from Taylor's Lane to Acton Lane sub-station, with switchgear, £2,900; new 700-kw. cable from Taylor's Lane to Anson Road, £3,350; and other items. From April 1st to December 31st last, 61 services were laid at customers' expense, amounting to £486. Having considered a report on negotiations for inter-linking and inter-working of electricity undertakings in the metropolitan area, and in view of the fact that the agreement entered into by the Council with the North Metropolitan Electric Power Supply Co. expires on March 31st, 1918, the electrical engineer has been authorised to make inquiries in connection with the situation.

TRAMWAY and RAILWAY NOTES.

Australia.—Recently one person was killed and 20 were injured by an electric car overturning at Burwood, near Sydney. The car carried 40 passengers.

The Melbourne Tramways and Omnibus Co. has been awarded £335,000 as compensation in connection with the transfer of the Melbourne Tramways to the Tramways Board.

Blackburn.—Female Labour.—The employment of females by the tramway department is said to have proved a pronounced success; a corresponding clerk, ticket clerk, two girls in the ticket stores, two inspectors, five drivers, and about 40 women conductors are employed, and others are learning to drive or receiving instruction as conductors.

Bury.—The Tramways Committee has had complaints as to the car service, and the manager explained that he had great difficulty in obtaining materials for repairs and renewals. An application has been received from the Tramway and Vehicle Workers' Association for an increase in the wages of female employés, and a Sub-Committee is to meet a deputation from the Association on the matter.

Continental.—Spain.—It is announced that the Spanish Minister of Public Works has just approved a scheme submitted by the city of Madrid for the construction of a metropolitan railway according to the designs prepared by D. M. Otamendi. The project, for which a concession has been granted for 90 years without any State guarantee or subsidy, comprises four lines, which are to connect the capital with the suburbs, and run from the north to the south and the east to the west. The lines are to be of double track and for electric traction; the first is to be completed in three years and the others in eight years from the stipulated date.

Italy. An agreement has been come to between the Italian Government and the Rome-Nord Tramways Co. for the construction and working of an electric railway from Rome to Viterbo, through Civitacastellana.

Halifax.—A heavy motor wagon collided with a tramway standard, last week, with such violence that the arm carrying the wires was smashed off entirely, and the live trolley wires fell over a length of road. A woman had her legs entangled, and received a shock from which she did not recover for several hours. The driver of a car, who was able to approach fairly closely, warned people of the danger, cut off the current, and notified the repair department. The tramway service was suspended for several hours during temporary repairs.

Haslingden.—Traffic Data.—During the nine months ended December 31st, the car-mile receipts of Haslingden tramways averaged 13·71d., as compared with 13·36d. for the same period of 1915, the total receipts being £6,559, as compared with £6,454. The mileage was 112,553, as compared with 113,644 in the nine months ended December, 1915. During the three months of October, November, and December, 1916, the car-mile receipts averaged 13·98d., as compared with 12·32d. in the same months of 1915. A reduction of car-mileage occurred, the figures for 1916 being 35,808 and those for 1915, 37,541.

Huddersfield.—Wages.—The Tramways Committee has granted an increase of 3s. per week in the bonus of male employés under the Union (excluding office staff), as from November 22nd, 1916, and a bonus of 1s. 6d. per week to the female employés (excluding office staff), from the same date.

The Committee has decided to charge for the carrying of parcels on the cars, 1d. up to 5 lb.; 2d., 14 lb.; 3d., 28 lb.; and that no parcel above 28 lb. be carried. It was further resolved that no parcels be carried after 5 p.m.

London.—An unprecedented stoppage of electric railway services on London suburban routes took place on Monday morning, when, owing to sleet having frozen on to the conductor rails, most of the exposed sections of such railways using the third-rail system were unable to run until the ice was thawed or broken off. The District, Metropolitan, South-Western, and North London Railways were particularly affected, and in some cases steam locomotives were requisitioned to haul the disabled electrics home, and steam trains ran a relief service. Attempts to scrape off the ice did not always succeed, and in some cases a hammer was required. The weather conditions as applying to electric railway working are stated to have been the worst which have been experienced since the lines were electrified.

L.C.C.—The Highways Committee reports that for the five weeks ended January 10th the total number of passengers carried on the Council's tramways was 53,160,172, giving a revenue of £221,279, as against 54,291,778 and £228,425 in the previous year; this represents a decrease of 1,131,606 passengers and £7,146 in revenue. The total traffic receipts from April 1st, 1916, to January 10th, 1917, were £1,951,183, an increase over the previous year of £147,109.

At the Tuesday meeting of the Council, it was stated that there had been 50 breakdowns in the tramway service between January 1st and Friday last. Mr. Hume, the chairman of the Highways Committee, in pointing out the difficulties which had occurred owing to the war, stated that they hoped by internal reorganisation to be able to effect an improvement, and a scheme would shortly be submitted which, though it would involve some cost to the Council, he hoped would be supported.

Stockport.—Strike.—Practically the whole of the employés on the Corporation tramways struck work on Saturday morning, and the service was suspended during the day. The employés were included in the recent award of Sir George Askwith, and the fact that the women workers were not included in the award was one of the causes of the strike. It is contended that they only earn 31s.-6d. on the full week, as against £2 by the men. The men also had a grievance that a former advance of ¼d. per hour had been discontinued, and that by the late cars being discontinued, their wages will be further reduced. The management's reply is that the late cars are being taken off because they have been run at a loss, and it is contended that the ¼d. referred to is included in the war bonus. Between 400 and 500 employés were concerned.

As a result of negotiation, the ordinary car service was resumed on Sunday. The men have been given a 52-hour week, and the question of the women's war bonus will probably be considered throughout Lancashire.

West Ham.—The tramway manager (Mr. Slattery), with a view to expediting the reconstruction of cars, has suggested the purchase of car bodies completed ready for mounting, and tenders for 20 such bodies are to be obtained.

The through service from Stratford to Chingford Mount is to be discontinued, and a service between Baker's Arms and the Docks, *viâ* Stratford instituted.

TELEGRAPH and TELEPHONE NOTES.

Cable Rates to the Dominions.—It is rumoured that the Report of the Dominions Royal Commission, which will shortly be issued, will contain recommendations for drastic changes in connection with the charges for telegrams to the British Dominions.

G.W. Railway.—Included in the work of the Signal Department of the Great Western Railway during the past year was the laying of 5½ miles of air-space core telegraph cable: in 1915 6½ miles were laid.

High-Speed Telegraphy.—The Committee appointed by the Postmaster-General at the end of 1913 to examine the various systems of high-speed telegraphy has just issued its report. The main conclusions arrived at are: That systems on the multiplex principle are definitely superior to the automatic high-speed systems on the large majority of main circuits for ordinary inland commercial telegraph work; the extension of systematic Wheatstone working should be discontinued; the Western Electric having yielded the best results, seven or eight quadruple duplex installations should be ordered; the five-unit alphabet as a code for printing telegraphy is better than the Morse code, leaving out of account news traffic and submarine cable communications.—*Daily News.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—Feb. 19th. Municipal Council. Meters, maximum-demand indicators, feeder regulators. Specification from E.L. Department, Town Hall.

March 5th. Council. One 7.500-K.V.A. turbo-alternator. See "Official Notices" January 5th.

ADELAIDE.—March 28th. P.M.G.'s Department. Telephones, telephone parts, line and battery material, &c. Shedules 444 to 453. —*Australian Mining Standard.*

MELBOURNE.—March 21st. Victorian Railways. Half-watt lamps and lanterns—*Australian Mining Standard.*

Banbridge.—February 3rd. Urban Council. Public lighting of the district with gas or electricity.

Bedford.—Electricity Department. Extensions, comprising buildings, boiler-house plant, turbo-generator, steam and water auxiliaries, switchgear, &c. See "Official Notices" January 19th.

Cheltenham.—February 14th. Corporation. Twelve months' supply of electric light fittings. Mr. J. S. Pickering, Borough Engineer.

Halifax.—February 12th. Corporation Tramways Committee. Stores and materials, including lighting materials, wheel brake blocks, trolley and overhead line materials, &c., for twelve months. Tenders to Tramway Engineer.

Keighley.—February 24th. Keighley and Bingley Joint Hospital Board. Electrical work at the Morton Banks Sanatorium. Mr. J. N. Clarkson, Clerk, 40, North Street.

London.—BATTERSEA.—February 6th. Electricity Department. Oils, engine-room stores, meters, joint boxes, &c. See "Official Notices" January 19th.

BERMONDSEY.—February 22nd. B. of G. Three, six and twelve months' supply of electric lamps. Mr. E. Pitts Fenton, Clerk, 283, Tooley Street, S.E.

Manchester.—February 2nd. Electricity Committee. Cooling towers. See "Official Notices" January 19th.

February 13th. Corporation Tramways Committee. Stores. See "Official Notices" to-day.

Middlesbrough.—February 1st. Corporation. Twelve months' supply of electric lamps. Mr. S. E. Burgess, Borough Engineer.

Portsmouth.—February 6th. Tramways Committee. Six months' supply of stores, including several electrical items. See "Official Notices" to-day.

New Malden.—January 31st. Malden and Coombe U.D.C. Installation of fire-alarm system. Particulars from the Council's Engineer.

South Africa.—DURBAN.—February 12th. Six four-ton electric travelling portable jib-cranes for the harbour.*

March 8th. Department of Post and Telegraphs. Installation of an automatic telephone exchange at Pietermaritzburg. See "Official Notices" January 19th.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Government Contracts.—List of new contracts placed during December, 1916:—

WAR OFFICE.

Distributing boards.—Dorman & Smith, Ltd.
Ebonite rod and sheet.—British Ebonite Co., Ltd.
Motor-driven fans and accessories.—J. Keith & Blackman Co., Ltd.; Sturtevant Engineering Co., Ltd.
Electric light fittings.—Barton & Sons, Ltd.; Cable Accessories Co., Ltd.; Electrical Conduits, Ltd.; Eureka Conduits & Fittings Co.; General Electric Co., Ltd.; Ingram & Kemp, Ltd.; Nettlefold & Sons, Ltd.; Oriental Tube Co., Ltd.; Perfecta Seamless Steel Tube & Conduit Co., Ltd.: Rainsford & Lynes, Ltd.; G. Roe & Sons; T. Saveker; Simplex Conduits, Ltd.; C. J. Thursfield & Co., Ltd.; Veritys, Ltd.; Walsall Hardware Mfg. Co.; Ward & Goldstone.
Generating sets.—Aster Engineering Co., Ltd.; Austin Motor Co. (1914), Ltd.; A. Lyon & Wrench.
Switchboards and dynamos.—Dorman & Smith, Ltd.; Lancashire Dynamo and Motor Co., Ltd.
Switches.—Sperryn & Co., Ltd.; J. H. Tucker & Co.
Electric wire.—British Insulated & Helsby Cables, Ltd.; Callender's Cable and Construction Co., Ltd.; I. Frankenburg & Sons, Ltd.; Fuller's Wire & Cable Co., Ltd.; W. T. Glover & Co., Ltd.; A. Green, Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Hooper's Telegraph and India-Rubber Works, Ltd.; Liverpool Electric Cable Co., Ltd.; Midland Electric Wire Co., Ltd.
Works services.—Electric lighting at Lympne: H. J. Cash & Co., Ltd. Electric lighting at Thetford: Tredegars, Ltd. Electric lighting at Turnhouse: Allan, Arthur & Ure.

INDIA OFFICE STORE DEPARTMENT.

Transmitters.—Siemens Bros. & Co., Ltd.

POST OFFICE.

Repairing wire apparatus.—Wynn, Timmins & Co., Ltd.
Telegraph apparatus.—I.R., G.P. & Telegraph Works Co., Ltd.
Telephone apparatus.—British L. M. Ericsson Mfg. Co., Ltd.; Peel-Conner Telephone Works, Ltd.
Tubular telegraph-pole arms.—Bullers, Ltd.
Submarine cable.—Telegraph Construction & Maintenance Co., Ltd.
Telegraph cable.—Henley's Telegraph Works Co., Ltd.; Johnson and Phillips, Ltd.; Siemens Bros. & Co., Ltd.
Loading coils.—Western Electric Co., Ltd.
Galvanometers.—Edison Swan Electric Co., Ltd.; W. G. Pye & Co.
Plates for stay-rods.—Bayliss, Jones & Bayliss.
Cable distribution plugs.—B.I. & Helsby Cables, Ltd.
Stay-rods.—Bayliss, Jones & Bayliss, Ltd.
Suspenders for cable.—P. Huntingdon & Co.
Bronze wire.—T. Bolton & Sons, Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. & Smiths, Ltd.).
Copper wire.—B.I. & Helsby Cables, Ltd.

Ireland.—NEWCASTLE WEST.—The Newcastle West Commissioners have decided to accept the tender of Mr. Wm. Phelan, managing director of Newcastle West Electric Light Co., for lighting the town.—*Freeman's Journal.*

London.—L.C.C.—The Highways Committee has received the following tenders for alterations and additions to switchgear in connection with the third new turbo-generator to be installed at Greenwich generating station:—

Ferguson, Pailin & Co., Ltd.	(accepted)	£2,444
British Westinghouse E. & M. Co., Ltd.		5,256
British Thomson-Houston Co., Ltd...		5,519

For additional steam, exhaust and condensing water piping, &c., required in connection with the new turbo-generator:—

Brightside Foundry & Eng. Co., Ltd.		£5,527
Babcock & Wilcox, Ltd.	(incomplete)	5,943
J. Spencer, Ltd.		7,055

The tender of the Brightside Foundry & Engineering Co., Ltd., has been accepted, plus £140 for thicker plates for the large circulating water pipes, and £235 for steam pipes with riveted flanges and for valves of a type different from the type originally specified.

Mechanical stokers for four water-tube Stirling boilers at Greenwich generating station, to render them suitable for burning coke or low-grade coal:

Underfeed Stoker Co., Ltd...	(accepted)	£5,447
E. Bennis & Co., Ltd.		5,945

The Stores and Contracts Committee has accepted the following tenders during the three months ended December 31st, 1916:—

Electric insulating material, Schedule No. 15 (40 firms invited to tender).—L. Andrew & Co. (items 2 and 9); R. W. Blackwell & Co., Ltd. (items 1, 6 and 7); G. Hattersley & Sons (item 10); Hooper's Telegraph and India-Rubber Works, Ltd. (item 8); G. MacLellan & Co. (item 3); Siemens Bros. & Co., Ltd. (items 4 and 5).

Electric lamps, Schedule No. 17 (15 firms invited to tender).—Maxim Lamp Works, Ltd. (items 1 to 7); Pope's Electric Lamp Co., Ltd. (items 8 to 27), estimated value £2,472 (metallic-filament lamps with filaments of drawn wire in one continuous length); Cryselco, Ltd. (items 8 to 27) (metallic-filament lamps with filament not of drawn wire), estimated value £2,538.

Electric lamps, Schedule No. 17 D (11 firms invited to tender).—Maxim Lamp Works, Ltd. (item 2), estimated value £3,437.

The Committee calls attention to the fact that of the eight firms who submitted tenders for electric traction lamps, seven quoted the same price and discount.

The Stores and Contracts Committee has arranged for the supply from various firms during the year 1917 of electric fittings and engine packings subject to current discount rates on catalogue prices, and for the supply of wrought-iron tubing until February 10th, 1917, at discounts off the standard list.

BOARD OF TRADE.—The Board of Trade has placed with Messrs. W. C. Tackley & Co., Ltd., of West Kensington, the contract for the entire installation of electric lighting for the British Industries Fair, which opens next month. The contract includes, for the stands for the two buildings—the Victoria and Albert Museum and the Imperial Institute—between 2,000 and 3,000 lights (25 and 32 C.P.) Supply is obtained from separate mains taken into both buildings by the Office of Works, and aerial wires are carried well over the top of the stands. The work is well in hand already. Messrs. Tackley will have a stand at the Fair.

Rawtenstall.—The tender of Messrs. Jones Bros., of Manchester, has been accepted for the lighting by electricity of a portion of Bury Road.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, January 26th. At 5 p.m. At the Imperial College of Science and Technology, South Kensington, S.W. General meeting.

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, January 30th. At 7.30 p.m. At the Engineers' Club. Paper on "Fuel Economy," by Mr. J. Drummond Paton and Mr. J. Frith.

Royal Society of Arts. Tuesday, January 30th. At 4.30 p.m. At John Street, Adelphi, W.C. Lecture on "Imperial Industries After the War," by Mr. O. C. Beale.

Chemical Society. Thursday, February 1st. At 8 p.m. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

Royal Institution of Great Britain.—Thursday, February 1st. At 3 p.m. At Albemarle Street, Piccadilly, W. Lecture on "The Mechanism of Chemical Change," by Prof. F. G. Donnan, F.R.S.

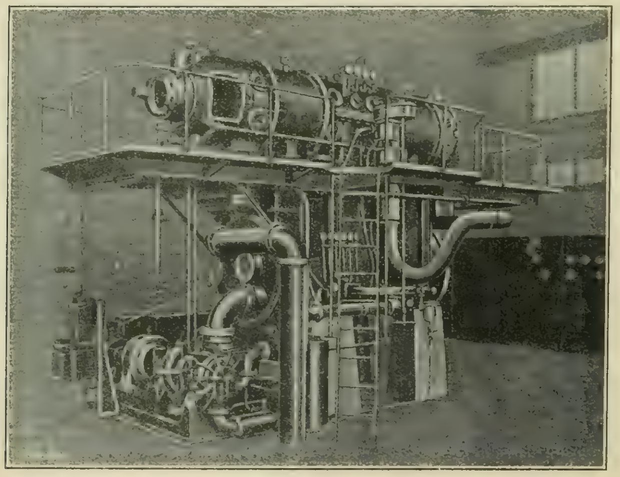
Friday, February 2nd. At 5.30 p.m. At Albemarle Street, W. Lecture on "The Supply of Gaseous Energy," by Dr. C. Carpenter.

NOTES.

Electrical Steel in France.—It is announced that the Société Paul Girod, which utilises the water power in the valley of the Arly at Ugine, has brought into operation a new electric steel furnace of 10 tons capacity. This will enable the production of electric steel to be increased to 150 tons per day.

Trade with Russia.—An important scheme for the promotion of closer commercial and educational relations between Glasgow and Russia was inaugurated at a public meeting in Glasgow, last week, convened by the Lord Provost. It was explained that Mr. William Weir, Director of Munitions for Scotland, had endowed for five years a lectureship in Russian at Glasgow University, and that Messrs. Brown and Messrs. Denny, shipbuilders, had promised a sum for five years for a Russian travelling scholarship. The Lord Provost appealed for £50,000. A fine response resulted.—*Daily Telegraph.*

Self-contained Turbo Sets.—In our issue of November 24th last, in discussing some aspects of power-station design, we referred to the apparent desirability of revising our ideas of engine-house design, in view of the evolution of types of generating plant which differ so essentially in constructional and operating characteristics from the plant types of the past. In the old days the bulk of the running plant demanding supervision was above the engine-room floor; nowadays the plant in the basement requires the most attention, the condensing plant being all-essential to efficient operation.



Self-Contained Turbo-Condenser Set.

It was suggested that, in view of tendencies in plant design, the most efficient arrangement would be to make the present basement floor the starting point for engine-room structures and to develop self-contained turbo-condenser plant, which, in addition to involving less costly buildings, would facilitate supervision of the running of the whole plant. Our view shows a turbine set of this type in a Continental power station.

Cable Makers' Association.—We are notified by the secretary of the Cable Makers' Association that they have left No. 64, Victoria Street, Westminster, S.W., and taken new offices at Sardinia House, Sardinia Street, Kingsway, London, W.C., to which address in future all communications should be sent.

Electric Starting Sets on Motor Cars.—One of the most noteworthy differences between American and British motor-car construction is the way in which electric engine-starting devices have been adopted as a standard fitting on the cars turned out on the other side of the Atlantic. While in this country but few car manufacturers have adopted such installations as standard. We note from a list of 181 different models of cars published lately in an American contemporary that no fewer than 177—that is, all but four—are provided with an electric engine starter.

L.C.C.—The Finance Committee reports to the Council that it has decided that, until further order, the rate of interest to be charged by the Council for loans to local authorities shall be 5½ per cent.

The Stores and Contracts Committee reports having made inquiries with regard to a number of firms who were suspected to be controlled wholly or largely by enemy aliens, and, as a result, has removed the names of three firms from the Council's lists of firms to be invited to tender for the supply of stores, &c.

A Vital British Industry.—The perfection of the high-speed internal-combustion engine, which began with the introduction of the motor-car 21 years ago, has re-modelled our methods of traction, and, at the same time, created a vast industry, with a large number of contributory trades more or less dependent on it. Among the most important of these may be classed the manufacture of magnetos. When war broke out there was only one British firm making magnetos, its output being under a 100 a week. Practically every magneto which went on to the motor vehicles, motor boats, and aircraft of Great Britain came from enemy Germany or from America. Till August, 1914, we had been content to go abroad for nearly all our magnetos.

But in a few short months British manufacturers got steadily to work. Some of the best scientific brains in this country were enlisted. New and special steels and other materials were evolved. To-day there are some 12 or more British firms making magnetos. Their entire outputs, reaching a total to date of over 165,000 magnetos, have been made for war purposes, and are used on aeroplanes, seaplanes, airships, motor lorries, motor ambulances, motor cycles, "tanks," big gun tractors, motor boats, wireless sets, searchlight sets, lighting sets, &c. In fact, it may be said that the war is being conducted on British-made magnetos.

After the war the resources of the British magneto manufacturers will be at the disposal of the British public. There will be no need to buy enemy or other foreign magnetos.

Lighting Restrictions in France.—As was mentioned in a previous issue, the French Government has published decrees for the purpose of bringing about a reduction in the consumption of gas and electricity for lighting. In the first place, Article 1 of the decree of November 21st, 1916, provides "that no new contract may be entered into or an increase made in any existing contract without the authority of the Ministry of War in the case of all distributing networks which supply either State establishments or private establishments and works which are occupied on work for the national defence." The decree was brought into force on December 19th, when the electricity supply undertakings concerned were specified as comprising (1) all those for the sale or distribution of energy whose generating stations have a total power installed which is equal to or greater than 500 KW., and (2) the companies which purchase from generating undertakings which are subject to the regulations of the decree, the whole or a portion of the energy which they resell. Lighting applications for less than 5 hectowatts, and those for power for less than 1 KW., however, can be satisfied by the companies in question without the advice of the military authority.

A further decree has been promulgated by the Ministry for the Interior in regard to the consumption of energy by lighting customers. According to this measure the maximum consumption of each user has been fixed on the basis of the actual consumption either in 1913 or 1915, but the total consumption cannot exceed 80 per cent. of the basis consumption. The latter was modified at the end of December, so that the permissive maximum daily consumption per person residing with the consumer is now 3½ hectowatts for a consumer who formerly used 5 hectowatts; 4 hectowatts as compared with 7 hectowatts previously, 4½ hectowatts as against 9 hectowatts, and 5 hectowatts as contrasted with 11 hectowatts formerly. In those cases where the consumption was over 11 hectowatts the daily consumption has been fixed at 5 hectowatts, plus one-sixth of the proportion of the basis consumption higher than 11 hectowatts. A variation of 10 per cent. is allowed.

Inventions for the Admiralty.—The Admiralty has issued a notice reminding the public that correspondence on naval matters should not be addressed direct to individual members of the Board of Admiralty, but in the case of inventions to the Secretary, Board of Invention and Research, Victory House, Cockspur Street, S.W., and, in all other cases, to the Secretary of the Admiralty.

Metropolitan Association of Electric Tramway Managers.—A meeting of the members of this Association was held at the Municipal and County Club, Whitehall Court, Whitehall, S.W., on Friday, the 19th inst., when there were present: Messrs. Ullmann (East Ham), chairman, Hammond (M.E.T.), vice-chairman, Bruce (L.C.C.), Schofield (Leyton), Harvey (Ilford), Slattery (West Ham), Mason (South Met.), Mackinnon (London United), and Goodyer (Croydon), hon. sec. Letters notifying inability to attend were received from Messrs. Stokes (Bexley Heath), Williams (Erith), and Murray (Walthamstow). Various matters of interest were discussed.

"Sterling" British Products.—While the Sterling Telephone and Electric Co., Ltd., has been busily engaged almost from the commencement of the war on work of national importance, the fact that until recently it had not been able to shake off wholly the trammels of its earlier associations no doubt detracted somewhat from the satisfaction of the management and staff. Hence, we suppose, it was felt that the purchase of all the enemy shares from the Public Trustee by Sir John Bethell and his friends, announced in our last issue, and the changes in the directorate, called for a special celebration, which, in accordance with British custom, took the form of a dinner, at which the staff and a few friends were the guests, about 120 in all, of the chairman and directors of the company. Sir John Bethell, Bart., M.P., presided, and was supported by Mr. Guy Burney (managing director) and Mrs. Burney, Sir Thos. Bethell, Mr. C. S. Syrett, and Mr. L. A. McGeoch.

After the loyal toast had been duly honoured, and the chairman had proposed "H.M. Forces," Mr. Burney proposed "The Staff," expressing his cordial appreciation of the magnificent work they had accomplished since the outbreak of war: before that event the company employed in all 300 persons—now, at Dagenham alone, their workpeople numbered over 1,400. He made special mention of the services of Mr. Sherwood, his right-hand man from the beginning, 16 years ago; Mr. Bell, with a record of 14 years of invention in telephone and signalling systems; and several other members of the staff, including ladies, who had been with the firm for 8 to 16 years. Many of their former colleagues were serving with the Forces—all by choice and not under compulsion—and happily there had not been one fatal casualty among them; their positions were kept open, and they would be welcomed on their return. He wished for closer contact between the staff and the workpeople, and to that end hoped soon to erect a club house near the works, on a site of 5½ acres, the whole of which would be available for recreation. Mr. Burney concluded by urging his hearers to be provident while they were prosperous, for, while he had every confidence in the future of the company, there might be a period of reaction for which they should provide in time.

In reply, Mr. Sherwood referred to the strong support and encouragement received from Mr. Burney by the staff, who had all worked together with the greatest goodwill, and Mr. Janes pointed out that their success was largely due to Mr. Burney's gigantic efforts to secure contracts and machinery.

Proposing "The Directors," Mr. Bell referred to their excellent qualifications for their office, and said they were a board that any body of men should be proud to serve. Mr. McGeoch, in reply, mentioned that he had for 17 years been associated with Mr. Burney, and endorsed a remark of Mr. Bell's that good material and the best workmanship should be the hall-mark of British manufactures in the trying times to come. Mr. W. J. Hammond proposed "The Ladies," and Mrs. Parrett, the supervisor of the welfare department, responded in an excellent speech, in the course of which she paid a tribute to Mrs. Burney as a real true friend to all the women workers.

In proposing the health of the managing director, Mr. F. S. Hooker dwelt on the indomitable courage and energy with which Mr. Burney had overcome innumerable difficulties, and had brought the company into its present strong position; his relations with the staff had been most cordial, and as a token of their appreciation of the way in which he had governed them, they wished to present him with a Cromwellian clock and an illuminated address. The toast was accorded musical honours, and Mr. Burney expressed his heartfelt thanks for these marks of their esteem, with which he was highly gratified. Afterwards reviewing the history of the company from its earliest days, he described how in 1902 he had placed on the market the first successful multiple-lever automatic interphone, of which enormous numbers had been sold. The Dagenham works were started in 1910, the whole of the staff being British from the commencement: they were getting on nicely until the outbreak of war put an end to their industrial activities. However, large contracts were obtained, which had amply compensated for the diminution of their ordinary business.

Mr. Burney then proposed "The Visitors," coupling with the toast the name of his first customer, Alderman Duncan Watson, who, in reply, expressed his continued satisfaction, over a period of 17 years, with the company's products; he regarded the example of the Sterling Co. as one that should be copied by every firm in the country. Mr. S. R. Worley, proposing "Prosperity to the Firm," expressed his admiration of the organisation of the company's works and of the care displayed for the comfort and happiness of the employés, and Sir John Bethell, in reply, stated that the establishment was the best organised of all that he had inspected; only housing accommodation was lacking, and that problem would have to be solved in the near future. The proceedings were enlivened by an excellent programme of music, &c. In spite of the restrictions imposed by war conditions, the occasion was a marked success in every way, and made an admirable start for the new *régime*.

Institution and Lecture Notes.—Belfast Engineers' Association. On Friday evening last a paper by Mr. C. G. [illegible] entitled "Electric Lifts on Land and Shipboard" was read by Mr. P. H. Stevens. The paper dealt largely with the mechanical side of the subject. In marine lifts, the author said that all the features of land lifts must be repeated, with additions. The pitching and rolling of a ship would demand stronger fixings for the winding engine, and this was still more true of all portions at the head of the lift well. The guides, in a cross sea, with the cage and balance-weight trying to swing as pendulums, would be subjected to serious cross stresses, and must not only be stiffer in action, but more firmly secured. Yet it must be remembered that no ship was absolutely rigid in heavy seas, and if no flexibility in fixing was provided, something must go. The swinging control cables below the cage were generally voted a nuisance, but the only alternatives were bare live conductors, as in a crane, or a weighted and guided pulley running in the bight of the bundle of cables. The first was clearly out of the question, and the second broke up the cables and set up dangerous short circuits. But if the fittings inside the well were so formed that the free-swinging bight could not catch beneath them when rising, there need be no trouble. All switches should be made hose-proof, and the motor and controller should be housed on a lower deck and properly protected from sea wash. The brake should be modified so that when free for running, with the ship rolling, the chocks should not be able to hammer the wheel.

Association of Mining Electrical Engineers.—At a meeting of the West of Scotland Branch, in Glasgow, on the 20th inst., Mr. H. A. M'Gubbie, convener of the Bell Signalling Committee, introduced a demonstration with mining signals and bells to comply with the new regulations set up by the Home Office. Various systems of sparkless signalling for underground use were tested and explained, including the Davis-Macdonald solenoid bell arrangement, a device fitted by the Sterling Telephone Co., the Davis-Railing patent relay, which has been introduced by the General Electric Co., the "Wigan" bell and relay supplied by Messrs. Heyes & Co., and Prof. Thornton's device for testing the efficiency of existing bells and relays. At an interval in the proceedings, a paper on "Modern Switch and Fuse Gear" was read by Mr. Alex. M'Phail (Kilmarnock).

Electric Power and the Output of Boots.—At Northampton Tribunal, on Tuesday, the Northampton Electric Light and Power Co., Ltd., appealed for the exemption of Alfred Hutchings, aged 29 (married), an electrician, wireman, and motor inspector, passed for Class B1, and William Trusler, 39 (married), general labourer, passed for Class A. A representative of the firm said the labourer was employed on the work of the new generating station, which was urgently required for the production of electricity for industrial purposes. The work was certified Class A, and was being carried out with the sanction of the Government. The Chairman: So far as the demand for current for industrial purposes goes, that will go down a great deal owing to men being taken from the boot factories. The Representative: It is not making any difference to our output, which is going up. Is not the tendency rather to replace men by machines, and so increase the demand for power? Mr. Gribble (a member of the Tribunal): That is certainly the logical conclusion. The Tribunal gave three months' exemption, with V.T.C. conditions in each case, and the military representative said he would have to appeal from the decision so far as it concerned Hutchings.

New American Electric Passenger Car.—The Milburn Wagon Co., of Toledo, Ohio, has introduced a new type of town passenger "electric," which appears to mark a considerable advance in this type of vehicle. The car seats four passengers in the enclosed body, and another one with the driver on the driver's seat. It has a wheel base of 105 in., and total length of 146 in.; it is equipped with a G.E. motor and controller, and wire wheels with 4-in. tires. The car speed is from 6 to 25 miles an hour, and the travelling radius is 60 to 80 miles with lead batteries (Philadelphia), or 70 to 90 miles on Edison batteries.

Moscow's Proposed New Electrical Station.—The responsible agent of the Belgian Central Electrical Station Co., of Moscow, D. P. Rotzoff, has announced in Belgium the refusal of the Town Council to return to the company its cash deposit for the concession to construct a second electrical station in Moscow. The Town Administration, without waiting for a claim from the company, is arranging to turn the deposit over to the town funds, and to use the piece of land purchased in the name of the town for the construction of a station. It is not believed in the Town Administration that the Belgian company will make any claim for the return of the deposit. Not only are the hopes of winning such claim very small, but there are other obstacles as well. In order to initiate such a claim, it would be necessary to deposit over 50,000 roubles in legal dues, and the company hardly possesses sufficient funds to do this.

Reversal of Rotation of Three-phase Motors.—Under certain conditions, when one phase of a three-phase distribution system is interrupted, the motors connected to the system may begin to rotate backwards. An instance reported by the *E.T.Z.* occurred on the system supplied by the Hoechst electricity works last year. Owing to the fracture of an insulator on the occurrence of a short-circuit, an oil-switch failed to close one of the phases, and the motors in a number of works started up in the wrong direction.

Volunteer Notes.—First London Engineer Volunteers. Headquarters, Balderton Street, Oxford Street. Orders for the week, by Lieut.-Col. C. B. Clay, V.D., Commanding :—

Monday, January 29th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30—8.

Tuesday, January 30th.—A volunteer fatigue party is required to assist the Quartermaster.

Wednesday, January 31st. Instructional Class, 6.15. Platoon Drill, Platoon No. 1.

Thursday, February 1st.—Platoon Drill, Platoon Nos. 5 and 6. Ambulance Class by M.O., 6.30.

Friday, February 2nd.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.25—8.25.

Saturday, February 3rd. Commanding Officers' Parade, 2.45. Uniform.

Sunday, February 4th.—Entrenching at Otford. Parade Victoria (S.E. & C. Railway Booking Office), 8.45 a.m.

(By order), Macleod Yearsley, *Adjutant.*

Trade Union "Discipline."—Mr. H. W. Thornton, general manager of the Great Eastern Railway, in a recent speech spoke of the lack of discipline in British Trade Unionism. According to the *Times*, he said it was nothing more or less than a pest. "He and his colleagues had frequently come to an understanding with the representatives of the men on some particular question, only to find that when the representatives went back to their constituents the whole thing was upset. If British Trade Unionism was to get on, and was to earn the confidence of employers, it must look to its internal discipline, and see that when a bargain was made by the leaders of a Union that bargain was adhered to by all the members of the Union as faithfully as it was adhered to by the employer."

Re Cedes Electric Traction, Ltd.—In the Winding-up Court, on Wednesday, Mr. Justice Astbury decided to postpone for six months an order for the compulsory winding up of this company, in order to enable the Board of Trade to decide whether it should exercise its powers under the Trading with the Enemy Act. The application was made by an English creditor. The winding-up order was made last April. It was stated that there were a number of unsecured English creditors, but that an enemy creditor now claimed a sum which, if admitted as a debt, would swamp the assets so far as the English creditors were concerned.

Prohibited Exports.—A Supplement to the *Board of Trade Journal*, of January 25th, contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported to various destinations from the Straits Settlements, Hong-Kong, Nigeria, Gold Coast, Jamaica, Barbados, Trinidad and Tobago, and British Guiana.

Technical Training for Disabled Sailors and Soldiers.—The Education Committee of the L.C.C., referring to the course of training to enable sailors and soldiers to qualify for employment as switchboard or sub-station attendants which has been established at the Northampton Polytechnic Institute, has considered the report of the Committee of the Institution of Electrical Engineers on the courses, and gives the following figures relating to the work accomplished in the three courses which have been held since the scheme commenced :—

	First course.	Second course.	Third course.
(*a*) No. of applicants for admission ...	22	21	22
(*b*) No. commencing the course ...	13	20	18
(*c*) No. approved for employment ...	15	14	—
(*d*) No. actually placed	13	12	—
(*e*) No. of applications from employers	16	42	over 50

The differences between the figures given under (*c*) and (*d*) are due to the fact that even at the end of the training, certain men were not ready to discontinue hospital treatment.

The increase in the number of applications from employers, and other evidence, such as the reports from employers on the work of those who passed through the course, seem to indicate that the course has been well planned, and that the men are being enabled to earn their own living.

New American Westinghouse Works.—According to the *Electrical World*, arrangements have been made by the Westinghouse Electric and Manufacturing Co. to construct a large factory on the Delaware River at Essington, Pa., not far from Philadelphia. The land has a deep water frontage, and provides sufficient area for a factory development several times as large as the East Pittsburg works ; it is reported that the new plant will cost between 5 and 7 million dollars, and employ 15,000 men.

Appointments Vacant.—Shift engineer, for Colchester electricity supply department ; temporary charge engineer (£3), for the Borough of Southwark electricity department. See our advertisement pages to-day.

Cornish Tungsten.—Steps have been taken to press on the working of the wolframite deposits on the Duchy of Cornwall estates at Hingston Down and Kit Hill ; new machinery has been erected, and it is understood that good progress has been made. Fine lodes of ore have been discovered, and it is the opinion of experts that in the future Cornwall will be able to produce a large proportion of the wolfram required in this country.—*The Times.*

Removing Drilling Tools from Oil and Gas Wells.—According to a patent of Walter O. Snelling, of Pittsburg, Pa., drilling tools which have become broken and jammed in drilling wells may be removed by introducing a salt solution, lowering a copper bar until it makes contact with the iron drill, and then passing a current of 300 to 400 amperes through the electrolyte. The nascent oxygen formed corrodes the iron, and this corrosion may be carried so far as to completely consume the tools, or only partial corrosion may be carried on, when the tools become dislodged and may be fished out. *Met. and Chem. Engineering.*

Consular Reform.—The recommendations of the Association of Chambers of Commerce as to the reform of the Consular Service have been heartily endorsed by the affiliated Chambers. The Association has received a letter from the Foreign Office stating that Lord Robert Cecil is prepared to receive a deputation, but suggesting that before a date is fixed the Council should study the report recently drawn up by a Foreign Office Committee respecting the proper organisation of the Government service of commercial intelligence in foreign countries. The Council of the Association has now expressed itself in agreement with the broad lines of this report.—*Daily Telegraph.*

The *Times* refers to the matter at some length in its issue of January 20th. The report to the Foreign Office is stated to be a confidential but very important one ; indeed, so revolutionary is it said to be that if the changes that it advises in the Consular Service are adopted, the position will be so altered that all recommendations will require to be reconsidered as a whole. The adoption of a general foreign trade policy is forecasted.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The General Purposes Committee of the L.C.C. report having granted leave of absence, owing to illness, for six months, if necessary, to Mr. A. L. C. Fell, the chief officer of tramways.

The Willesden Urban District Council has decided, in view of the progress of the electricity undertaking and the important duties discharged by Mr. Blake, that his salary, as from April 1st next, be increased from £400 to £500, and thence by two annual increments of £50 to £600.

West Ham Corporation has granted the following increases of salary, amongst others, in connection with the working at the electricity department, the figures being exclusive of war bonuses payable :—Mr. E. Tombs, stores manager, from £200 to £220; Mr. J. Layton, senior shift engineer, 70s. a week to 75s.; Mr. A. J. Giffin, ditto, 67s. 6d. to 72s. 6d.; Mr. W. Bridger, ditto, 65s. to 70s.; Mr. W. Spittle, ditto, 62s. 6d. to 67s. 6d.; Mr. W. J: Watson, mains foreman, £147 to £160; Mr. W. A. Wiggins, electricity collector, from £150 to £165, increasing after 12 months to £175.

Mr. Wm. Mills, Glasgow, has been appointed chief assistant at the Falkirk T.C. electricity works, at £150 per annum.

General.—Mr. S. E. Bastow, who for the last four years has been joint manager of Bruce Peebles & Co., Ltd., Edinburgh, has accepted the position of chief engineer to British Dyes, Ltd. Mr. Bastow's headquarters will be at Huddersfield. Mr. John H. Bunting, who for the last four years has been joint manager of Bruce Peebles & Co., Ltd., has been appointed general manager of the company.

Mr. Ethelbert Rendell has been given a commission as Second-Lieutenant in the Tyne Electrical Engineers, R.E.

Ald. J. P. Smith, J.P., who has been chairman of the Barrow Corporation Electricity Committee since its formation in 1897, has been admitted to the freedom and livery of the City of London in the Feltmakers' Company.

Mr. J. B. Hamilton, the Leeds city commercial manager since 1914, and formerly tramway manager, has been appointed Director of Trades Regulations in the Admiralty department, now being organised by Mr. Lynden Macassey, K.C., for control of labour in shipyards and machine and boiler works. All the Leeds Corporation Committees have approved Mr. Hamilton's acceptance of the post, conditionally on his being available as necessity may arise. His salary will be paid by the Corporation, the Admiralty, as in the case of other municipal officials lent, bearing the expenses incidental to the appointment. As commercial manager of all municipal undertakings at Leeds, Mr. Hamilton has the direction of 8,000 workers.

Mr. Thomas F. Maylor, who before the war was assistant chief inspector at Messrs. Dick, Kerr & Co.'s, Ltd., Preston, and who is now chief inspector at a large Government munition factory in the Metropolis, has been presented with a gold watch, subscribed for by the employés as a mark of esteem.

Roll of Honour.—We have received a copy of the latest Roll of Honour of Edmundsons' Electricity Corporation, Ltd., from which it appears that there are 404 men from the associated undertakings now serving with the Forces. Eighteen of the staff have made the supreme sacrifice. The D.S.M. has been gained by J. C. Knight, of the Frome undertaking; the D.C.M. by C. W. Saunders, of the Twickenham undertaking; and the following have won the Military Medal:—V Johnson, of Godalming; J. Polkinghorne, of Hayle; and J. Summers, of Hamilton.

Lance-Corporal R. TONGE, Lancashire Fusiliers, previously reported missing, and now reported killed, was employed by the British Westinghouse Co., at Trafford Park.

Private J. McLAUGHLIN, who has been killed in action in Mesopotamia, was employed by Messrs. Dick, Kerr & Co., Preston.

Captain HARRY RICHARDSON, R.E., has been "mentioned" for distinguished service at the Front. Captain Richardson, who is the general manager of the Dundee Corporation electricity department, has been at the Front with his unit for 18 months.

ALFRED H. ADAMSON, late sub-station attendant to the Poplar electricity undertaking, has been awarded the Military Medal.

Private T. MACDONALD, of the Cheshire Regiment, killed in action, was at the British Westinghouse Works, Trafford Park.

The Military Cross for gallantry in action has been awarded to Captain H. S. LAVERACK, East Yorkshire Regiment, formerly an engineer at Messrs. Siemens Bros. Dynamo Works at Stafford.

Private E. L. GORDON, Royal Warwickshire Regiment, who has died of wounds received in action, was with Messrs. Bullers, Ltd., of Hanley.

Second-Lieutenant J. E. TOWNSEND, R.F.C., who has been killed whilst flying at Bristol, was at the Rugby works of the British Thomson-Houston Co., Ltd.

Obituary.—MR. F. FARQUHAR.—The death has occurred, at the age of 39 years, of Mr. Francis Farquhar, manager of the electrical department of Messrs. Claud Hamilton, Ltd., Aberdeen.

MR. R. W. MARTIN.—Mr. Richard W. Martin, electrical engineer, of Castle Cary, aged 35 years, was killed whilst motor cycling on January 13th. He collided with the wheel of a trap after turning a corner, and he died the next night after undergoing an operation.

MR. W. TALLETT.—The death has taken place, suddenly, at the age of 50, of Mr. Wm. Tallett, electrician, of Malvern, who was for nearly 30 years engaged in the business of Messrs. Sparkes & Houlton, Ltd., of Malvern.

NEW COMPANIES REGISTERED.

William Taylor (Electric Lamp) Co., Ltd. (145,750).—This company was registered on January 11th, with a capital of £300 in £1 shares, to carry on the business indicated by the title. The subscribers (with one share each) are: W. Taylor, 8, India Street, E.C., electrical engineer; J. Berg, 8, India Street, E.C., insurance broker. Private company. W. Taylor is the first permanent director. Registered office: 8, India Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Woking Electric Supply Co., Ltd.—Issue on various dates from May 24th, 1914, to May 2nd, 1915, of debentures totalling £2,630 (£1,200 being conversions), parts of a series of which particulars have already been filed. (Notice filed January 11th, 1917.)

Electric Construction Co., Ltd.—Satisfaction of debenture stock: The whole of the £50,000 4½ per cent. redeemable second mortgage debenture stock secured by trust deed of February 18th, 1899, was redeemed by purchase in 1909-10, but resolutions were passed by the board to keep the stock alive for purpose of re-issue. By board resolution of January 11th, 1917, the whole of the said stock was cancelled, and the property comprised in the trust deed has been released.

Burnham & District Electric Supply Co., Ltd.—Debentures dated January 2nd, 1917, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Lloyds Bank, Ltd.

Tyne Electric Steel Foundries, Ltd.—Issue on December 18th, 1916, of £5,700 debentures, part of a series of which particulars have already been filed.

Issue of January 12th of £4,500 debentures, part of a series of which particulars have already been filed.

CITY NOTES.

French Electrical Companies.

The accounts of the *Société Gramme* show gross profits amounting to £23,000 for the year 1915-16, as compared with £17,000 in the previous twelve months, and net profits of £10,000 and £4,600 in the two years respectively. It is proposed to pay a dividend of £1 2s. per share, being the same rate as in 1914-15, and to place £2,400 to a war reserve fund.

The Compagnie Parisienne de l'Air Comprimé reports for 1915-16 gross profits of £21,000 from the compressed-air business, and interest of £59,000 from investments, as compared with £23,000 in the case of the former department in 1914-15. The net profits amount to £63,000, as in the previous year, and the dividend is to be at the rate of £1 4s. per share, as in 1914-15.

The accounts of the *Compagnie Générale d'Electricité of Paris* show gross profits of £199,000 for 1915-16, as compared with £163,000 in the previous year. After defraying interest charges on loans, &c., the net profits are stated to have reached £172,000, including the balance forward, as compared with £124,000 in 1914-15. The directors recommend the payment of a dividend of £2 per share, as against £1 in the preceding twelve months.

The Société Industrielle des Téléphones, which owns six manufactories (of which five are situated in the war zone), reports gross profits for 1915-16 amounting to £260,000, as compared with £117,000 in the preceding year. After deducting general expenses and interest on loans, the net profits are returned at £204,000, as against £73,000 in 1914-15. The sum of £60,000 has been set aside for depreciation, as compared with £30,000 in the previous year, and £44,000 has been placed to the contingency fund. The recent meeting sanctioned the payment of a dividend of £1 4s. per share, this comparing with 12s. per share in 1914-15. It was then mentioned that the cable steamer *Francois Arago* had been sold, and the amount of the difference between the book price and that realised from the sale had been devoted to depreciation of the works at Calais.

Austrian Companies.

The Oester. Brown-Boveri Werke, of Vienna, report net profits amounting to £32,000 for the year ended on June 30th, 1916, most of which has been applied to the extinction of the loss incurred in 1914-15. It is stated that in consequence of the larger turnover, and the increased demands made upon the productive capacity, the company intends to erect large works on the outskirts of Vienna. The necessary funds are to be provided by the augmentation of the ordinary share capital from £187,000 to £354,000, which issue is being taken over by the Austrian Daimler Motor Co. At the same time, an agreement of long duration has been concluded between the two companies, the association of the Motor Co. bringing Baron von Skoda within the scope of the electrical industry. The existing capital of the Brown-Boveri Co. is held partly by the United Electricity Co., of Vienna, and partly by a syndicate composed of the Lower Austrian Discount Co., the Pesth Commercial Bank, and the Swiss firm of Brown-Boveri.

The report of the *Ver. Elektrizitats Gesellschaft, of Vienna*, states that the company's works continued to develop in 1915-16. The manufacturing firms associated with the company were fully occupied during the year, and were also now employed to the limit of their capacity. In the case of the electricity supply works, the consumption of energy had increased everywhere, and the traffic on the tramways had also expanded. On the other hand, the prices of raw and other materials had risen beyond every expectation. The United Glow Lamp & Electricity Co., of Ujpest, in which the company was interested, had paid a dividend of 12 per cent. for 1915-16, as compared with 8 per cent. in 1914-15, and the United Electricity & Machinery Works, of Pest, had again been able to distribute 6 per cent. The Austrian Brown-Boveri Co. was exceptionally well provided with orders for the Army authorities and for private customers. The accounts of the Ver. Elek. Ges. indicate net profits of £37,000, as against £44,000 in 1914-15, and the dividend is at the rate of 7 per cent., as compared with 4 per cent. in the previous year.

Aluminium Corporation, Ltd.—The Aluminium Corporation has deposited a Bill for introduction into Parliament next session "to arrange for the extinction of its participating shares." The preamble states that 5,000 of these participating shares were issued at the incorporation of the company in 1900, and are now entitled to a dividend "equal to eight times the dividend of 7 per cent. payable on each £1 of the preference stock, and, on a return of assets, to the sum of £8 in respect of each participating share." The Bill, therefore, proposes to empower the Corporation to increase its capital by the creation of £40,000 preference stock, and to distribute this stock among the holders of the participating shares in the proportion of £8 of the stock for each 1s. share. The new preference stock is to rank equally with the existing preference stock, and is to be entitled to the three years' cumulative dividend of 7 per cent. now in arrear on that stock.—*Times*.

Northampton Electric Light & Power Co., Ltd.—The new issue of shares has been subscribed for in a manner with which the directors are quite satisfied. Applications were sent in for 29,935 shares, and these have all been allotted. The issue was of 50,000 £1 shares at par, and had the prospectus been sent out a few days earlier, and the clash with the War Loan avoided, there is no doubt that it would have been over-subscribed. There will not be the slightest difficulty in obtaining the full £50,000, and the new works are being pushed forward with the fullest possible speed.

The New War Loan.—The General Electric Co., Ltd., have taken up the new war loan to the extent of £200,000, of which £100,000 is new money.

A number of other well-known electrical and engineering concerns appear in the newspaper lists as large subscribers, among them being British Insulated & Helsby Cables, Ltd., Mather & Platt, Ltd., Automatic Telephone Manufacturing Co., Ltd., the Federation of British Industries, &c.

Brazilian Traction, Light & Power Co., Ltd.—Dividend, 1 per cent. on the ordinary capital stock, payable March 1st.

STOCKS AND SHARES.

Tuesday Evening.

The question which continues to engage most discussion in the Stock Exchange is whether national interest is served by vicarious selling of securities in order that the money may be put into the War Loan. This applies to all the markets, but particularly those connected with investment stocks and shares.

Talking the matter over with a well-known member of the electric lighting and supply section, he took the view, which is supported by a good many other people in the House, that whereas if a holder of shares sells them in the Stock Exchange the buyer probably utilises money which in any case would not have been put into the War Loan; and accordingly the capital which is furnished by the realisation of the shares is definitely assured of going into the War Loan if the seller has made up his mind to apply it in this way.

The buyer in the Stock Exchange would regard the money which he pays for the shares as being part of his capital, and therefore to be employed in the business. His surplus funds would go into the War Loan, but not his ordinary working capital; and it is the latter which he uses for the purchase of shares from present holders. The chain of the argument has one or two weak links. If this process were carried out all round, the logical consequence would be a severe slump in all other securities, and an indirect damaging of the credit of the War Loan itself by-and-bye. It is further open to the objection that it affords too much opportunity to the ever-present bargain-hunter. But, on the whole, there is a good deal to be said for it; and that proprietors of stocks and shares are acting in the manner indicated is seen from the way in which the course of quotations tends quietly downwards.

This tendency is noticeable amongst the Home Railway debenture and other pre-ordinary stocks. Instead of standing at levels which return 4¾ to 5 per cent. on the money, as the stocks did just lately, prices have come down to levels at which 5¼ or 5½ per cent. is to be derived from the best-class issues in this market. The prior-charge stocks of the Underground Railway companies have not varied much. They had their fall, as a matter of fact, some six weeks ago, and have rested at the lower figures then established.

Business round the House is quiet, as, indeed, is appropriate, considering the War Loan. Naturally, no attempt is being made by the Stock Exchange to advance the claims of other securities to the attention of investors. The way is being left open for the War Loan, and that alone, unanimous effort being directed towards assuring for this the all-round success which it can only hope to achieve by a good deal of work on the part of those intimately concerned, and a certain amount of self-sacrifice on the part of the country generally.

In the circumstances, prices are remarkably firm. The week started in rather an amusing fashion, in consequence of the weather conditions, which brought about failure of the electric current on some of the suburban lines. This furnished glorious excuses for the unpunctual office boy, and disorganised for an hour or two the arrangements of a good many other people. Prices on the whole are steady. There is little business being done in the shares of the Underground Electric Railways; the 6 per cent. income bonds fell ½ to 90½, and the shilling shares are easier at 6s. Metropolitan Surplus Lands dropped to 46, and Central London ordinary shed a point. London Electric debenture is 2 down at 67½.

Pending the declaration of the February dividends, there is next to nothing in electricity supply shares. The prospects of the success of the "Safety First" campaign do not seem to be particularly bright; and so even this little bull point is becoming dimmed. Therefore the prices of stocks and shares in all the illumination companies are slightly depressed. City Lights and County ordinary are 5s. lower. Of the foreign shares, Madras gave way to 14s.

The same quietude is noticeable in the list of manufacturing shares. General Electric preference fell 5s., and Electric Constructions remain heavy at 20s. A fall of 27s. 6d. in British Aluminium ordinary was brought about by efforts to realise on the part of those who had recently bought the shares lower down, and wanted to take their profits, presumably with the intention of putting the money into the War Loan. A little animation occurred in these; otherwise, the course of the market has been placid almost to stagnant.

Talk of a tax upon companies' profits over 8 per cent. in the United States served to bring about some reaction in the prices of securities connected with power companies on the other side which have been making munitions for this country and her allies. It would seem as though the United States were taking a leaf out of the book of Mr. McKenna, and contemplating a tax on the lines of the excess profits duty. So far, however, the matter does not seem to have got beyond the rumour stage.

Anglo-American Telegraph rose a point to 94, but the deferred is a little duller at 22¼. United River Plate Telephones eased off to 69⅝, and except for these insignificant changes there is nothing fresh to report in this section. Callenders are a little easier at 12¾, and the other manufacturing shares are firm.

In the foreign group prices remain as they were. A good deal of nervousness is expressed with regard to the state of affairs in Mexico, and the issues of the various Mexican railways are very heavy and depressed. The industrials, however, are not affected. One man declared that the prices for the utility bonds had already fallen so low that there was scarcely any room for them to drop further without losing their places altogether. The British Columbia rises are well maintained, and Brazil Tractions revolve around 49, the market being strengthened to some extent by the declaration of the usual quarterly dividend of 1 per cent.

In other parts of the industrial market business has fallen off noticeably. There is still a fair amount being done in rubber shares, where prices continue good by reason of the price of the raw material clinging closely to 3s. per lb. Amongst the metals, the rise in the price of tin attracts more attention in that it is bringing orders for the tin companies' shares. But copper interests are still dull and heavy.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1914.	Dividend 1915.	Price Jan. 23. 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary ..	5	6	8⅜	—	7 8 2
do. do. do. 4½ Pref..	4½	4½	8¼	—	6 18 6
Chelsea	5	4	3	—	6 13 4
City of London	9	8	11	— ¼	7 5 5
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10	— ½	7 0 0
do. 6 per cent. Pref.	6	6	9⅞	—	6 1 6
Kensington Ordinary	9	7	5⅝	—	6 4 5
London Electric	4	8	1⅜	—	6 10 5
do. do. 6 per cent. Pref.	6	6	4 7/16	—	6 15 4
Metropolitan	3½	8	2¼	—	6 13 4
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 4 0
St. James' and Pall Mall ..	10	8	6	—	6 13 4
South London	5	5	2⅞	—	6 19 0
South Metropolitan Pref. ..	7	7	1 3/32	—	6 7 8
Westminster Ordinary	9	7	5⅝	—	6 4 5
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	94	+1	6 7 8
do. Def.	80/-	33/6	22¼	— ¼	6 14 10
Chile Telephone	8	8	7xd	—	5 14 3
Cuba Sub. Ord.	6	6	8¼	—	6 8 6
Eastern Extension	7	8	13⅞	—	*5 15 4
Eastern Tel. Ord.	7	8	138	—	*5 16 0
Globe Tel. and T. Ord.	6	7	12¼	—	*5 14 3
do. Pref. ..	6	6	9⅞	—	6 1 6
Great Northern Tel.	22	22	37	—	5 19 0
Indo-European	13	13	49	—	6 12 8
Marconi	10	10	2 1/16	—	8 14 9
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord. ..	10	10	2¼	—	4 9 0
United R. Plate Tel.	8	8	6⅝	— 1/16	*6 0 9
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13⅞	—	*5 15 4
Home Rails.					
Central London, Ord. Assented	4	4	64½	—1	6 5 0
Metropolitan	1¼	1	23½	—	4 5 1
do. District	Nil	Nil	16⅛	—	Nil
Underground Electric Ordinary	Nil	Nil	2	—	Nil
do. do. "A" ..	Nil	Nil	6/-	—6d.	Nil
do. do. Income	6	6	90½	— ½	*6 12 7
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4 13/16	—	6 1
Anglo-Arg. Trams, First Pref.	5½	5½	8	—	9 4
do. 2nd Pref. ..	5½	5½	2¾	—	—
do. 5 Deb. ..	5	5	64½	—	7 15 0
Brazil Tractions	4	4	49	—	8 3 4
Bombay Electric Pref.	6	6	10¼	—	5 17 8
British Columbia Elec. Rly. Pfce.	5	5	62	—	8 1 4
do. do. Preferred	—	Nil	44	—	Nil
do. do. Deferred	—	Nil	38½	—	Nil
do. do. Deb.	4½	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	25	—	Nil
do. 6 per cent. Bonds	—	Nil	22½	—	Nil
Mexican Light Common ..	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	16½	—	Nil
do. 1st Bonds ..	Nil	Nil	27½	—	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	2 13/16	—	5 6 9
British Aluminium Ord. ..	5	7	27 6	—1/-	5 16 3
British Insulated Ord.	15	17½	11¾	—	7 5 10
British Westinghouse Pref. ..	7½	7½	2 9/32	—	6 11 4
Callenders	15	20	12¾	— ⅛	7 17 0
do. 5 Pref.	5	5	4	— ¼	6 5 0
Castner-Kellner	20	22	8 5/16	—	6 12 7
Edison & Swan, £3 paid ..	Nil	—	7/16	—	Nil
do. do. fully paid ..	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	61½	—	6 10 1
Electric Construction	6	7½	15/16	—	8 0 0
Gen. Elec. Pref.	6	6	9½	— ¼	6 6 4
do. Ord.	10	10	13¾	—	7 5 6
Henley	20	25	16	—	7 13 10
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12½	—	*8 0 0
Telegraph Con.	20	20	88	—	*6 5 0

* Dividends paid free of income-tax.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING DECEMBER, 1916.

The official returns of electrical export and import business for the last month of the year just ended show a further falling off in value of the exports—the decline having set in in October—and a considerable appreciation in import values.

The total value of the December exports was £405,921, as compared with £438,830 in the preceding month; the only branches of business attaining a higher level than in November were machinery, battery, and telegraphic exports, while considerably reduced values were recorded in telephonic, cable, and lamp exports particularly.

The imports total for the month of £246,252 was much in excess of the November figure of £198,492, increased values of cable, lamps, battery, and telegraphic and telephonic material having entered this country, in comparison with November. Electrical machinery imports were only a trifle in excess of those of the previous month.

The re-exports at £13,104 show a reduction of some £5,000 on the November figures.

Export business with India showed some improvement, and French purchases, though less than in November, were little less valuable than India's.

Practically all the importers into this country increased their business during the month, the U.S. more particularly so.

Dutch imports reached nearly £28,000 in value, and Japan—the newcomer—shows a total of £17,700.

It will be noted that nearly £62,000 worth of lamps and parts entered this country during the month.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	2,229	4,890	580	38	607	1,826	36,946	1,799	118	521	848	3,047	53,449
Netherlands, Java and Dutch Indies ...	512	10,466	826	22	61	140	1,096	445	190	324	2,625	247	16,954
Belgian Congo...	36	4	8	23	5	13	...	...	6	...	145	20	260
France	2,665	721	1,332	236	12	184	21,308	6,230	467	43	2,195	11,360	46,753
Portugal	5	2,651	41	227	5	44	514	...	386	...	112	3,242	7,227
Spain, Canary Isles and Spanish N. Africa...	202	210	512	19	...	1,266	5,296	23	151	...	...	792	8,471
Switzerland, Italy and Austria-Hungary ...	791	14	...	...	...	37	17,446	56	321	...	306	4,127	23,098
Greece, Roumania, Turkey and Bulgaria ...	516	...	10	23	...	7	3,500	...	23	...	...	...	4,079
Channel Isles, Gibraltar, Malta and Cyprus...	91	426	4	17	...	66	17	...	17	...	18	400	1,056
U.S.A., Philippines and Cuba	851	...	489	2	14	...	5,080	...	...	5	247	6,237	12,925
Canada and Newfoundland	133	31	672	166	7	535	1,789	...	328	39	...	20,266	23,966
British West Indies and British Guiana ...	109	56	...	6	10	...	...	...	20	21	5	299	526
Mexico and Central America	22	252	116	3	...	9	36	...	...	...	400	...	838
Peru and Uruguay	9	9	183	9	...	...	215	...	6	14	...	4	449
Chile	527	690	6	184	2	79	899	...	88	13	1,180	73	3,741
Brazil	84	363	459	253	7	535	763	378	56	26	7	1,486	4,417
Argentina	704	4,343	704	934	...	448	2,203	235	703	104	296	6	10,680
Colombia, Venezuela, Ecuador and Bolivia...	7	109	2	81	...	...	1,431	...	...	1	...	6	1,637
Egypt, Tunis and Morocco	192	737	157	472	9	...	2,640	...	367	47	42	407	5,070
British West Africa	233	96	7	62	32	...	567	...	628	7	360	556	2,548
Rhodesia, O.R.C. and Transvaal	878	1,714	611	412	...	100	3,088	95	110	19	206	6	7,239
Cape of Good Hope	122	886	406	199	14	305	1,665	179	232	24	...	1,427	5,459
Natal	1,142	2,268	428	16	11	333	892	...	2,236	9	291	8	7,364
Zanzibar, Brit. E. Africa, Mauritius & Aden	75	30	246	55	...	89	476	1,262	10	5	519	113	2,880
Azores, Madeira and Portuguese Africa ...	22	42	21	93	...	416	183	...	4	1	19	302	1,103
French African Colonies and Madagascar...	8	52	...	25	...	...	26	...	...	...	...	...	111
Persia	...	...	...	8	...	...	7	...	...	21	7	...	43
China and Siam	615	3,334	583	731	...	1,368	4,064	235	345	10	27	41	11,353
Japan and Korea	1	10	9	9	20	246	2,360	500	340	...	16	663	4,174
India	1,774	13,681	4,827	2,487	55	2,574	12,184	3,554	7,335	522	228	710	49,931
Ceylon	257	897	127	78	73	18	6	112	103	...	...	37	1,708
Straits Settlements, Fed. Malay States and Sarawak	612	761	719	374	13	317	778	6	146	...	97	523	4,346
Hong Kong	...	279	541	87	...	375	577	450	145	30	14	58	2,556
West Australia	162	330	182	332	6	48	204	...	16	5	...	6	1,291
South Australia	37	393	279	393	...	524	591	...	326	4	2,100	167	4,814
New South Wales	1,139	5,454	1,112	1,090	10	1,180	8,534	2,080	918	49	520	7	22,093
Victoria	4,001	7,162	2,325	859	...	626	8,273	1,230	260	...	2,031	29	26,796
Queensland	127	576	167	160	...	179	359	...	329	27	482	444	2,850
Tasmania	...	...	196	113	9	...	1,765	...	...	...	...	...	2,083
New Zealand and Fiji Islands	1,009	5,967	1,417	1,186	8	293	1,815	2,198	760	22	4,238	400	19,313
Total, £	21,899	69,904	20,304	11,484	990	14,180	149,953	21,067	17,490	1,913	19,581	57,516	405,921

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
Russia, Norway, Sweden and Denmark ...	...	...	...	244	6,844	...	2,977	885	2,302	994	838		15,084
Netherlands	30	...	...	16,473	9,677	...	90	...	1,654	...	...		27,924
France	162	4,787	156	...	389	796	2	...	8,508	2,225	411		17,436
Switzerland	1,050	...	113	163	...	1,708	5,935	...	2,728	547	...		12,244
Italy	...	2,873	...	...	...	...	...	...	...	...	200		3,073
Japan	632	...	215	7,767	8,027	...	...	...	1,070	...	...		17,711
United States	7,838	7,930	1,203	6,147	5,804	1,356	9,675	34,088	15,208	6,081	55,688		151,018
Total, £	9,712	15,590	1,687	30,794	30,741	3,860	18,679	34,973	31,470	9,847	56,137		244,490

Additional imports.—Spain, carbons, £700. Canada, glow lamps, £288; arc lamp parts, £25; batteries and accumulators, £639; electrical goods, £110.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
Various countries, mainly as above ...	1,604	696	...	4,622	765	1,017	2,443	...	334	105	1,518		13,104

Total Exports: £405,921 **Total Re-Exports: £13,104** **Total Imports: £216,252**

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned which is not necessarily the country of origin

ELECTRICAL EXPORTS AND IMPORTS DURING 1916 AND PREVIOUS YEARS.

In accordance with our usual custom, we publish in this issue a graphic summary showing the trend of British electrical export and import business during 1916 and previous years, the curves being based on the monthly statistics supplied to this journal by the Customs authorities.

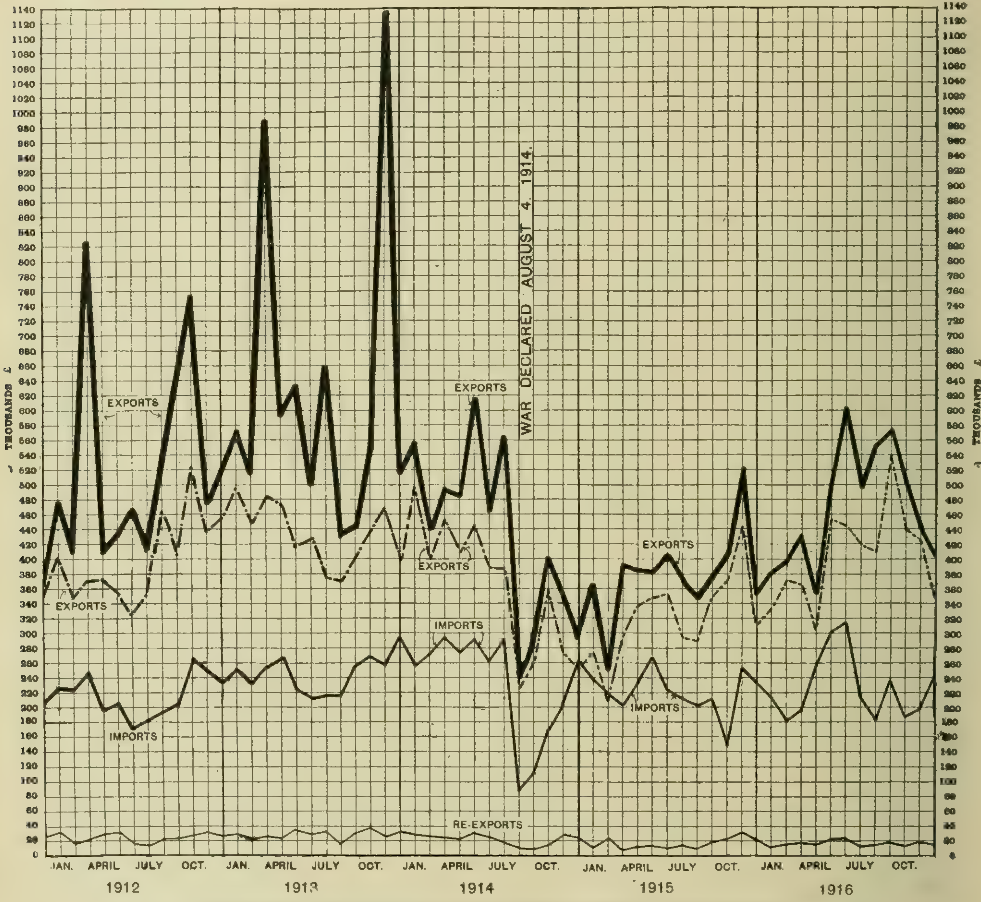
It is, perhaps, superfluous to write at any length on the factors influencing external electrical business during the year—the war exercises a tighter grip on our industry than it did a year ago, and the difficulties connected with labour, finance, shipping, &c., referred to in our remarks in January last year, have been considerably accentuated, and, indeed, further handicaps in the shape of business restrictions have been added.

Under the circumstances, there would be every excuse for a dwindling export business in electrical goods, but such has not been the case, our overseas electrical business having shown a marked improvement in values over that of the previous year, as will be gathered from the two upper curves of fig. 1.

It will be noted that the extreme fluctuations of value due to telegraphic export business have been absent since the war started, and that the second (dot-and-dash) curve indicating the more steady general business (exclusive of telegraphic material) compares very well with 1912 in value.

The imports curve, on the other hand, does not, on the whole, show any particular appreciation in value during 1916, as compared with the previous year, such as one might expect, although during May and June record values of electrical material entered this country from abroad, and mainly from America.

Although there has been a marked tendency towards the restriction of importation of certain classes of goods into this country, this probably did not affect electrical imports to any extent during the past year; and, indeed, it does not appear probable that any diminution of such business will occur while the war lasts, whatever may be the case afterwards.



The lower export curve (dot-and-dash) is exclusive of telegraphic exports. Value in thousands of £.

Fig. 1.—Chart showing Monthly Electrical Exports and Imports during the past Five Years.

The re-export business was much the same as in the previous year, remaining at a reduced level in comparison with pre-war days.

The gross values of our electrical exports and of the telegraphic materials included therein for the five years covered by the curves in fig. 1 were as follows:—

1912	...	Gross £6,300,000	Telegraphic £1,500,000
1913	...	„ 7,568,000	„ 2,388,000
1914	...	„ 5,189,000	„ 835,800
1915	...	„ 4,564,000	„ 690,300
1916	...	„ 5,628,000	„ 776,300

The respective monthly averages of general business (exclusive of telegraphic exports) were: 1912, £400,000; 1913, £432,000; 1914, £362,000; 1915, £323,000; and 1916, £404,300.

The value of electrical material imported into this country during 1916, according to our monthly statistics, was £2,736,000, representing a monthly average of £228,000. These figures compare with a total of £2,646,000 and monthly average of £220,500 in the previous year, and show a comparatively small appreciation in value under the circumstances, the totals being less than those of 1914 and 1913.

The re-exports showed comparatively little fluctuation from month to month, and only reached a total value of nearly £193,000, thus being even smaller in extent than in 1915, when the total was £198,000. The monthly averages for the two years were £16,000 and £16,500 respectively.

Turning to fig. 2, the curves on which deal with the most prosperous sections of our electrical export business—viz., machinery and cables—it will be seen that these branches have no reason to complain as regards the progress made, the amount of business in both cases showing a marked increase on the previous year.

The electrical machinery export values will not, of course, bear comparison with the palmy pre-war times, but electrical cable exports established a record both for the year's business and for an individual monthly total. For the whole year electrical machinery exports were valued at £1,719,000, as compared with £1,482,000 in 1915; the cable exports reached a total value of £1,342,000, which was much in excess of the previous year's total of £916,000;

further, the value of cable exported in September reached a total of nearly £169,000, being the highest value so far recorded by us. It should be noted that the above cable export figures are exclusive of the values of telegraph and telephone cables, which appear in their own sections.

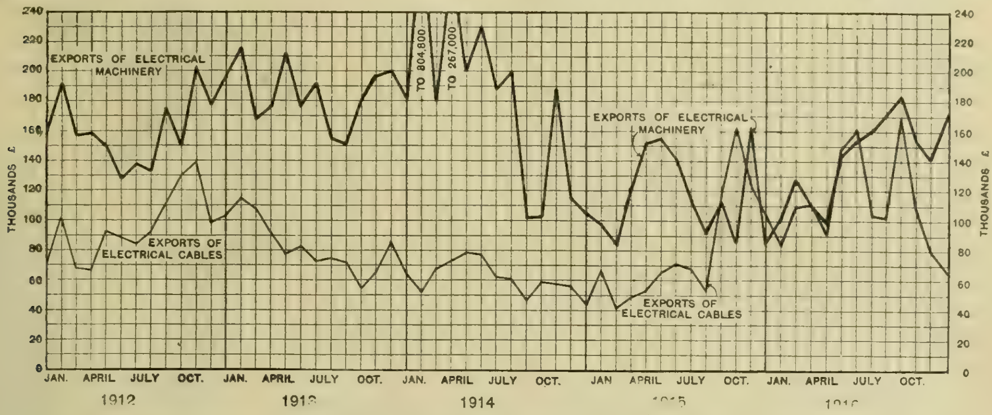


Fig. 2.—Monthly Exports of Electrical Machinery and Electrical Cable—other than Telegraphic and Telephonic Cable—during the past Five Years.

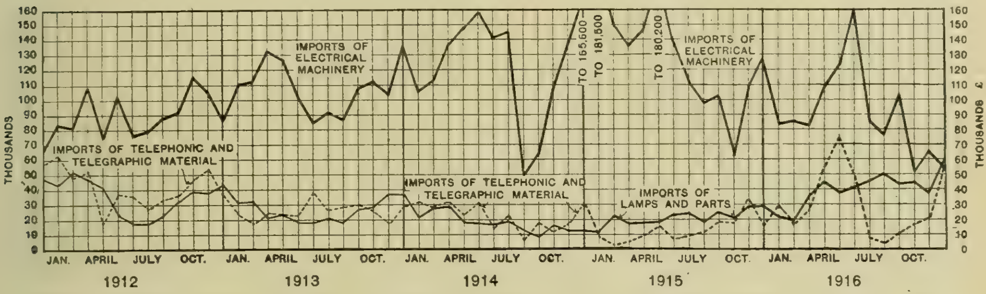
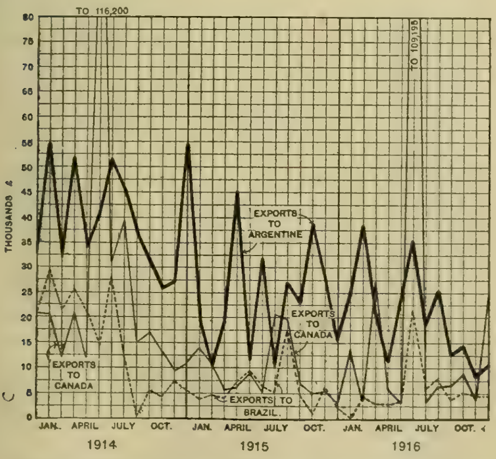


Fig. 3.—Monthly Imports of Electrical Machinery, Telegraphic and Telephonic Material and Cable, and Electric Lamps and Parts during the past Five Years.

Fig. 3, containing representative curves of value for machinery, telegraph and telephone, and lamp imports, shows, as regards the first-named, a decided falling off in comparison with the previous year.

The values of telegraphic and telephonic material imported into this country showed an upward tendency during 1915, which continued until last May, when an abnormal total some £75,000—was reached, the values subsequently dropping away to normal at the end of the year.

Throughout the greater part of the year the importation of electric lamps and parts reached abnormal values, which show little signs



Upper curve includes New Zealand, Australian States and Tasmania; lower curve includes Cape, Natal, Transvaal and Orange River Provinces, and Rhodesia.

Fig. 4.—Electrical Exports to Canada, Argentina and Brazil, 1914-16.

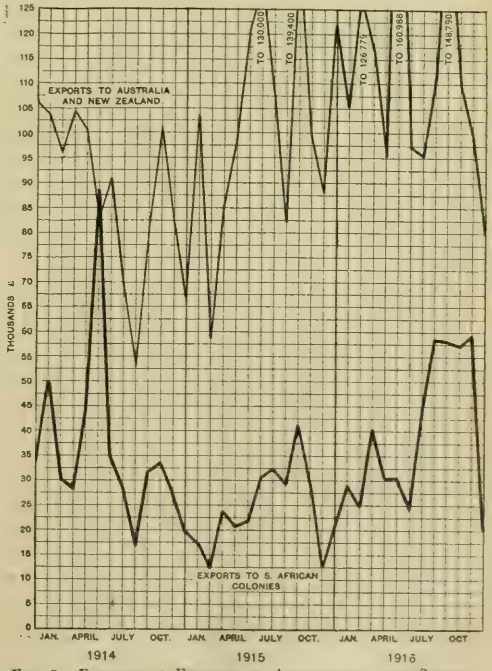


Fig. 5.—Electrical Exports to Australasia and South Africa, 1914-16.

of falling off. The following total figures for the last two years are of interest :—

Imports.	*1915.*	*1916.*
Machinery...	£1,543,000	£1,080,000
Telegraph and telephone material...	154,600	368,000
Lamps and parts	256,600	483,000

Purchasing Countries and Importers into the United Kingdom.

Figs. 4 to 9 deal with another phase of our electrical business, which is of considerable interest in view of the widespread effect of the war on international trade. In this connection, figs. 4, 5, and 6 indicate the course of business in what are normally progressive markets for British goods, and it will be noticed that while Argentinean business continued to fall off during 1916, and electrical exports to Brazil and Canada remained in a depressed state, yet trade with India, China, and our Australasian and South African Colonies has shown a gratifying revival, the upward tendency being strongly marked in some cases.

Our export business to Japan, with the exception of one month in which some £100,000 worth of telegraphic material was included, on the whole remained lifeless, although reaching a greater total due to the above cause than in 1915.

The position is not an unexpected one, as the Japanese electrical manufacturing business has undoubtedly made great strides during the last few years ; so much so, indeed, that her name now figures as an importer of electrical material into this country to quite a considerable amount. Undoubtedly the most satisfactory branch of our electrical export business is that with Australia and New Zealand (see fig. 5), which has shown a continuous improvement on pre-war times despite difficulties in communication. The improvement in South African business may, perhaps, be traced to the withdrawal of German competition, and no doubt progress in China—the country of great expectations—is due to a similar cause. It should be noted, however, that Japan in some branches of electrical business is beginning to compete in India, China, and South Africa, and no doubt the effect will be felt in the next year or two.

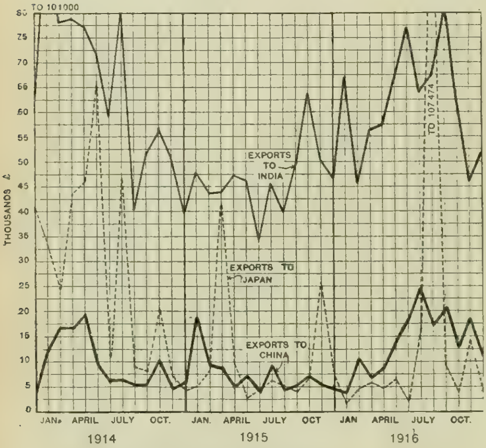


Fig. 6.—Electrical Exports to Japan, India and China, 1914-16.

The gross value of our electrical exports to the above-mentioned countries for the years 1914, 1915, and 1916 were as follows :—

	1914.	*1915.*	*1916.*
India	£784,000	£557,000	£743,000
Australia and New Zealand...	1,032,000	1,234,000	1,345,000
Argentina	448,000	279,000	244,000
South Africa	434,000	293,000	476,000
Canada	318,000	112,000	217,000
Japan...	320,000	128,000	179,000
Brazil...	176,000	73,000	68,000
China...	117,000	88,000	166,000

As pointed out in our remarks a year ago, the war has caused a partial redistribution of our electrical export business, and allied and neutral European nations account for a much larger proportion of value than in pre-war days. The figures for French purchases from us, for instance, show continuous expansion for the last three years, viz., 1914, £150,000 ; 1915, £321,000 ; and 1916, £601,559 ; it will be noted that, with the latter total, France has become one of our very best customers for electrical goods, and it is to be hoped that means will be found to permanently secure the goodwill of our near neighbours in this branch of trade.

The Scandinavian group of countries, together with Russia, purchased £474,000 worth of electrical material from us during 1916, as compared with £465,000 worth in 1915, and £253,000 worth in 1914, showing that this branch of business has improved, though not to the extent of the previous year.

The last set of curves, in fig. 7, deals with the principal countries importing into Britain, amongst which the United States has occupied the premier position since German overseas business was abruptly suspended in August, 1914.

Although our American cousins sold to us, roughly, 63 per cent. of our total purchases of electrical material, recent months have shown a falling off in values, and, on the whole year, the total of £1,700,000 was less than for 1915 (£1,855,000), though still in excess of the best effort of Germany in pre-war days, viz., £1,632,000 in 1913.

From France we received a smaller value of electrical material, viz., £151,000 worth, as compared with £167,000 worth in 1914.

Belgian business disappeared early in 1915, but Dutch imports—mainly in the form of lamps—attained such solid proportions during the year, that we have given her a place on the chart, as also Japan, for reasons which will be apparent from preceding remarks.

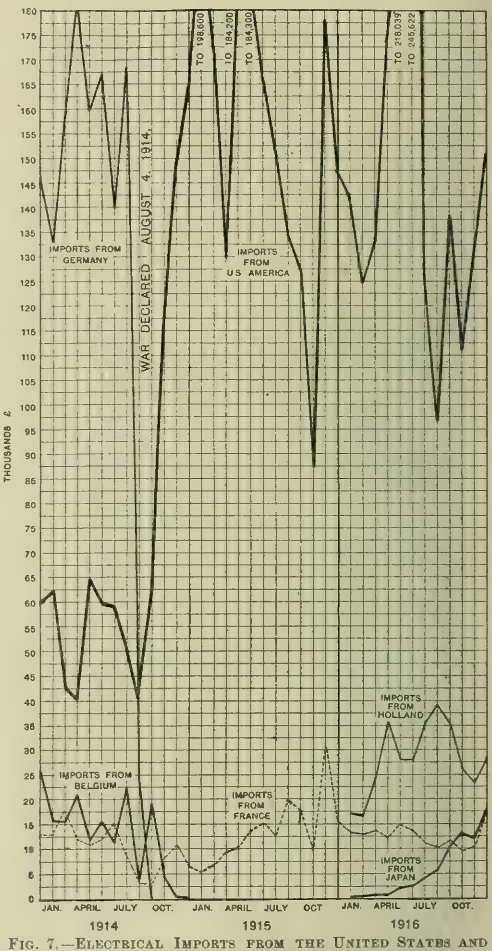


Fig. 7.—Electrical Imports from the United States and France during 1914-16 ; from Holland and Japan in 1916 ; and from Germany and Belgium in 1914.

Dutch electrical imports into this country ranked next to those of the United States in value, amounting to £337,000 in 1916, as compared with £153,000 in the previous year, and only £60,000 in 1914.

Of the Dutch total, lamps and parts account for some £311,000 in value, or nearly £26,000 a month, as against £10,000 a month in 1915, and only £1,400 a month before the war. No doubt we are engrossed in more vital occupations than lamp making, otherwise the situation would be extremely disappointing.

General.—In concluding our remarks, we can only point out that, with the duration of the war still uncertain, and so many adverse factors present, the prospects of the electrical industry are naturally overcast at the moment.

One may well ask, however, whether in the event of a sudden cessation of hostilities, there is any prospect of our electrical industry being prepared for the task which may confront it in the event of a regrouping of international trade relationships taking place. It cannot be denied that an industry which in normal times exported material worth six or seven millions sterling annually, while at the same time competing material from abroad valued at some 2½ millions a year was sold almost on its doorsteps, has considerable need to set its house in order.

TRADE AFTER THE WAR.

The third report of the Special Committee on Trade during and after the war, to the Council of the London Chamber of Commerce, is divided into four sections. No. 1 deals with Commercial and Industrial Organisation generally. Herein it is stated that the question of improved methods of business after the war naturally involves some possible difference of opinion according to the requirements of particular trades, industries, or markets, and that so-called "improvements" are of value only to the extent to which they are practicable, and can be best appreciated when existing methods are understood and explained. There is also a wide distinction between the methods employed in the home and overseas markets respectively. The Committee affirm their conviction that the practical application of measures for the extension of trade and industry after the war will be mainly a matter for private enterprise. Merchants and manufacturers alike are alive to the need for preparation on business lines, but there are certain measures which can only be effective with the discriminating support of the Government, whose aid, as in the past, should, broadly speaking, only be given with regard to action which the individual himself is unable to take. Apart from the question of discriminating tariffs, Government intervention is only considered desirable within certain defined limits. A closer connection between the business community through their appointed representatives and the various Government Departments—co-ordinated as far as possible through a Ministry of Commerce—is held to afford the most likely prospect that co-operation between trade interests and the Government will be really effective. There is found to be a growing tendency to organise collective representation of manufacturers or merchants on a co-operative basis through the agency of persons, firms, companies, or associations for both the overseas and home trade. This plan, which has been applied successfully by engineering and other firms, affords a means of reducing the expenses of individual action and ensuring capable representation, more especially in foreign countries. The Committee holds, however, that export merchants representing a number of manufacturers in similar lines will probably continue, in view of their foreign connections and financial standing, to be valuable auxiliaries in the promotion of British trade. There is a necessity in many trades for the larger employment of competent commercial representatives to bring goods directly under the notice of the retailer or consumer; also the appointment of travelling representatives to visit agents where principals themselves are not available. The need for a combination of linguistic ability with technical knowledge emphasises the need for the study of foreign languages at an early age or concurrently with the acquisition of technical knowledge. The requirements of common interest to all traders in which State aid is desirable relate to:—A tentative tariff; a Ministry of Commerce and Industry; the improvement of the commercial side of the Consular service; the restriction of the operations of enemy traders within the Empire after the war, perhaps by continuing in force many of the provisions of the Trading with the Enemy and other emergency Acts; the improvement of means of transport on land and water, and penalising enemy shipping as recognised in the Paris Economic Conference recommendations; and the co-operation of the State in the promotion of a Trade Bank or Banks, to furnish financial accommodation of a special kind to traders doing business abroad, not otherwise provided for under the existing system.

If the foregoing requirements are satisfied, little assistance will be required enabling the adoption of more effective voluntary action in regard to:—The printing of trade catalogues in various foreign languages; the greater use of the metric system of weights, measures, and currency; the establishment of improved British organisations for obtaining information as to the status of foreign clients; and the holding of trade exhibitions at home, abroad, and in the Dominions.

In regard to industrial organisation, the Committee says that the vital interests of the manufacturer in the whole scheme of economic progress of the country must be recognised, whether in relation to the home or the export trade, and his claim to special recognition in the matter of tariffs and well-directed State aid is indisputable. "The State must clearly play a more active, and even sympathetic, part in these problems, without undue interference with the development of private enterprise," but the two must act in combination if the best results are to be attained. It is considered that the principal question which arises in connection with the subject of industrial organisation is the future relationship between employers and employed. The Committee quotes Mr. Neville Chamberlain's outline of the wants of Capital and Labour as follows:—

THE WANTS OF CAPITAL.

1. That labour should put forth its utmost effort in production.
2. That there should be reasonable notice of any change in wages.
3. That labour should not be unnecessarily withdrawn.

THE WANTS OF LABOUR.

1. A greater share in the distribution of the wealth it creates.
2. Greater regularity of employment.
3. Improved conditions of life in the factory and the home.

To these desiderata the Committee add the following recommendations as a basis for negotiation between Capital and Labour:—

(*a*) As regards the remuneration of employés the principle of payment by results should as far as possible be adopted by employers and employed.

(*b*) The basis of rates of payment for labour should involve such a scale as will ensure for all willing and efficient workers a fair and reasonable standard of living.

(*c*) The Government should afford opportunities for considering the amendment of the Trade Disputes Acts and of any provisions of the Factory and Workshop Acts other than those relating to the health of the workers.

(*d*) Encouragement should be given, as far as possible, to profit-sharing and co-partnership agreements, or premium and bonus systems on lines which have proved beneficial to employers and employed in the past, subject to the special conditions of particular trades, and to the maintenance of the standard rates of wages.

The Committee views with hope the conferences that have taken place between employers and the trade unions, and urges that such should be encouraged.

In this same section the practical relation of science to industry is reviewed. It is believed that the various agencies that are now at work on this matter will have far-reaching results. Among other points mentioned is the necessity for making the scale of remuneration for trained scientific employés such as will encourage students to prepare themselves to take part in the industrial campaign of the future. Other subsidiary questions mentioned relate to the use of State factories for private industrial work after the war, encouragement of technical education after the statutory school age, the amendment of the Patents, &c., Acts, removing restrictions to the adoption of new processes, labour-saving appliances, and new inventions; the improvement of all kinds of transport, better Government commercial intelligence information respecting competition and new openings, further direct representation of manufacturers in the Dominions, a greater sympathy on the part of the Government in regard to the promotion and amendment of legislative measures affecting British industry (especially in relation to conditions of labour), and "a preference on the part of Government Departments and local authorities for goods produced within the British Empire when needed for the requirements of the State."

In Section 2 the Committee deals with commercial and industrial policy; Section 3 relates to the treatment of enemy shipping (the ton for ton policy of the London Chamber of Commerce, and the after-war proposals of the British Imperial Council of Commerce); and Section 4 discusses finance and insurance. Practically one-half of the publication consists of a collection of appendices, which include the Paris Economic Conference recommendations, extracts from the Government Committee report on a Trade Bank, and memoranda relating to a Ministry of Commerce, the Consular Service, Restraint of Enemy Trade, the Registration of Business Names Bill, Anglo-Italian trade, &c.

Russian Electrical Control.—According to the decision of the Council of Ministers, the *projet de loi* drawn up by the Ministry of Trade on the transmission of electricity, has been returned to it for the purpose of removing the difference between the Ministry of Trade and the Ministry of the Interior. The difference consists chiefly of the desire of the Ministry of the Interior to subject the control of electrotechnical installations to the general police, whilst the Minister of Trade, in his *projet de loi*, contemplates centralising the whole control of the transmission of electric current in the hands of his own officials. As a result of mutual consideration, the Minister of the Interior agrees that it is possible to revise the *projet de loi* prepared by him on the police control of electrical installations, and to accept almost without correction the *projet* of the Trade Department. On the question of authorising new electrical installations, the Ministries of the Interior and of Trade have introduced a clause in the agreement making the authorisation of the electrotechnical installations completely independent of the consent of the representatives of the Ministry of the Interior. In case of the disapprobation of the representatives of this Department in local or central Committees *re* the electrical business, such disagreement is to be decided by the Council of Ministers.

The Ratho Railway Smash.—Commenting on the accident at Ratho, the *Edinburgh Evening Dispatch* remarks that "the smashed train was lit by electricity and not gas, and, as a result, there was no danger from fire to the numerous passengers who were pinned down, and who could not be rescued for over an hour after the accident. Had the train been equipped with gas, there is little doubt that the smash, as was the case at Gretna and Hawes Junction, would have been turned into a fierce and terrible holocaust, that would have intensified the horrors and casualties of the disaster manifold. As it was, the injured were spared that awful fate."

IMPORT TRADE OF CEYLON.

The following figures, showing the value of the imports of electrical and allied material into Ceylon during 1915, are extracted from the recently-issued official statistics. The values for the previous year are given for purposes of comparison, and notes added of any increases or decreases:—

	1914. Rupees.	1915. Rupees.	Inc. or dec. Rupees.
Manufactures of copper.—			
From United Kingdom ...	30,000	45,000	+ 15,000
.. India	29,000	20,000	– 9,000
.. Germany	22,000	—	– 22,000
.. Other countries .	1,000	2,000	+ 1,000
Total ...	82,000	67,000	– 15,000
Electrical materials.—			
From United Kingdom ..	160,000	118,000	– 42,000
,, Germany	5,000	—	– 5,000
,, Other countries	16,000	8,000	– 8,000
Total	181,000	126,000	– 55,000
Scientific instruments.—			
From United Kingdom ...	19,000	16,000	– 3,000
.. India .	—	3,000	+ 3,000
Total	19,000	19,000	—
Lamps.—			
From United Kingdom	135,000	62,000	– 73,000
.. Germany ...	72,000	13,000	– 59,000
.. Other countries .	26,000	32,000*	+ 6,000
Total	233,000	107,000	– 126,000
Machinery, foundry and workshop.—			
From United Kingdom ...	651,000	554,000	– 97,000
.. United States .	12,000	5,000	– 7,000
.. Other countries ..	2,000	2,000	—
Total	665,000	561,000	– 104,000
Other machinery, dutiable, not including tea, textile, and oil-making.—			
From United Kingdom ...	41,000	13,000	– 28,000
.. Germany	2,000	—	– 2,000
.. Other countries	3,000	3,000	—
Total .	46,000	16,000	– 30,000
Ditto, free.—			
From United Kingdom .	696,000	625,000	– 71,000
.. Germany .	96,000	8,000	– 88,000
.. United States	50,000	14,000	– 36,000
.. Other countries	30,000	183,000	+ 153,000
Total . .	872,000	830,000	– 42,000
Telephone materials —			
From United Kingdom	6,000	11,000	– 5,000
.. Germany	1,000	—	– 1,000
Total ...	7,000	11,000	– 4,000

* Japan Rs. 11,000.

(N.B.—15 Rupees = £1.)

Sounding by Electricity.—Experiments have recently been made on the banks of the Ohio River with an electric sounding apparatus, the principle of which is to produce at the bottom of the water, by towing a metallic body, a noise which is observed with a telephone receiver on board a boat. The plummet consists of a hollow cast-iron case about 45 cm. long and 10 cm. in diameter, which weighs 18 kg.; it is suspended from an armoured cable, containing two insulated conductors, which are connected to a microphone fixed inside the plummet and to the receiving apparatus at the surface. Tests have been made at speeds from 3·2 km. to 9·6 km. per hour. When the boat passes over shallows of clay or sand, a characteristic hissing sound is heard, whilst friction on rocks or gravel gives rattling sounds. Generally the sounds produced are easily audible at the receiver, except when the bottom consists of a very fluid mud. The depth is determined by the length of cable run out, and the speed of the boat, which causes the cable to assume a slanting position: these factors being known, the depth can be read from tables. The advantage of the method is that continuous soundings can be taken in a sheltered position and without slackening the speed of the vessel.—*Le Génie Civil.*

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Published expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

329. "Method of controlling speed of internal-combustion engines by means of electrical ignition." E. H. Cambridge & G. S. Macgregor. January 8th.

331. "Adjustable resistances and inductances." F. de Cannart d'Hamale. January 8th.

362. "Electric heating devices." British Thomson-Houston Co. (General Electric Co., U.S.A.). January 8th.

363. "Electric arc devices." P. K. Devers. January 8th. (U.S.A., March 26th, 1916.)

368. "Apparatus for electric lighting." Sir W. G. Armstrong, Whitworth & Co. and A. S. Cheetham. January 8th.

400. "Automatic or wireless steering control." W. G. de F. Garland and C. Tuckfield. January 9th.

414. "Electric starting devices for internal-combustion engines." V. A. Trier. January 9th.

426. "Electric switches." H. Garde. January 9th.

436. "Induction coils or transformers." M. A. Codd. January 9th.

438. "High-frequency alternators." J. Bethenod & F. Girardeau. January 9th. (France, August 10th, 1915.)

449. "Stators of electric generators." J. Bethenod & E. Girardeau. January 9th. (France, August 10th, 1915.)

452. "Mechanical circuit-breaker for electrically-heated water apparatus." D. White. January 10th.

467. "Process of cleaning ignition plugs of internal-combustion engines." S. Cooper & M. J. Varley. January 10th.

468. "Sparking plugs for internal-combustion engines." C. Hurst, Ltd., A. M. Patton & R. F. Spiller. January 10th.

481. "Electrically-heated wearing apparel, &c." J. W. Jenkins. January 10th.

488. "Telegraph and telephone apparatus." International Electric Co. & H. E. R. Roose. January 10th.

502. "Electric controllers." British Thomson-Houston Co. (General Electric Co., U.S.A.). January 10th.

528. "Electric welding machines." T. E. Murray & H. R. Woodrow. January 10th. (U.S.A., March 8th, 1916.)

538. "Apparatus for electric welding." J. Crichton. January 11th.

555. "Telegraphic printers." E. E. Kleinschmidt. January 11th.

560. "Electric lampholders." W. Engelke. January 11th.

564. "Pocket lamp or torch." C. West. January 11th.

565. "Controller for electric time signals." M. E. Pugh. January 11th.

566. "Bearings for instruments." British Thomson-Houston Co. (General Electric Co., U.S.A.). January 11th.

577. "Electrical signalling or indicating apparatus for indicating at a distance numerical data." E. A. Graham. January 11th.

578. "Electrical apparatus for transmitting and indicating orders, numerical data, &c." E. A. Graham. January 11th.

579. "Mine-door operating apparatus." W. M. Hummel. January 11th.

584. "Clutch mechanism for electric cranes." W. S. Hubbard. January 11th.

609. "Ignition plugs." W. A. Clark, H. G. Longford, W. W. Longford & Sphinx Manufacturing Co. January 12th.

614. "Electric warehouse crane." W. Spencer. January 12th.

619. "Ignition chamber of two-cylinder and multi-cylinder internal-combustion engines." J. G. Sandwall. January 12th. (Sweden, February 10th, 1916.)

625. "Signalling device." Western Electric Co. January 12th.

634. "Device for obtaining non-alternating currents of maximum tension by the aid of three-phase or polyphase electromotive forces of low tension with one single-induction coil." E. Balzarini. January 12th.

640. "Overload circuit breakers." Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.). January 12th.

686. "Magnetic material." A. F. Berry. January 13th.

691. "Casings for telephone receivers." H. W. Dover. January 13th.

695. "Device for reversal of primary current and for periodic communication of secondary circuit, to improve working of induction coil." E. Balzarini. January 13th.

PUBLISHED SPECIFICATIONS.

1915.

17,781. Apparatus for Rendering Water Radio Active. L. Pagliani. December 20th.

18,115. Alloy for Arc Welding. D. H. Wilson & S. M. Rodgers. December 29th. (June 16th, 1915.)

1916.

622. Electric Cigar-lighting Outfit. R. K. Hearn. January 14th, 1916. [102,749.]

892. Production of Hard Composition from Formaldehyde and Phenols with Carbohydrates, Albuminous Materials, and Tannins. K. Tarassoff. January 19th, 1916. [102,751.]

1,620. Means of Equalising or Balancing Electric Currents applicable to Rotary Converters. A. H. Railing & C. C. Garrard. February 3rd, 1916. (Addition to 11,905/13.) [102,757.]

2,405. Electric Switches. C. W. Gray. August 15th, 1916. [102,766.]

2,582. Dynamo-electric Machines. R. V. Morse. February 21st, 1916. [102,768.]

4,342. Electric Light Reflectors. M. J. Railing & C. H. Pitman. March 23rd, 1916. [102,772.]

4,959. Electric Means for Producing Musical Notes. L. de Forest. April 24th, 1915. [100,358.]

6,962. Inter-communication Telephone System. J. W. Dungey & C. B. Kersting. May 16th, 1916. [102,786.]

7,040. Railway Vehicle Controlling Systems. W. B. Murray. May 17th, 1916. [102,787.]

9,032. Electric Relays. W. R. Sykes Interlocking Signal Co. & R. W. Tarrant. June 27th, 1916. [102,793.]

9,140. Switch-operating Mechanism for use with Transformers and other Electric Starters. W. Barraclough. June 29th, 1916. [102,794.]

13,445. Railway Signalling Apparatus. N. D. Rabady & W. H. Dyson. January 4th, 1916. (Divided application on 142/16.) [102,806.]

THE

ELECTRICAL REVIEW.

VOL. LXXX. FEBRUARY 2, 1917. No. 2,045.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: February 2, 1917. [No. 2,045.

Page

Depreciation... ... 113
High-Speed Telegraphy ... 114
The Pirelli-General Cable Works (*illus.*) ... 115
Some Considerations Affecting the Use of Electricity in Agriculture (*concluded*) ... 116
Errors of Direct-Current Ampere-Hour Meters, by G. W. S. (*illus.*) ... 118
High-Speed Telegraphy ... 119
New Electrical Devices, Fittings and Plant (*illus.*) ... 120
Legal ... 121
Correspondence—
  British *v.* German Manufacturers ... 122
  Women and "Shorts" ... 123
  An Appeal for Calendars ... 123
  Sapphires for Industrial Purposes ... 123
  City and Guilds Examinations ... 124
  The Sale of Foreign Motors ... 124
Breakdowns in German Plant ... 124
War Items ... 125
Business Notes ... 126
Notes... ... 130
City Notes ... 133
Stocks and Shares ... 134
Market Quotations ... 134
The Filtration of Air (*illus.*) ... 135
Rural Transmission Lines... ... 135
Principles Involved in Computing the Depreciation of Plant, by F. Gill and W. W. Cook ... 136
Industrial Research ... 138
The Work of the B.E.A.M.A. ... 139
A Committee of Provincial Electric Supply Companies ... 140
New Patents Applied for, 1917 ... 140
Abstracts of Published Specifications ... 140
Contractors' Column ... Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

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OFFICE :—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.

AUCKLAND N.Z: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.

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NEW YORK: D. Van Nostrand, 25, Park Place.

PARIS: Boyveau & Chevillet, 22, Rue de la Banque.

PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Loescher & Co., Corso Umberto 1° 307.

SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.

TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE "ELECTRICAL REVIEW'S"

ELECTRICAL & ALLIED TRADES DIRECTORY

(THE RED BOOK),

1917 EDITION,

IN PREPARATION.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

DEPRECIATION.

It will not be gainsaid that when Mr. F. Gill and Mr. W. W. Cook tackled the thorny question of depreciation of engineering plant, with a view to providing a rational basis of agreement between engineers, accountants, and financiers, they displayed an altruistic courage worthy of the highest praise. Moreover, they set about the undertaking in a manner which commands attention and respect, whether one agrees with their conclusions or not, and they have been rewarded by discussions which, if they reveal the most varied views upon the subject of the paper, at any rate bear witness to the keen interest which it arouses in the minds of those to whom the paper was addressed. The curious difference of opinion displayed, for instance, between the speakers at Birmingham and those at Edinburgh needs some explanation; on the other hand, in Yorkshire "honours were even," and in London the feeling was distinctly in favour of the authors' views.

In approaching this question from an impartial point of view, it should be borne in mind that it is hedged about by a host of divergent and incompatible considerations, some of which, indeed, are wholly irrelevant from a scientific standpoint, but yet exert a controlling influence upon the views of those responsible for decisions. As one speaker remarked at Leeds, expediency only too often overrides all theoretical arguments. One factor, to the admission of which Mr. Cook strongly demurred, is the presence or absence of net profits out of which a due amount can be set aside as a provision for depreciation. Again, in the case of municipal trading undertakings, the question whether the sinking fund (which *must* be provided) truly represents depreciation or should be supplemented by further provision is an old bone of contention; and when the affairs of a company are under consideration, solicitude for the shareholders' dividends, and in the case of a supply or tramway company, the liability to purchase of the undertaking by the local authority, have also to be reckoned with. Add to these factors the accountants' expressed aversion to "complicated book-keeping" and the difficulty which they experience in explaining to business men (is not the adjective misapplied?) any method but the "straight-line system," the impossibility of prophesying the duration of the economic life of an item of plant, the instability of all human affairs such as market prices, taxation, and interest on loans, not to mention wars and earthquakes, and it will be seen that the subject by no means lends itself to exact and rigorous analysis.

The authors necessarily took account only of those factors which could be regarded as strictly relevant to the subject from the point of view of what, without disparagement, we may call pure theory; the science of psychology is still far from the stage at which measurement is possible, and many of the obtrusive extraneous considerations to which we have referred will be seen to lie within its sphere, whilst others are on the knees of the gods. In the case on which the authors based their argument, no doubt the best possible means must be employed to form a reasonable estimate as to the amount of the annual charges upon the plant that is to be installed, especially when widely different alternatives present themselves, such as the choice between steam and gas power, or between manual and automatic telephone switchboards; but once the plant is put in operation, we cannot avoid the conclusion that the conduct of the business, and the decision as to the proper rate and system of depreciation to adopt, must be allowed to depend very largely upon the circumstances of the moment when the annual revision of accounts takes place. No matter what agreement may be reached on theoretical grounds, that is fairly certain to be the actual course adopted in practice.

The subject is of peculiar interest at the present time, when the question of purchase of the Metropolitan supply companies is looming in the not distant future, and the present owners are perforce called upon to have regard to the value that will be placed upon their property, especially in the not unlikely event of purchase before the expiry of the statutory period. Under these conditions, that part of the paper in which the authors deal with "the value of the plant in place" will be of particular interest to them, but whether they will feel it to their advantage to adopt the method of valuation recommended by the authors is somewhat questionable. Moreover, another question here arises—outside the scope of the paper, but of material importance, nevertheless—namely, the value of the plant expressed in terms of the price that it would fetch on its merits in the open market, which would not necessarily bear any definite relation to the value at which it might stand in the books of the company, as depreciated. In this connection, it is impossible to ignore the fluctuations in value that have been, and may be, induced by war conditions, and here, again, no process of analysis avails to take account of all the relevant considerations. The solution will be arrived at by the judicial estimate, otherwise the glorified guesswork, of the arbitrator in the light of rival and highly divergent claims. The authors take no account of goodwill in connection with depreciation, nor could they be expected to do so, though Mr. Selvey introduced it at Leeds; but it is, nevertheless, a factor that will provide abundant scope for forensic eloquence and bills of costs unless the purchase is deferred to the statutory limit.

Not only is the method of allotting depreciation a contentious problem; the question of maintenance is also one that affords much scope for discussion. The precise point where the line should be drawn between repairs and renewals, and the question whether to charge such items to maintenance or to renewals, are proper and prolific subjects for debate. But we have not space to enter upon this wide field. In conclusion, we venture to put forward once more a counsel which is no stranger to our columns, namely, no matter what system of depreciation is adopted, the management will do well to build up, as soon as possible, a substantial reserve fund. Until this is done, no municipal trading department should be depleted of its profits in order to relieve the rates, and no company should declare large dividends for the sake of indicating a prosperity which in the light of subsequent developments may prove illusory.

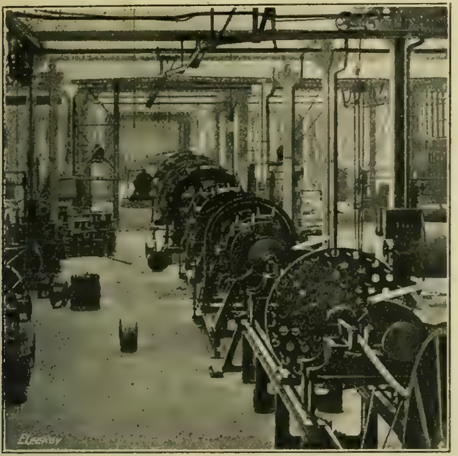
High-Speed Telegraphy.

The report on this subject, of which we commence an abstract on another page, while it suffers from the fact that the outbreak of war brought the elaborate experimental investigations which had been contemplated to a sudden standstill, nevertheless marks an epoch in the history of the evolution of high-speed telegraphy in this country. Incidentally, we may congratulate ourselves on the leading position occupied by the British Post Office and British inventors in the development of this interesting branch of the science of long-distance communication, a position to which New Zealand has contributed in no small measure, for several of the most useful and successful devices have been invented by sons of that progressive Dominion—Messrs. John Gell and Donald Murray. The latter in particular has laboured incessantly in this field, and has evolved a remarkable series of apparatus, besides focusing public attention upon the subject by his able writings.

The complexity and almost infinite variety of the inventions which have been developed in the hope of solving the problems of high-speed telegraphy were abundantly illustrated in the classic paper read by Mr. H. H. Harrison before the Institution of Electrical Engineers last year, and it is interesting to note that both he and Mr. Murray have recently joined forces with Messrs. Creed, Bille & Co., who also stand in the front rank in this connection, and will, without doubt, give a good account of themselves thus reinforced in the future.

The Committee's report, without excessive technical detail, tersely outlines the purpose and character of each of the devices that have been tested or put forward, and constitutes an able summary of the present position. It is made clear that the requirements of the British telegraphic service should be closely studied by inventors before they devote their brains to the task of complying with them, for the conditions are by no means simple or obvious. But for the transfer of many of the telegraph lines to the trunk telephone service, it appears that there would have been no special need of high-speed apparatus other than the classic Wheatstone. Even under the conditions thus set up, not every high-speed system is applicable to the traffic requirements, one of the most pressing of which is the necessity of a ready means of communication between the terminal operators, for the purpose of making corrections, &c. Again, the organisation of the traffic presents special problems which would not naturally suggest themselves to the mind of the casual observer. Hence it is that, after mature deliberation, the Committee arrives at the extremely important conclusion that "systems on the multiplex principle are definitely superior to the automatic high-speed systems on the large majority of main circuits for ordinary inland commercial telegraph work." Thus, "at one fell swoop," are swept aside so many ingenious instruments, the fruit of untold pains and lavish outlay. This is the outstanding feature of the report, which goes on to give the palm to the Western Electric Co.'s system, but keeps the door open for others. We believe that Mr. Murray's pioneer work deserves a considerable measure of credit in this connection, but, above all, we must not omit to pay homage to the memory of the French inventor, who is entitled to rank with our illustrious Wheatstone—namely, the originator of the five-unit alphabet and of the modern multiplex system, Baudôt.

THE PIRELLI-GENERAL CABLE WORKS.



Cable-stranding Machines.

Although the new cable factory of the Pirelli-General Cable Works, Ltd., at Southampton, has been in operation for some two years, it was not until last month, owing to the exigencies of the war and the pressure of work, that an official description of the plant was issued by the company. From the excellent brochure which we have now received, we have extracted the following particulars, which, while not pretending to present an adequate account of the establishment, may serve, at any rate, to indicate the nature and scope of the works.

The company was formed jointly by the Italian firm of Pirelli & Co. and the General Electric Co., Ltd., of Great Britain, both concerns of world-wide reputation, and combining commercial experience with technical ability of the highest order. Hence the cable works had the advantage of starting with the support of a huge organisation and vast resources, which guaranteed to it success from the very commencement. Moreover, it was set in operation at a time when the national emergency called for the employment of every possible instrument of production, and has thus been enabled to carry out important contracts for Government departments; at the same time, the circumstances under which it was inaugurated rendered it impossible to signalise the event in the usual manner, and consequently operations were quietly commenced without any public function.

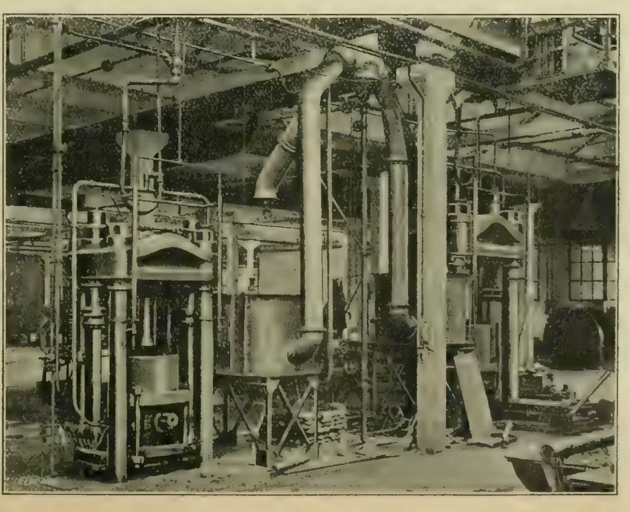
The firm of Pirelli & Co., which has been established for over 40 years, possesses factories at Milan and Spezia in Italy, and at Barcelona in Spain, and employs at Milan alone over 6,000 workers; owing to its progressive character and the excellence of its research department, it has long held a position in the front rank of cable manufacturers. The General Electric Co., Ltd., one of the largest firms of electrical manufacturers in the British Empire, needs no introduction to our readers, with whom its name is a "household word."

The whole of the plant being entirely new, the works enjoyed the advantage of starting on the most up-to-date lines and with the most efficient types of machinery throughout. The lay-out of the plant is also planned with an eye to the most economical production. A private pier gives access to the site by water, and is equipped with a 10-ton electric crane, while an overhead monorail system with electrical propulsion affords facilities for transporting loads up to 7 tons in weight to any part of the works. The main building is of two storeys, to which others can be added if necessary—but only one-third of the area owned by the company is at present covered, so that there is ample room for extensions. The shops are well lighted and ventilated. The heavy machinery is mounted on the ground floor, where the rubber washing, cleaning, and calendering plant, the stranding and covering machines, the vulcanising and testing tanks, lead presses, and stores are situated. All the machinery is driven by "Witton" motors, which derive their power from the Southampton Corporation mains. A boiler house supplies steam for the cable-heating and drying chambers, and two gas producers provide for the heating of the lead furnaces. The works are lighted with Osram and Osram-Atmos lamps.

The cable machinery is capable of laying up as many as 450 wires in one cable, and can deal with cables up to 1,500 sq. mm. section. Both rubber and paper insulation is employed, the latter type of cable being lead-sheathed. Wire and tape armour is also provided when required.

The testing rooms are of exceptional excellence, being equipped with apparatus for investigating the properties of all the materials used in cable manufacture, and test pressures up to 300,000 volts A.C. are available, the

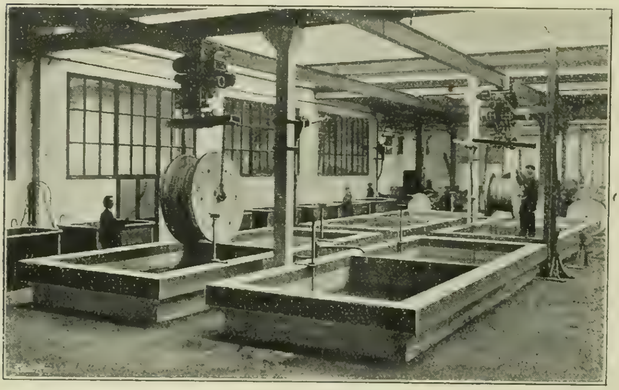
Braiding and Paper-lapping Machines.



Lead Presses for Sheathing Cables

current being generated by a "Witton" alternator and transformed up. An electrostatic voltmeter of the Jona type, with a maximum range of 200,000 volts, and transformers giving various test pressures, are provided.

On the upper floor machines are installed for the manufacture of the smaller wires and cables for electric lighting, telegraphs and telephones, bells, &c., and afford employment for female labour, which in the past has had little scope in Southampton. Other departments include offices, stores, repair shops, &c., the last-mentioned being equipped with heavy machine tools capable of making the new machinery for future extensions to the works. We give herewith some views of the cable shops, to illustrate the character of the equipment, which we hope at some future date to describe more fully, and conclude with an expression of our best wishes for the success of the factory in the strenuous times to come.



Cable-testing Tanks.

SOME CONSIDERATIONS AFFECTING THE USE OF ELECTRICITY IN AGRICULTURE.

(*Concluded from page* 89.)

It is, of course, well known that our near neighbour France has for many years carefully fostered her agricultural resources, and, amongst other matters which have occupied attention in official circles, is the possibility of extending the use of electricity for agricultural purposes, largely with a view to helping out the scarcity of labour after the war. A good deal has already been done in this direction by the enterprise of French electric power companies, by the co-operative action of French farmers, and by a valuable measure of Government assistance.

In France there are extensive distribution networks, and electrical energy can be purchased cheaply enough on the line of transmission, but the problem there (as elsewhere) is to supply the farms situated at some distance from the transmission routes. Solely from the point of view of cost, it is impossible for the supply company to serve such consumers *as individuals*, but the difficulty has been overcome by a number of agriculturists co-operating in the provision of a distribution system, and, if necessary, of a generating station to supply it.

It was to facilitate the realisation of such co-operative schemes that the French system of collective agricultural credit was first established, and there seems to be no doubt that this system will play a very important part in future, and not only in France. Mutual agricultural credit was organised in France by the Act of November 5th, 1894, which created district banks for agricultural credit. It was laid down that the capital of these banks could only be found by subscription from members of agricultural syndicates, and one of the objects of the district banks was to make advances to the local banks of the syndicates. This excellent preliminary to the solution of the financial difficulties which are at the back of so many agricultural problems was followed by another law (March 31st, 1899), which placed an advance of £1,600,000 from the Banque de France at the disposal of the Government for application to loans (free of interest) to the district banks, in order that these in turn might render more effective assistance to the local societies. Still later, the law of September 29th, 1906, organised long-term agricultural credit, and authorised the Government to draw on the funds up to £1,600,000, and remit sums to the district banks, free of charge, for the benefit of agricultural co-operative societies seeking loans for approved purposes. Societies thus financed are required to repay the district banks by annual instalments over periods up to 25 years. Outstanding principal is subject only to 2 per cent. interest per annum. Advances to the local society in respect of agricultural operations or the purchase and installation of machinery, &c., are made by the district bank as the work proceeds. The total amount of the advances may not exceed twice the capital subscribed by the society to the local bank, and the capital itself is made up of shares, of which every member must purchase at least one. The shares bear interest at not more than 4 per cent.

Societies desirous, or formed with the sole object of establishing a central station to serve a group of farmers, or of purchasing energy in bulk from a power company, are admitted to the full benefits of the scheme of financial assistance outlined above, and are thus relieved of the immediate capital expenditure. Naturally, the societies have to pay, in the long run, the same amount (plus interest) as they would have to pay for a central station, or for a feeder and sub-station, if they paid outright in the first instance. This means that the cost per unit for electrical energy is relatively higher until the capital debt is discharged, but the burden of the latter is distributed over anything up to 25 years. The price per unit is at first such that the annual receipts provide for interest and depreciation on the loan, costs of working and maintenance, and, in addition, the accumulation of a reasonable reserve fund. After the loan is repaid, the price per unit naturally decreases very considerably. If the receipts

Pirelli-General Cable Works: High-pressure Testing Room.

show a surplus, after making the above provisions, it is divided between consumers (who must all be members of the society), in proportion to their consumption.

There is no limit to the number of district banks which may be established, and at the end of 1913 there were 98 distributed all over France, so that co-operative agricultural societies could be founded and operated anywhere.

It cannot be too strongly emphasised that the obstacles in the way of really general utilisation of electricity in agriculture are those of finance and those of conservatism. The manufacturers can supply electrical equipment suitable for every farm need[*], and agriculturists could, if necessary, obtain electrical equipment on easy terms by the co-operative society system, especially the larger electric motors (as needed for ploughing, threshing, &c.), which can only be used economically on a co-operative basis. At the back of such co-operative societies must be agricultural banks, with a measure of State support. Granted the organisation for financing co-operative societies there still remains the task of persuading agriculturalists to form them, and it will fall upon central station engineers and electrical manufacturers to boost the advantages of electric power in agriculture just as they do in its other industrial applications. In this special application, however, they might go further, not only overcoming the conservatism of farmers, but showing them how the financial problem may be solved by co-operation, and even assisting in securing the necessary organisation and Government support for co-operation.

It may be of interest to give a few particulars concerning a French limited liability co-operative society in the Roisel (Somme) sector, which has as its object the supply of electricity for agricultural purposes, or, more specifically, its object is "to facilitate agricultural operations by supplying electricity for all purposes," and, with this end in view, the society makes contracts and loans to secure the proper installation and use of apparatus for its members. The society has members in 36 communes, and is established, in the first place, for a period of 20 years. The original capital was £8,000, in 2,000 shares of £4 each, and this can be increased by decision of a general meeting, or it may be reduced (by not more than 10 per cent.) by calling in shares.

Each member must hold at least one share, £1 being paid on application and the remainder as and when demanded. Each share is indivisible, will not be redeemed at a premium, and will not bear more than 4 per cent. interest. A certain proportion of all fresh capital issued is reserved to old shareholders, the admission of new members is controlled, and any member may retire, or he may be expelled for a sufficient reason, so long as the capital is not reduced more than 10 per cent. by such action. Until all State loans have been repaid, the capital may not be reduced below that on which the loans were granted. Members retiring or expelled are bought out by the society (at not more than par), but they are still liable, to the amount of their former shares, for debts contracted by the society during their membership.

The administrative council of the society comprises nine members, each of whom holds at least 10 shares during his whole term of office, these shares being inalienable and deposited in the society's bank as a guarantee. The normal period of office is three years. The council is given full control over affairs of the society and, *inter alia*, it fixes the price of current and the conditions of supply once a year. Any or all of the powers of the council may be delegated by it to a working committee of three members. A technical director (possibly not belonging to the society) may be appointed to work under the council. In general meetings, five shares (£20) counts as one vote, but no member may exercise more than 10 votes. Consent of a general meeting is necessary in the case of proposed deals involving £4,000 or more, and in the case of work proposed to be done at a cost of £800 or more to the society. A valuable opportunity of furthering the aims and interest of the society is afforded by the annual meeting, for which one delegate is nominated from each commune. As regards the distribution of profits, any surplus after paying redemption and working expenses is taxed 5 per cent. to provide the statutory reserve; then 4 per cent. interest is paid to shareholders, and 10 per cent. of any surplus still remaining is placed to supplementary reserve, the balance being divided amongst shareholders. The reserve funds are not repayable to members under any circumstances; in case of liquidation any balance from reserve is to be applied to encouraging agricultural co-operation, or to other works of agricultural amelioration.

The constitution and aims of this society form a very good example of the businesslike yet sympathetic lines on which such a scheme must be operated if it is to succeed. Not the least pleasing feature of the society's statutes is the provision whereby non-members may have two lamps on practically the same terms as members. This rule reserves the benefit of wholesale electric lighting and of electric power to the members, without denying to "outsiders" the great convenience which even a couple of filament lamps may bring.

In concluding these remarks we may draw attention to two further matters which may have a considerable influence on the future development of rural electricity supply, viz., ploughing and transport. As most of us are aware, a revolution on a small scale is occurring in connection with ploughing—the oil tractor and plough which so many people scoffed at a few years back has, owing to war-labour conditions, been forced into use, and it is said that over a 100 firms are building suitable engines for ploughing purposes. This is a development which may as easily react in favour as against electric ploughing, if we choose to develop agricultural electricity supply on an extended scale. Given a shortage of labour, the farmer must adopt mechanically-driven ploughing and cultivating appliances, and that type which requires the least labour and least costly fuel, and is inexpensive in upkeep and most simple in operation, should appeal most strongly to him.

Of the three "power" systems in use, viz., the "cable," the "tractor" and the self-contained motor plough, we know from Continental and British experience,[*] that electric cable ploughing is a greater labour-saver, and less costly in plant and operation, than steam ploughing by cable; an American writer (Koester) some years ago gave the comparative capital costs of electric and steam cable plough tackles as $11,000 and $14-15,000.

The disadvantage cited against the electric tackle—that it is not self-propelled—could obviously be overcome.

According to an English writer on the general question of ploughing[†] a set of 14-H.P. nominal ploughing engines, with a six-furrow plough, can plough 20-25 acres per day, or cultivate 50-55 acres; in a season 3,000-4,000 acres are dealt with. Such a set is usually hired at 10s. to 12s. per acre, the farmer finding coal and water; it requires four men and a boy, also a man and horse for carting. The cable system allows of any practicable depth of ploughing, and the cables are good for 6,000-8,000 acres before renewal.

Obviously the high initial outlay is against the use of a steam-operated cable system by small or medium farms, unless they hire, in which case the time of use has to be arranged.

The less costly and more mobile oil tractor has been developed in a variety of sizes, ranging from 7 to 60 traction H.P. and from 15 to 120 B.H.P., and the 25-30 B.H.P. machine is suggested as suited to conditions in this country. The traction efficiency appears to be 50-60 per cent., but limits of 30-70 per cent. are sometimes reached; a Canadian test showed a weight of 535 lb. per B.H.P., and 61 per cent. of this delivered at the draw-bar when ploughing. It is interesting to note that the draft of ploughs in different soils varies from 227 lb. in loamy sand to 660 lb. in blue clay, with a furrow 5 in. deep and 9 in. wide, and that a 10-12 H.P. engine on a self-contained plough is considered sufficiently powerful for two furrows in medium land, the machine weighing about 1 ton, and ploughing about 3 acres per day. These figures should be of interest to electrical men who are considering rural supply work, because the battery-plough and battery-tractor are obvious possibilities with an intensively developed farm-electric supply system. This also applies to the question of transport, which is bound up with the employment of the electric tractor, which is already in considerable favour for industrial use. But there is also to be considered for large farms, or for co-operative working, the use of narrow-gauge light railways with battery or trolley tractors, such as have, in fact, been employed on the Continent, and with which our own Light Railway Commissioners were, according to a writer in the *Times*, originally intended to deal.

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[*] Many of the existing standard agricultural machines operate at too low speed for efficient electric driving. This is, of course, due to these machines having been developed for hand operation or for slow-speed belt driving, and there is no reason why modified machines should not be built for direct coupling to high or medium-speed electric motors Co-operation is required between electrical manufacturers and makers of agricultural machinery.

[*] "Electric Ploughing," ELEC. REV., February 11th, 1916.

[†] "Mechanical Aids to Farming," *Commercial Motor*, July, 1916.

It is obvious that rural transport will have to be reorganised in the future, and, given the necessary supply facilities, there is no obvious reason which electricity should not play a prominent part in connection with it.

ERRORS OF DIRECT-CURRENT AMPERE-HOUR METERS.

By G. W. S.

The present article is an attempt approximately to investigate, from a theoretical standpoint, the errors of direct-current ampere-hour meters. The shapes of the curves of both mercury and commutator meters are well known, but it would seem only empirically. An investigation of these curves from a theoretical standpoint is not only interesting, but valuable, as it will throw considerable light on their nature, will point out a rational method of testing the two types of meters, and, incidentally, will explain the remarkable difference in the performances of meters of the mercury and commutator types.

Considering first an ideal meter of either type, without solid or fluid friction, in which the same field is used for braking and driving, we have, C being current, B flux, ω angular speed, a and e constants, equating torques

$$e\,\omega\,\mathrm{B}^2 = a\,\mathrm{C}\,\mathrm{B},$$
$$\omega = a\,\mathrm{C}/e\,\mathrm{B},$$

showing that the speed of a meter for a given current is inversely proportional to the flux. This is now generally known, but it is interesting to recollect that in a descriptive pamphlet of a well-known meter, published not many years ago, it was stated that, as the braking and driving fluxes were identical, an alteration in the strength of the magnets would not affect the accuracy of the meter.

The case of a meter with solid friction only may now be considered. The fundamental equation now becomes, f being frictional torque—

$$a\,\mathrm{B}\,\mathrm{C} = e\,\mathrm{B}^2\,\omega + f,$$
$$\omega = a\,\mathrm{C}/e\,\mathrm{B} - f/e\,\mathrm{B}^2.$$

The error is accordingly $-f/e\,\mathrm{B}^2$, and it is interesting to note that this varies inversely as B^2, emphasising the advantage of powerful magnets.

Consider now the meter with the armature at rest, and with a current infinitesimally less than starting current passing. We shall now have—

$$0 = a\,\mathrm{C}_s/e\,\mathrm{B} - \mathrm{F}/e\,\mathrm{B}^2 \text{ and } \mathrm{F} = a\,\mathrm{B}\,\mathrm{C}_s,$$

C_s being starting current and F being standing-still friction.

It is difficult to estimate the ratio between F and f, the friction when the rotor is moving. It is quite probable that in the case of mercury meters, even at minute speeds, the armature has a tendency to be lifted off the bottom jewel, the friction thereby being very considerably reduced. In the case of a commutator meter, there will be no such tendency. As a rough approximation, $\mathrm{F}/f = n$ may be taken as 3 for a mercury meter and 1¼ for a commutator meter.

We have accordingly, $f = a\,\mathrm{B}\,\mathrm{C}_s/n$.

The error can now be written, $-a\,\mathrm{C}_s/n\,e\,\mathrm{B}$.

The percentage error η is therefore, $-100\,\mathrm{C}_s/n\,\mathrm{C}$.

This error, it must be noted, is the difference between the actual and ideal speeds of the meter. It is not the same as the inaccuracy of registration, for, as is well known, the wheel work of the counting train of a meter is so adjusted as to make the algebraical average of the various inaccuracies as near zero as possible.

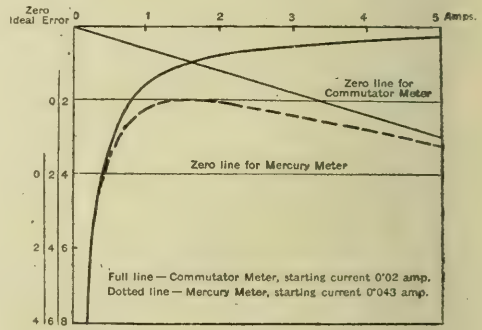
The results obtained above apply with close approximation to a commutator meter, and also to a mercury meter at low speed. They demonstrate that the curve of a meter in these circumstances is a rectangular hyperbola, and that the performance of the meter depends upon the starting current and the ratio of stationary to moving friction.

To take a numerical example, with a commutator meter having $\mathrm{C}_s = 0{\cdot}02$ ampere, $n = 1\frac{1}{4}$, the percentage error at ¼ ampere will be $-6{\cdot}4$. Since the meter will probably be adjusted to read 2 per cent. fast at ideal speed, the inaccuracy will be, at ¼ ampere, 4·4 per cent. slow. With a mercury meter, C_s being 0·03, and n being 3, the percentage error will be -4. As the ideal speed will, for reasons to be explained later, probably be about 3¾ per cent. fast, the inaccuracy of the meter at ¼ ampere will be ¼ per cent. slow.

It may occasionally happen that a mercury meter will give a satisfactory test at low load with an unsatisfactory starting current, this indicating that n has a higher value than 3. In such a case the rotor will usually be found to be out of truth or improperly balanced, a state of affairs that needs correction. The suitability of starting current as a criterion of the accuracy of a meter is not, therefore, vitiated by such an example.

The case of a meter having both solid and fluid friction has now to be considered. The simplest way to deal with this problem is to assume that fluid friction introduces an error proportional to ω^2. Since ω is very nearly proportional to C at the higher speeds when fluid friction ceases to be negligible, we may consider this error to be proportional to C^2.

The error may be written $-f/e\,\mathrm{B}^2 - g\,\mathrm{C}^2$, g being a constant, percentage error $\eta = -100\,\mathrm{C}_s\,n\,\mathrm{C} - m\,\mathrm{C}$, m being a constant. The shape of the curve is now altered. There is now a minimum arithmetical error for a finite value of C. The curve can be constructed by adding the ordinates of the original curve to those of a straight line $x = m\,\mathrm{C}$. The shape of the curve is very little modified for the lower speeds of the meter.



Errors of D.C. Ampere-hour Meters.

The result of the correction for fluid friction by weakening the flux by an amount proportional to the current may be investigated as follows :—

The speed, neglecting errors, without the correcting device is,

$$\omega = a\,\mathrm{C}/e\,\mathrm{B}.$$

The increased speed due to correction—

$$\omega' = a\,\mathrm{C}/e\,(\mathrm{B} - \mathrm{s}\,\mathrm{C}), \text{ s being a constant.}$$

We therefore obtain very approximately, $\mathrm{s}\,\mathrm{C}$ being small—

$$\omega' - \omega = a\,\mathrm{s}\,\mathrm{C}^2/e^2\,\mathrm{B}^2.$$

The result of the correction as regards the errors of the meter is of the second order of smallness, and may be neglected. As the result of the correction of the meter is proportional to C^2, its effect is to diminish the constant m in the equation giving the error of a mercury meter, and in no way to alter the nature of the curve. By increasing the number of turns in the correcting coil, it will be possible almost exactly to counteract the effect of fluid friction, or even to over-compensate the meter. This is rarely done, and it will be explained that it is advisable slightly to under-compensate the meter.

The accompanying diagram will make these results clear.

The full-line curve is a rectangular hyperbola, and represents the performance of a commutator meter. The straight line represents the effect of uncompensated fluid friction, and the dotted curve represents the effect of both solid and fluid friction as found in a mercury meter. A consideration of these curves will show very clearly why a mercury meter gives greater accuracy at low loads than a commutator meter. With a commutator meter the full-load speed is relatively the greatest, and the zero inaccuracy line has so to be adjusted that at this load the meter is not more than 2 per cent. fast. With a mercury meter, the speed at full load is relatively much smaller, and the zero inaccuracy line can be adjusted to a lower position, as shown. It will be seen from the diagram that although the ideal error of the two meters at ¼ ampere may be the same, the inaccuracy of the commutator meter will be 2 per cent. greater than that of the mercury meter. It will also be clear that it is advantageous for the curve of the mercury meter to drop slightly at the higher loads, as this allows the zero inaccuracy line to be shifted to a lower position than otherwise.

The equation for the error of a mercury meter may be written—

$$\eta = -(p/\mathrm{C} + m\,\mathrm{C}):$$

we easily obtain by differentiation that the smallest arithmetical error occurs when $\mathrm{C} = \sqrt{p/m}$. It therefore follows that if from observed values of C and η, p and m can be calculated, this value of C can be obtained. This value can, however, be ascertained by trial for different types of meters, and will be found to be fairly constant for each type, it being remembered that C is the current in the bath of the meter.

It therefore follows that the three criteria necessary to determine the accuracy of a mercury meter are tests at full load, at load of minimum arithmetical error, and starting current. If these criteria are satisfactory, other tests are superfluous. In the case of a commutator meter two tests are sufficient, starting current and full-load speed.

HIGH-SPEED TELEGRAPHY.

An important report was issued last week by the Committee appointed by the Postmaster-General at the end of 1913, to consider the position of high-speed telegraphy for the information of the Post Office. It states that when the only high-speed systems available were the quadruplex Morse and the Wheatstone, neither of which was satisfactory, a sufficient number of wires was provided to carry the traffic with low-speed apparatus, and as the volume of telegraphic traffic has been at a standstill for some years, there has not been an urgent demand for the increased use of high-speed apparatus. It would not be desirable to take down existing wires in order to justify the application of high-speed apparatus to the remaining wires. A reduction in the number of telegraph wires has, however, been effected by converting some of them into trunk telephone wires, and in the development of the telephone service this policy of conversion must continue to be followed. In this way the economical multiplication of high speed telegraph circuits can be effected. The economy will be twofold, first, by the saving of wires, and secondly, by the increased output per operator which is yielded by certain of the high-speed systems.

In the Post Office service the duplex method of working is normally adopted on all lines where the traffic justifies it. A duplex Morse circuit has a speed of 30 words per minute in each direction, and a total carrying capacity of about 60 words per minute. All systems which provide a greater output than this are classed as high-speed systems.

Of these there are two classes, commonly called automatic and multiplex. The first provides an actual higher speed of working with a limit of two channels in opposite directions; the other class distributes the higher speed of the circuit among three or more operators. Of the first class, the Wheatstone, an automatic high-speed Morse, is the typical instrument; of the second class, the Quadruplex, as applied to the Morse system, and consisting of two duplex circuits on one wire, is typical. A departure from the Morse system was adopted in the shape of the Baudot telegraph system; this is worked on the multiplex principle, *i.e.*, any even number of channels up to 12 can be provided on a single circuit, working simultaneously and equally divided between the two directions.

Numerous experiments have been made by the Post Office with various types of apparatus designed to improve the service. Many of the instruments that were the subject of evidence before this Committee had undergone actual trials before its appointment. Although the carefully designed series of tests which it was hoped would illustrate and support the Committee's recommendations could not be proceeded with, owing to the outbreak of war, the ample information available has enabled it to make certain definite recommendations without prejudice to further developments which may arise after the war.

Amongst the systems which have been investigated during the last 30 years, the following are still in use by the British Post Office:—The Creed receiving perforator, whereby ordinary Wheatstone signals are utilised for reproducing a Wheatstone slip, and thus enabling a message to be retransmitted without perforating fresh slip by hand (45 in use); the Murray multiplex (type printing on ordinary telegraph forms), in which a perforated slip is prepared by means of a keyboard perforator and passed through a transmitter, the signals being sent to line *via* a distributor which connects the line in turn to each of the transmitters, a synchronised distributor at the receiving end distributing the received signals to the printers (one double duplex, London-Manchester); Gell keyboard perforator, which prepares Wheatstone slip with electromagnetic punches (over 150 in use); the Creed printer, in which perforated Wheatstone slip at the receiving station controls a pneumatically operated typewriter (40 in use); the Booth-Baudot duplex (six inland circuits); the Siemens automatic (type-printing), actuated by perforated slip, with a transmitter, synchronised distributors, and an electromagnetic typewriter (one duplex circuit, London-Liverpool); the Kleinschmidt keyboard perforator, similar to the Murray perforator; and the Western Electric multiplex (type-printing), using perforated slip, distributors synchronised by the ordinary signalling currents, and a typewriter (one quadruple duplex circuit, London-Manchester). When the last statistics of the International Bureau of the Telegraphic Union were issued, the United Kingdom had 11,061 low-speed instruments in use, and 670 quadruplex, 795 Wheatstone, and 22 Baudot high-speed instruments; France, with 12,714 low-speed instruments, had 1,155 sectors on the Baudot system; Germany, with 12,455 low-speed instruments, had 30 Baudot, 27 Wheatstone, one Murray, and 16 Siemens high-speed instruments; Italy, with 15,514 of the former, had 19 Wheatstone, 152 Baudot, and four Rowland sets; and Russia, with 9,796 of the former, had 121 Wheatstone, 115 Baudot, and three Murray high-speed instruments. Other countries showed far less development in high-speed telegraphy.

The Committee held 28 meetings, and received evidence from inventors and other experts regarding the various systems. The question resolved itself into a rivalry between automatic high-speed systems on the one hand, and the multiplex on the other, though the inventions of Mr. Creed and the advent of various keyboard perforators had affected the situation of the former, and the inventions and writings of Mr. Murray had intensified interest in high-speed telegraphy generally. But three new and important systems were brought to the notice of the Committee, namely, the Siemens automatic printing telegraph, and the multiplex systems of the Western Electric Co. and the Automatic Telephone Manufacturing Co.

The Morse code employs groups of symbols of varying lengths for the different letters, while in the five-unit code permutations of positive and negative impulses, always five in number, are employed; the former is used for Wheatstone working, but most of the multiplex and automatic systems use the latter, which for printing telegraphs has substantial advantages.

The question whether Wheatstone working should be employed systematically during particular hours each day, or only spasmodically at times of pressure, has been a much-debated one ever since the Wheatstone patents came into the possession of the Post Office, and the system still presents problems in organisation, though these have been modified by the introduction of the Creed receiving apparatus, which produces punched slip instead of the Morse tape, enabling the message to be translated into type letters by the Creed printer, or retransmitted without translation. But even with the addition of the Creed inventions, the Wheatstone system is not a desirable one for commercial telegraph work, as the operators are not in direct communication, and there is difficulty in obtaining corrections. Multiplex working has the advantage of placing the operators in direct association with one another, exactly as if they were working low-speed duplex, so that any apparent error or failure can at once be rectified. Moreover, the working speed of the printers does not exceed 120 words per minute, and this rate cannot be maintained continuously. The greatest objection to the extensive adoption of the Creed instruments is their cost to purchase and maintain. The Gell keyboard perforator for preparing Wheatstone slip at the sending end of a circuit is one of the most efficient instruments that the Post Office has tried for this purpose, but costly. Mr. Gell has also invented an automatic switch to connect two or more Wheatstone transmitters direct to line in turn, saving line, time, and labour, and this is recommended for further trial. The Kleinschmidt keyboard perforator is cheaper than the Gell, and works satisfactorily. The Siemens-Halske is a direct printing system, with keyboard perforators at the sending end; at the receiving end, the received impulses act directly, without the interposition of a perforated slip, on the printing mechanism.

(*To be concluded.*)

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

White's Patent Corrosion-Proof U-Seal Fittings.

We have from time to time noticed the growth of the series of corrosion-proof fittings for use in conjunction with cab-tire-sheathed cables in bad situations, which has been developed on the basis of the patent of Mr. J. C. White, electrical engineer to the St. Helens Cable and Rubber Co., Ltd., Warrington. The list has steadily lengthened, and now provides for the bulk of the requirements of chemical works, explosives factories, &c., where extreme precautions are necessary to guard against the corrosion of the fittings and lamp-caps by acid fumes, accidents from shock, and ignition of explosive gases; our congratulations are due to the inventor and his firm on the ingenuity of these devices, representing a great advance on the original patterns, and the excellence of the materials and workmanship embodied in their construction.

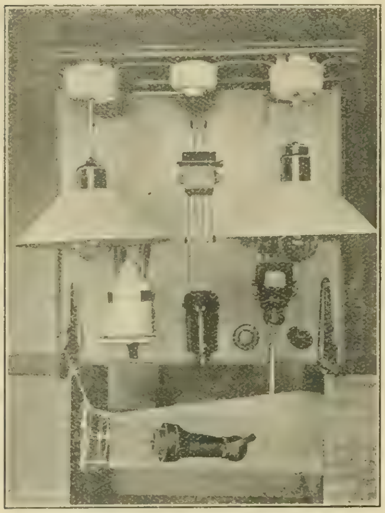


Fig. 1. White's Corrosion-proof Fittings.

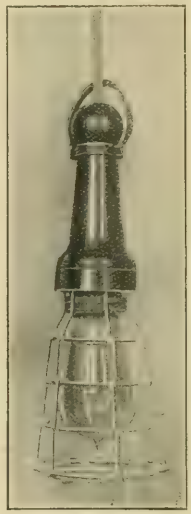


Fig. 4.—Portable Hand-lamp.

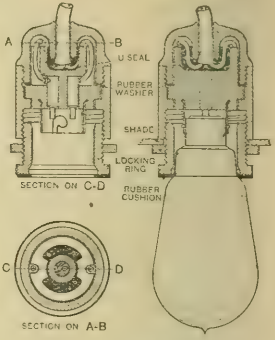


Fig. 5.—Sections of Pendant Lampholder.

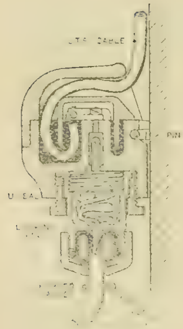


Fig. 2.—Section of Socket and Plug.

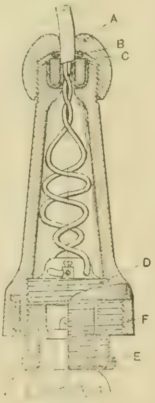


Fig. 3. Section of Hand-lamp.

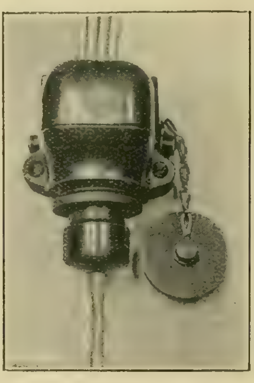


Fig. 6.—Socket and Plug.

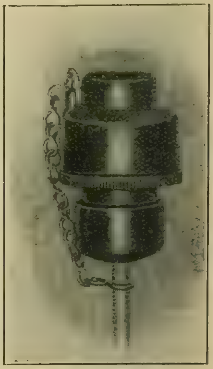


Fig. 7.—Plug with Cap on.

We illustrate in fig. 1 a showboard comprising the apparatus referred to, among which are several new items of which particulars will be of interest to our readers. Fig. 2 shows in section a corrosion-proof wall socket and plug, composed mainly of ebonite. The socket is attached to the wall by screws through lugs, and is provided with the U-seal filled with compound which characterises nearly all these fittings; after wiring with "C.T.S.," either single or loop-in, which is an easy matter, the compound is poured in, the connections are covered with an ebonite diving-bell cap, and a hood is slipped on, and locked with an ebonite pin. The socket faces downwards, so that no liquid can rest or accumulate on the contacts, and when not in use the opening is closed with a screwed cap. The plug is shown in section in the same view; it is provided with a rubber gasket fitting round the flexible C.T.S. cable, and a barrel containing slack leads, which are attached to the contact pins. An ebonite locking ring secures the plug when in position, and is closed by a cap to protect the pins at other times. The strain is taken off the leads inside the plug by an ingenious and effective method, the tough sheathing being split and turned back over the U-seal, and gripped between the cover and the barrel as shown, the rubber gasket being simultaneously squeezed, so as to render the whole fitting water-tight.

The complete plug and socket, and the plug alone with its cap on, are shown in figs. 6 and 7.

A section of the portable hand-lamp is given in fig. 3. At the upper end the flexible cable is gripped without pinching the conductors, as explained above, and the connection is made water-tight by the cap A, gasket B, and ring C. Slack leads within the ebonite handle connect to the lampholder D, which is of the simplest possible construction, and easy to wire. When the lamp is in place, the collar E, which carries an elastic ring, is screwed back to lock the lamp and make a water-tight joint with the bulb. The guard, of tinned iron wire, the ends of which are bent to fit the recesses shown, is then put in position and locked securely with the collar F. The whole forms a very substantial fitting, with not a single metal screw, except in the terminals, and offering no possible opportunity for any exposed metal part to become alive. A leather loop, containing no metal parts, is attached to the handle. Fig. 4 shows the complete fitting.

Fig. 5 gives sections of a corrosion-proof pendant-holder with U-seal, which explains itself, in the light of the foregoing remarks, except that the cord grip consists of a wedge of wood inserted in the end of the cable to expand the sheathing, and a rubber washer closes the space containing the terminals. The shape of the U-seal is seen in the sectional plan.

Lastly, fig. 8 shows a "Goliath" half-watt lampholder in earthenware; in this case the terminals, which are arranged for loop-in wiring, are enclosed in a chamber, which is afterwards filled with melted compound through a hole in the cap, which is finally closed by a screw plug. This holder is unaffected by the heat from the lamp, by acid vapours, &c., and a nut with an asbestos cushion, which is screwed down on the glass, prevents access of fumes to the metal parts. It will be seen that a very complete and practical set of fittings has been developed, and the samples before us show that in construction and material they are all that could be desired.

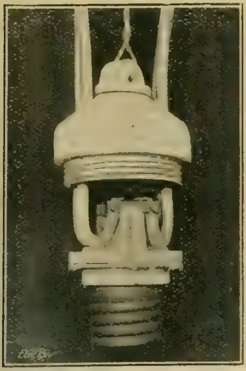


Fig. 8.—Parts of "Goliath" Lampholder.

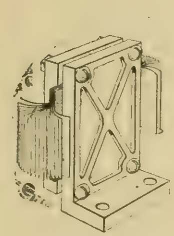


Fig. 9.—Precision Condenser.

Precision Condensers.

Edmund B. Wheeler and Morton Sultzer, of East Orange and New York respectively, propose in Patent No. 1,200,063, a method of manufacturing electric condensers which not only permits of adjusting and maintaining the capacity to a high degree of accuracy, but which also allows of a very rugged construction. Heretofore, in condensers of the stack type, it has been customary to use tinfoil between successive layers of insulation. In view of the very low tensile strength of tinfoil, it is proposed that part of the tinfoil sheets be replaced by copper or aluminium foil, and it is found sufficient to have the last few sheets on each side of the condenser formed of this stronger metal. Clamping plates are used for compressing the sheet material to a high degree. It is found that the use of a few sheets of conducting material of high tensile strength in these condensers permits an accurate adjustment of the capacity of the condensers as a whole. This adjustment is accomplished by having the capacity at first a little larger than desired, and then pulling out sheets until the desired capacity is obtained. When this stage of the manufacture has been reached, the condenser is placed in a suitable furnace and is maintained at a high temperature to remove any traces of moisture and excessive quantity of air. The condenser is then dipped into a molten mass of sealing mixture. Its construction is shown in fig. 9.—*Electrical World.*

Battery Ignition for Petrol Motor Vehicles.

A new departure in current-distributor breaker mechanism in connection with battery ignition on petrol motor vehicles has recently been introduced by the **Pittsfield Spark Coil Co.**, of Pittsfield, Mass., U.S.A. As will be seen from the accompanying drawings, which represent in an exaggerated form the stages of the action of the device, the arrangement, notwithstanding the unusual action, is extremely simple. The essential feature is the employment of two stout spring-steel blades A and B—one being slightly longer than the other—each of which, it will be noticed, carries a contact point. The cam is shown as being in the form of a square with rounded corners, being intended for a four-cylinder engine; it would, of course, be hexagonal for a six-cylinder engine, octagonal for an eight, and so on.

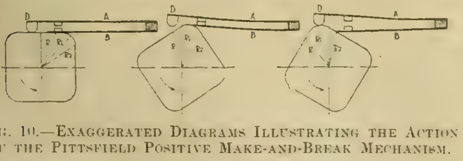


Fig. 10.—Exaggerated Diagrams Illustrating the Action of the Pittsfield Positive Make-and-Break Mechanism.

With the cam in the position shown at the left, the ends of both the blades are resting on the cam, but the platinum points are not in contact. As the cam turns, it first lifts the blade B, bringing the platinum points together. This causes the blade A to be lifted to the position shown in the centre diagram, thus keeping the platinum points together with a firm pressure. Immediately the point of the cam strikes the extremity D, the circuit is broken, and thus the cam mechanically "makes," and immediately afterwards mechanically "breaks," the circuit. Since both the make and the break are made by the cam, both are equally positive, and the contact can neither fail to make nor to break, the action being entirely independent of the strength of the springs. Other claims made for the arrangement are that, owing to the short duration of the contact, the current consumption is small, thus reducing the demand on the battery, and that the positive action permits the distributor to operate with perfect regularity at speeds in excess of the highest engine demands.

The distributing sets to which the new make-and-break device is fitted are made up into units 6 in. long × 3½ in. diameter, the unit including the coil and condenser, so that the only external wire is a single lead to the battery, in addition, of course, to the high-tension leads to the sparking plugs in the engine. The coil and condenser are also so fitted that they can readily be removed in one piece, and so give access for any adjustments of the interrupter mechanism.

LEGAL.

Cedes Electric Traction, Ltd.

In the Winding-Up Court, as briefly reported in our "Notes" last week, an application was made to Mr. Justice Astbury to stay proceedings in the winding-up of Cedes Electric Traction, Ltd., in order that the Board of Trade should have an opportunity to decide whether they desired to exercise their rights and duties under the Trading with the Enemy Act, the allegation being that this was a company under the control of alien enemies with debts owing to English creditors.

In giving judgment, his **Lordship** said that the company was registered in 1910 and was said to be under the control of enemy subjects, and it was alleged that its share and debenture-holders were alien enemies. The summons to stay proceedings was by an English creditor, who obtained judgment against the company in 1915 for £1,500. Subsequently in the same year the company issued £3,000 worth of debentures, and in December, 1915, a winding-up petition was brought by another English creditor. In January last year the Trading with the Enemy Act was passed, and in April, 1916, the petition came on for hearing, and the usual winding-up order was made without any of the facts that he had stated being brought to the attention of the Court. It appeared that there were a number of unsecured English trade creditors of the company. A foreign enemy now claimed to be a creditor for a very large sum which, if the debt existed, would absolutely swamp the assets so far as the English creditors were concerned. The business was now being carried on by a Receiver for the debenture-holders, who were said to be alien enemies. The application to stay the winding-up temporarily was to give the Board of Trade an opportunity of considering whether they wished to act under the legislation he had referred to. Subject to proper undertakings being given by the applicant, he thought the application ought to succeed, and he proposed to stay the winding-up for six months to give the Board of Trade the opportunity already mentioned. It was stated that the undertakings would be given.

Breach of Electricity Regulations.

A sequel to the death of Thomas Bennett, of Peak Dale, Buxton, employed by the Buxton Lime Firms Co., Ltd., came before the Buxton magistrates on Saturday, the company being charged with having failed in two instances to comply with the electricity regulations made under the Factory and Workshops Act. Last September Bennett, who was employed as a wagoner, was found lying dead on an iron pipe near a tunnel, fearfully burnt on several parts of the body. The pipe contained a cable used for lighting purposes. Mr. W. H. Grenard, of the Home Office, instructed by the Public Prosecutor, appeared for the prosecution, and Dr. Eastham was for the defence.

Mr. Grenard stated that the electricity passed along a power wire and a lighting wire; they went partly through a metal pipe. The question of lighting had nothing to do with the case. On September 13th Bennett was missed, and an alarm was raised. He was found dead, with his left hand and arm on the pipe through which the lighting current ran. If the pipe had been properly earthed in accordance with the regulations, death would never have occurred.

Dr. Eastham submitted that the case was misconceived. The man was not killed in the tunnel. He had to climb up a 4 ft. 6 in. wall, and had gone a yard or two up the embankment. It was not a thoroughfare. The pipe was placed in an inaccessible place, and his clients thought it was in such a position that no one could get at it, and no one's duties took him there. He submitted that the case for the prosecution had not been established, and that the company were not responsible for contributing to the man's death.

The **Chairman** (Mr. T. H. Lowthian) said the Bench were unanimous in the first case, and imposed a fine of £10; the second case would be dismissed on payment of costs.

Broken Trolley Wire.

At the Belfast Recorder's Court, James Dwyer and his wife claimed damages from the Belfast Corporation for injuries received in October last through the falling of a trolley wire while they were standing at the corner of a street. His Honour awarded £5 to Dwyer and £4 to his wife.

Battersea Borough Council *v.* Juchau.

At the Wandsworth County Court, before Judge Harrington, on Monday, the plaintiffs brought an action against George Juchau, now of 49, Northcote Road, to recover £14 1s. 4d. for the installation and hire of three electric lanterns outside 40, Northcote Road.

Mr. E. T. **Dale**, for the plaintiffs, said the case was brought as a matter of principle. The lanterns were supplied and erected under an agreement for their use for three years, but owing to the police regulations the lights were in use only a few months, and though under the agreement the Council had the right to charge the full amount, they offered a reduction of 75 per cent. to all customers. Defendant never availed himself of the offer. He was charged rent till September, 1915, and, in addition, the actual cost of installation.

F. **Thwaites**, a clerk in the Council's service, produced the agreement dated July 14th, 1914. Apart from a small meter rent, the hire agreement was 13s. 9d. per quarter, or £2 15s. a year for each lamp.

Defendant, in reply to the Judge, said he was an Englishman. He had only been able to use the lights three or four days when war broke out. Therefore he did not think he owed the money, as he had not had the light.

Judge Harrington said he understood defendant was charged with the expense of being supplied with the fittings. He considered the Council had acted very considerately in making the reduction they had.

Mr. Thwaites said the full amount would have been £24 18s. 9d., but defendant was only charged with the cost of the installation. Defendant was still carrying on business in the same road, having changed from one side to the other, but he had never determined his contract. The undertaking was to use the light for at least 650 hours per annum.

Defendant agreed that he had entered into the contract, and had paid £2 3s. 3d. under it. The three lamps were outside the shop, but he had not had the light, and he was not going to pay. He had never asked the Council to take back the lamps.

Mr. Dale referred to the case of the Leiston Gas. Co. *v.* Leiston-cum-Sizewell Rural District Council, a similar action, where it was held that the contract held good. In this case the amount would have been £8 6s. 10d., had the defendant been reasonable, but it was now over £14.

Judge Harrington said it was quite clear from a decision in a similar action, which was upheld on appeal, that he would have to decide against defendant, though it might seem a hard case. He gave judgment for the amount claimed, with costs.

Rugby Urban District Council *v.* Smith.

At the Rugby Police Court, last week, Hugh Leslie Smith was summoned by the Urban Council for feloniously using electricity between August 1st and October 15th last year.

In November, 1913, defendant applied to have the electric current installed at his house for power and heating purposes only, but when an official visited the premises on October 16th last he found wiring for lighting purposes had been put up in practically every room, and that lamps of 60 or 80 c.p. were in use; also that in an attic used as a workshop there was a lamp of 300 c.p. The charges for current for heating and power purposes at Rugby were respectively 1¼d. and 2d. per unit, as against 4½d. per unit for lighting. It was also found that behind a picture in the hall of the consumer's house the cable had been bared for a space of 1½ in. and prepared for making connections; and that the seal of the fuse box had been broken, the Council's fuses taken away, and others of a stronger and different make put in, by which means it was possible to get a great amount of current without it having passed through the meter at all.

Defendant pleaded guilty to the charge, but said the large lamps were used for warming the rooms only.

A fine of £10 and costs was imposed, the Chairman (Mr. T. A. Wise) remarking that he was sorry to find a man in defendant's position guilty of such a mean fraud.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

British v. German Manufactures.

Your leader appearing in the current issue on preference for British manufacturers has brought the previous report on breakdowns to German plant to my notice again, and, without any desire to take up too much of your valuable space, I should like to explain the precise position in regard to the alleged Newport breakdown, supplementing it by a few comments on your more recent leader.

I am not aware how you obtained your information regarding the Newport plant. Had you communicated with me on the subject I should have been pleased to give you the fullest information. Presumably, you extracted the information from the copy of the annual statement of accounts and report sent you in the ordinary course. In that report it was mentioned that a 3,000-kw. A.E.G. turbo-alternator had been out of commission for five weeks, due to breakdown, *including the annual overhaul.* These latter words you carefully omitted. The reason why no detailed information was given in the annual report was that it was not desired to again refer to an alleged regrettable error which had been fully dealt with at the time by inquiry, and regarded as closed.

The actual facts are as follows:—The plant was installed in 1913, being put into commission on December 17th, since when it has practically run continuously, that is to say, day in day out, and for the greater portion of the time dealing with the major part of the total output. No single defect or trouble had occurred with it up to the time of the breakdown above referred to. On that occasion, apparently, the auxiliary oil supply used in starting up the set was not in operation, with the result that before the set reached full speed the centre bearing heated up, running the metal sufficiently to let down the shaft on to the labyrinth glands. This was the total extent of the damage done, and, obviously, had nothing to do with the design or the construction of the plant itself.

The delay in putting the plant into service again was partly due to the fact that new labyrinth glands had to be made, which occupied a considerable time, and further, the opportunity was taken to make a thorough overhaul, including the condenser equipment.

I am not at all suggesting that there is not a possibility of trouble in the future. Careful observation leads me to think that certain parts of the turbine will require renewal earlier than was anticipated, due to causes of a metallurgical nature; but this, I suggest, is by no means an uncommon feature, and had even been met with in the case of British-built turbines.

I do not propose to pursue this particular case further; but in regard to the general statement contained in your report as to the defective design and construction of certain German-built plants, these were purchased by Britishers, presumably with their eyes open, and on the advice of some of the most eminent consulting engineers in this country, and in many cases purchased, not by much-maligned municipal authorities, but by private limited companies, where certainly the question of price could hardly have been the ruling factor. Moreover, unfortunately, I believe much British plant has suffered from the same lack of experience as the German: it would, for instance, be interesting to know how many British-built turbo-alternators were out of commission in 1913 alone due to breakdown. I do not think that British manufacturers, as a body, would exactly care to see a published list.

I am not for one moment suggesting that, therefore, British plant is not superior to German-built plant. We have all, no doubt, got decided opinions upon this, both in regard to practical design and construction, and workmanship in erection, the latter a most important factor; but to pick out a number of isolated cases of breakdown and to hold them up as generally condemning any particular country's manufactures seems to me illogical.

Incidentally, if the particulars as set out by you are typical of German plant, there is, I suggest, a direction in which the outlook of the war for this country and her Allies is most hopeful, for there is evidently not only the attrition of man-power and economic attrition working in our favour, but, further, the attrition of machinery assisting us; for it can surely only be a matter of time before the major portion of German plant within the German Empire will have broken down under the excessive strains imposed upon it, and they will be unable to continue the manufacture of munitions in a sufficient quantity, being too busily engaged upon the repair of the driving plant.

Turning to the leader in your current issue, one is glad to note a prominent technical journal placing to the fore the question of the position of British manufactures after the war. A careful perusal of your leader, however, leaves the impression that your underlying political tendencies have been allowed to prejudice your better judgment.

There can be no engineer in the country to-day who would, if he could possibly help it, place an order after the war for any single item with a German company if a similar article, be it large or small, could be purchased within the Empire, or from an allied or neutral nation, no matter how attractive the proposition might be; certainly I could not imagine any giving the German market an opportunity to tender? It is to be hoped that in the outside industrial world similar conditions will exist. It, therefore, seems rather unnecessary to attack the alleged past actions of municipal authorities in particular to carry home your argument. Many of the statements on this point are devoid of foundation.

It is easy to be wise after the event; but who in the early summer of 1914 would have questioned the propriety of giving the German market an opportunity to tender? It is extremely unfair, therefore, to attack to-day the general business policy pursued in pre-war times.

But why particularly single out public authorities for attack and make little reference to private limited companies? It is common knowledge that some of the biggest British contracts placed in Germany were given by private companies.

Your suggestion that deputations to the Continent had anything to do with the contemplated, or definite, placing of contracts abroad is more in keeping with the hysterical vapourings of certain sections of the non-technical Press. Contracts were placed abroad because it was a sound commercial proposition to do so under the then existing conditions. That such conditions should not be permitted to exist after the war goes without saying; how to ensure such safeguards as will effectively prevent it in the future is a matter for deep consideration, primarily and essentially a political and economic question; that it cannot be divorced from politics appears self-evident from your leader.

Tariff walls alone will never secure to this country the requisite safeguards, and there is always the danger that ultimately they will re-act prejudicially against all sections of a community, and the consumer in particular. Much more is necessary: A more intensive culture in the form of higher technical education, made compulsory, if necessary, specialised development and elaborate research work, particularly in the fields of chemistry and metallurgy, supported by generous contributions from the State, and, preferably, the inauguration of national institutions for such purposes. It is in this direction that engineers can best help, leaving the political and economic considerations in the hands of Statesmen.

Regarding labour and wages conditions, how are these to be regulated in the manner you indicate? They vary considerably in different parts of this country, and enormously so as between this country and our Colonies, but I take it the latter will certainly be given free trading opportunities within the Empire. Further, the municipal trade-union and fair-wages clause does not require a firm to pay the rate of wages in force within the particular municipal area, as you seem to imply. It is only required that the manufacturers shall pay the rate of wages current in their own district; it would be difficult to suggest a fairer arrangement.

Take the case of the allied and neutral nations, *i.e.*, France, Italy, America, or Switzerland, more particularly the former: Is it to be suggested that they should be debarred from entering into our home markets and benefiting from the total exclusion of Austro-German competition? Yet, how are wages conditions in these countries to be co-ordinated with ours? As a rule, in the engineering industry the rate of wages and conditions of labour in continental countries are, generally speaking, lower than in this country, and much lower than in the Colonies, but it is certainly to be hoped that, for this reason, neither our Colonies, nor our Allies, will be unduly penalised, but will be given free and ample opportunity to enter into vigorous competition with the British manufacturer; nor will it be any disadvantage to the purchaser for them to do so, but rather an advantage. As to why this should be so, you throw out a very plain hint when you state that, "What we have to guard against if we are to carry with us the co-operation of the public authorities is the temptation to raise our prices to such an extent as to play into enemy hands." Precisely; in truth may one say: *Rem acu tetigisti.* Have we here an indication of the underlying future commercial policy of British manufacturers, particularly in the electrical industry?

It is quite obvious that the total exclusion of the Austro-German market might provide a splendid opportunity for the exploitation of the British purchaser, to the advantage of the British manufacturer.

Anyone who has had an opportunity of visiting Germany and gaining even a superficial insight into the internal economic conditions and commercial policy, cannot fail to have observed how the German purchaser has been exploited, to the advantage of the German manufacturer, who has at the same time been able to carry on his peaceful penetration in foreign markets. It is well known that the German purchaser in the past has had to pay anything up to 20 per cent. more than he should have done for German-built machines in order that excess profits might be used to compete in and undercut the foreign market. Judged by our standards, it may seem a very immoral policy; but this would not seriously concern the apostles of German Kultur, who have reduced such methods to a scientific system, fostered and taught by their professors and intellectuals, and Jewish financiers, and supported in a practical manner by State subsidies. It is to be devoutly hoped that the British purchaser will not permit himself to be exploited in the same way in this country, not even in order that the British manufacturer shall be able to compete in the Continental market.

There appeared in a recent issue of your contemporary, *Engineering*, very full particulars regarding proposals for a great electrical development in Bavaria after the war. That the German Government should have the time at its disposal under existing conditions to develop so fully a scheme of the magnitude therein outlined is significant, and a fuller knowledge of these and similar intentions should do more than any amount of semi-political propaganda to foster and create commercial impetus and efficiency in this country, and arouse the British manufacturers and purchasers to a truer perspective of things, thereby enlarging their outlook and stimulating a broad-minded international industrial policy.

A. Nicholls Moore,
Borough Electrical Engineer.

Newport (Mon.), *January 22nd*, 1917.

[Mr. Moore's motto is evidently *Fiat justitia, ruat coelum!*—or, in more homely phrase, "Give the devil his due." We have no objection to this, and accordingly we commend Mr. Moore's candour in admitting that the breakdown was the result of negligence; as for the reference to the annual overhaul, it is clear from his remarks that this had nothing to do with the breakdown, and that the plant would have been out of commision for some weeks owing to the breakdown alone. Had our correspondent mentioned in his report the cause of the breakdown, we should not have included this item in our list; but he anticipates that its inclusion will be justified at a later date, for he foreshadows trouble with the turbine in the future.

Mr. Moore's detachment from mundane affairs is exemplified in the judicial impartiality with which he holds the scales between British and German manufactures, and his suggestion that the former are not faultless. No one said they were; but the Germans have specifically claimed that the workmanship and design of their products are such as to render breakdown impossible, and such claims can, and should, be refuted by specific instances of their falsity. The majority of the instances that we gave related not to "much maligned municipal authorities," but to companies, and we have pleasure in publishing a supplementary list in this issue. It is not for us to compile a similar list of breakdowns of British plant, or to fight the Germans' battle for them in any other respect. We are acutely conscious that we are at war, and while we admire the chivalry of the French officer of old, who courteously invited our troops to fire first, we hold that consideration for the feelings of the barbarians who are ranged against us would be casting pearls before swine.

For the rest, we are content to leave our correspondent's remarks, and the leading article which he attacks, to the judgment of our readers. Any "broad-minded international industrial policy" which will assist the Teutonic policy of "peaceful penetration" in the future, to the detriment of British electrical industry, is quite outside the compass of our sympathies. Since writing his letter Mr. Moore has probably read the proposals of the supreme head of the German electrical industry regarding preparations for the next war, which appeared in our "War Items" last week.—Eds. Elec. Rev.]

Women and "Shorts."

I do not wish in any way to ridicule the assistance the fair sex are giving in all spheres of labour at the present crisis, but I certainly think there are many instances where female labour can *not* be resorted to with advantage and safety.

One naturally hears "things" through the general power and sub-station gossip, such as female switchboard sub-station and turbine attendants, the Marylebone Council being great on this, with the following result: quite recently they had a "short" in one of their subs., in which they employed female labour. I don't know if the attendants got the "blues" over it, but they had perforce to call in the aid of the ubiquitous "Bobby," which recalls to my mind two perhaps rather ancient and hoary, though at one time very popular songs; and I think one might very advantageously be entered in the general instructions for sub-station attendants by the above Council, thus:—

If you want to right a "short"
Ask a p'liceman.
Little Miss Lovebird, the other day,
Had a short-circuit down Marylebone way;
Her assistant and she almost had fits,
They thought the sub-station was going to bits,
So they went and fetched a policeman.

Exciter.

An Appeal for Calendars.

Would any of your advertisers care to send us a few calendars for 1917? These would be very acceptable, as they are not, as you are aware, an Army issue.

F. L. Cater, A.M.I.E.E.,
Second-Lieutenant, A.S.C.

373 M.T. Co., A.S.C., Newmarket.

Sapphires for Industrial Purposes.

Our Queensland Government's geologist, Mr. B. Dunstan, wrote in his mining report, January 22nd, 1916, thus: "Just as the crystallised diamond would be quite unfit for industrial purposes, *i.e.*, for draw-plates or certain pivots, and contra-pivots, the same with the crystallised sapphires; it is only the opaque sapphires that are tough enough to be used for industrial purposes." I was puzzled that, of later years, gem dealers and cutters of draw-plates, pivots, and contra-pivots in Europe boycotted these grades of sapphires to such an extent that the Queensland gem miners, who were dependent on their whole sapphire output, were driven to misery, and many of them had to leave the gem mines, the miners' situation getting worse, so that at the beginning of 1914 I had to make a trip to Europe for investigation. This was not an easy undertaking, because, through a clever combination, the whole gem trade in Europe is more or less shrouded in a mysterious darkness.

However, through an article written in a Parisian magazine, *La Science et la Vie*, of April, 1914, by Mr. Ch. Boulanger, Preparator at La Sorbonne and the Faculty of Sciences of Paris, I learned that many factories had been established here, where the scientific sapphires, rubies, and white sapphires were manufactured in such fabulous quantities that each factory could produce daily from 96 to 112 lb. of these artificial gem stones; it is only natural that the greater part of these chemically-made crystals turned out defective, and could not be cut into gems for jewellery, and the Continental lapidaries soon conceived the idea of cutting these artificial gems into draw-plates, pivots, and contra-pivots for sale to the wire-drawers and electricians, and our Government has been letting this go on for many years without taking any notice of Mr. B. Dunstan's statement. This encouraged some more manufacturers to make chemical imitation stones, having the composition of alumina 57 per cent., silica 33 per cent., and other mineral substances 10 per cent., as these were easier for cutting.

According to information obtained from some wire-drawers and electricians, this traffic forced most of them to go in more for the use of the expensive carbon-diamonds for draw-plates, because draw-plates of our hard opaque Australian sapphires were not often offered to them for sale, as in olden times.

It thus happened that a large electrical wire-drawing firm here asked me to supply them with four carats sized good carbon-diamonds for draw-plates; as I had none, I sent them samples of our hard opaque Australian four carats sized sapphires. They found out, after trying these, that they could replace the diamond draw-plates, and ordered from me for frs. 120 these sapphires; the same quantity of four carats sized good carbon-diamonds would have cost them about 83,125 francs. Afterwards I submitted samples of the same grades of sapphires to wire-drawers of brass, copper, iron, and steel wires, which gave equally satisfactory results. The worst thing is that only a few of the largest wire-drawing and electrical firms have cutters attached to their factories, and the others are dependent on the Continental manufacturers of draw-plates, pivots, and contra-pivots for their supplies. How would it be if in England, wire-drawers and electricians would attach to their factories lapidaries for the cutting of the said articles? In buying the rough, hard opaque sapphires themselves, they would not only realise handsome profits, but they would help also our Colonial gem miners to get a sale for these grades of genuine gem stones, and thereby better their critical position.

H. Bengtsson,

Delegate for the Queensland Gem Miners.

Paris, *January 21st*, 1917.

City and Guilds Examinations.

In their last two letters on the above subject, Messrs. A. P. Lundberg & Sons express regret that no teacher of the subject of "Electrical Installation Work" has had the *energy* to join in the correspondence, and conclude their letter in your issue of January 26th with the remark: "There are obvious reasons, of course, why men in that position should hesitate to state their views publicly."

Quite so; and one of the strongest reasons is that they are assisting their country in the production of urgent commodities, merely being *visiting* teachers at the polytechnics and other similar centres. There are few (if any) teachers of the above subject who are engaged fully, as it would not be possible for the students to attend except in the evening. Perhaps Messrs. A. P. Lundberg & Sons will oblige with a list of obvious reasons, and, while doing so, keep in mind that some men will never attempt to write a letter for publication even though, by so doing, they would serve a good cause.

In one of their letters on the same subject, a reference is made to students of the Grade II Classes being able to enter Grade I examinations and obtain certificates of the same class as when taking the examination in the previous year. The explanation is that, as it requires two years' training after passing through Grade I to prepare students successfully for the final examination, teachers and others concerned consider it beneficial to the students to enter the Grade I examination during the first year in the Grade II classes in order to keep them in touch with the earlier work.

As to whether the subject is grossly neglected or not, it would be beyond the average teacher's ability to define. They know how the subject is taught in the centres where they are engaged, and perhaps learn of the happenings in a few others, but not sufficiently to be able to generalise. Maybe Messrs. Lundberg & Sons, in addition to conducting switching competitions, which have a good educational value apart from being admirable from the advertising point of view, also engage in teaching "Electrical Installation Work"; if so, there may be many teachers who would welcome the following information:—

1. How many students they have coached successfully for the City and Guilds examinations during the last three years?
2. What were the total student-hours per session?
3. The percentage of students actually engaged in the subject as a trade?
4. Why the Final Grade is presumed to require two sessions' training after passing through Grade I?
5. Is it not a fact that when a student has attended two sessions of the "Wiring Classes" he joins the Intermediate "Electrical Engineering Classes," that is, if he is diligent, wishing to pass beyond the practical stage in order to obtain higher technical knowledge and skill?
6. Would it not tend to higher percentages of successes in the examinations if the students were actually engaged on "Electrical Installation Work" as a trade?

The writer always found the subject of "Electric Wireman's Work" (now named "Electrical Installation Work") well catered for in the polytechnics to which he has been attached, and has known a good proportion of students taking Grades I and II of Electrical Engineering to attend the practical wiring class in conjunction with their course.

No doubt the reason wiremen have been in the minority at classes will be found in the following list:—

1. Their work necessarily takes them into outlying districts, preventing them attending regularly.
2. Employers have never seriously encouraged technical training among their wiring staff.
3. Men of mature age object to displaying their lack of knowledge before juniors.

More could be added.

It was recently announced in your columns that the Electrical Contractors' Association had seriously tackled the subject of examinations of wiremen, and we may hope that, in addition to being permitted to nominate an examiner, the Association will inquire into the teaching methods employed, and see that there are no grounds for caustic comments from manufacturers.

No Energy.

The Sale of Foreign Motors.

We are continually receiving letters from old customers (no doubt in common with other firms) stating that they want machines under Class "C." They offer us their orders, and, as is well known, all electric motor manufacturers have had to give an undertaking not to supply Class "C" material owing to the copper and steel restrictions; yet the letters that we receive regularly contain a sentence such as follows:—"Unless you are in a position to supply us with the machines we shall have to obtain them elsewhere." We should like to know what firms are doing this dirty trade, and what precaution can be taken to prevent it. Also, are firms who import foreign motors allowed to sell them without a certificate and Ministry of Munitions permit number? If so, it is a gross unfairness, and giving our foreign competitors an unequal chance. We never object to foreign competition on a fair basis. If our factories cannot produce all the electric motors that are essential for war purposes, it is only right that they should be imported, but this concession should be rightly used, and not abused, and we trust some steps will be taken in the matter to prevent its continuation at an early date.

Higgs Bros.

W. F. Higgs.

Birmingham, *January 26th*, 1917.

BREAKDOWNS IN GERMAN PLANT.

In a paper recently read before the South African Institute of Electrical Engineers, Mr. A. E. Val Davies gave some interesting examples of breakdowns of German plant in connection with the South African power companies during the last four years. The author stated that his list could be greatly extended.

He explained that the generators, which represent an aggregate of 218,800 k.v.a., are all of the turbo-alternator type, their ratings varying from 3,500 to 18,000 k.v.a., and their speeds being either 1,000 or 1,500 r.p.m. The ratings of the transformers, which are all of the water-cooled type, vary from 4,000 to 12,500 k.v.a., the total being 388,500 k.v.a.

In seven generators, each of 12,000 k.v.a. and of identical design, the joints between the stator bars and the end bends were of most primitive design, and were, to start with, mechanically weak. Three hollow rivets were provided to hold the two forked ends of the bends to the bar, and the joint thus made was soldered with a soldering iron. When these joints were opened up a great majority of them were found to be devoid of solder inside, there being merely a beading of solder round the edges. The usual cause of failure was that the beading cracked away, leaving the joint held by the rivets only; it then heated up and gradually burnt away the surrounding metal till the joint ultimately failed by the melting off of the end of the bar and bend. On three occasions the following arcing burnt into the binding wire of the rotor, which thereupon slacked away and ripped the insulation from the remainder of the end windings. This defective joint was responsible for the loss of many thousands of pounds directly and indirectly.

The rotors of all the generators are fitted with wire binders round the ends of the rotor windings. Abutting the rotor poles a copper alloy wire, with an ultimate strength of 40 tons per sq. in., is used to prevent to a certain extent the magnetic leakage which would occur if steel wire were used, and special steel wire, with an ultimate strength of 128 tons per sq. in., is then laid on in the remaining space, both wires being laid on at a tension corresponding to 20 tons per sq. in. There can be no question as to the mechanical strength of these binders, and their construction eliminates the possibilities of internal stresses and unrelieved strains to which a solid shrunk-on cap might be subject; but this hardly compensates for their unfortunate proclivity, once the outer turns are burnt through, of stripping into miles of wire, which forthwith is ground up in the air gap of the machine, ruining not only the windings, but often the core plates of the stator as well. This unfortunately occurred three times. In two 18,000-K.V.A. machines, of different speeds and design, the rotor binding wire was found to heat up to a temperature sufficient to melt the solder, which was flung off upon the end-windings of the stator.

A breakdown occurred in a 12,500-K.V.A. machine fitted with a dry air-filter, composed of a zig-zag arrangement of filter cloths in wooden frames, which was placed below the generator floor level. Owing to the failure of a current transformer installed 12 ft. away from the filter and on the generator side of it, severe arcing presumably set fire to the filter cloths, although, according to the specification, they were supposed to be fireproof, and the whole filter became ignited

In one case a bank of four 6,000-K.V.A. transformers working on a ratio of 80,000 to 20,000 volts, failed within a few days of each other owing to the perforation of their respective water-cooling coils, which were of iron, and the consequent flooding of the windings. In the case of the first, a lump of zinc was found in the bore, and this caused a stream of water, which was decidedly acid, to impinge on the side of the tube, which was finally punctured by the continued erosion. In the other transformers obstructions were also found in the pipes, which in several cases all but blocked the bore. In a batch of six transformers there were failures in four, owing to perforation of their lead cooling coils, the breakdowns being due to faulty drawing or extrusion of the tubing. In some of the faulty coils the thickness of the metal varied from a few thousandths of an inch on one side to nearly ¼ in. on the other side, the proper thickness being ⅛ in.

A 12,500-K.V.A. core-type transformer was removed for examination after tripping, and when an attempt was made to lift off the upper yoke of the core it was found to be thoroughly welded to one of the vertical limbs. This breakdown was due to a succession of failures of the insulation round the core bolts in both the top and bottom yokes. The resultant flow of current melted into a solid mass almost a cubic foot of iron core plates in both the yokes, and presumably, after the pad of insulating material between the yoke and limb had been damaged, a further circulation of current took place across the joint thus made. The net result of this breakdown was the scrapping of the machine.—*The Times Engineering Supplement.*

WAR ITEMS.

Enemy Companies Winding Up.—A Supplement to the *Board of Trade Journal* of February 1st contains a complete list (to January 25th) of the names of firms which have been ordered by the Board of Trade to be wound up under the Trading with the Enemy Amendment Act, 1916. The date of the order is given in each case, together with the name and address of the Controller appointed, and an alphabetical index of the firms is included.

Discharged Men in Kinemas.—The Kinema Employment (and Sale) Bureau, of 18, Cecil Court, Charing Cross Road, W.C., which has been finding light employment in various capacities in kinemas for disabled and discharged soldiers and also employment for the wives of soldiers now serving at the Front, has several vacancies on its books. A free register of discharged and disabled men is kept.

Labour After the War.—Mr. J. Hodge, the Minister of Labour, is reported to have stated, in a recent speech at Manchester, that he was about to form a big central committee, and four or five hundred local committees in different parts of the country, to consider the vast problem of after-the-war employment. He referred to the great need for hearty co-operation between employers and employed in connection with this and other problems of labour and industry.

Controlled Works.—The total number of controlled establishments is now 4,719.

Exemption Applications.—At the Plymouth Tribunal, two apprentices to electrical engineering, who had each paid a £50 premium, applied for exemption. The Military opposed the application on the ground that the lads were 18 and passed for general service. The Mayor remarked that it was hard that any advantage of the premiums paid should be forfeited, but in view of the new circular the Tribunal felt they could give no exemption.—*Western Morning News.*

At Southwark, Coun. T. E. Hewitt, a member of the Tribunal, carrying on business as an electrical engineer at Newington Causeway, applied for the exemption of three employés, all passed for general service. These were a sheet metal worker, 28, single; a tinsmith, 26, single; and a second tinsmith, 23, married. He stated that these were the only three men left working at the bench. Under existing conditions he could not expect lengthy exemptions for them, but he asked that he might keep them until he had completed a Government contract. The men had been in certified occupations until recently, but were now taken out of the list. Before the war he had 17 bench hands and five fitters, but now only had left these three bench hands, one fitter, and a foreman, and if these men went he would have only the foreman and fitter left. He had a row of empty benches with no men to do the work. His present contract would take just over a month to complete, but he was doing the hardest part of the bench work himself. Three months' exemption was granted in each case

At Southport, the borough electrical engineer applied for four men, who, he said, were formerly badged. The Minister of Munitions had informed him that if they were called up he must send a certificate to the Recruiting Officer that they could not be called up until substitutes were found. The cases were adjourned for inquiries.

At Rochdale, Mr. G. Webster, in appealing for J. Crossley (36, single), overhead electric wireman; J. W. Milnes (35, single) and J. Hird (37, married), the two last-named motormen, said he had only two skilled wiremen to look after 40 miles of overhead equipment, and on some of the older sections the calls for the wiremen were more than double what they were two years ago. It would take a stranger a considerable time to get into the method of the Rochdale feeder system, and unskilled men were out of the question. As to the drivers, he had to study the safety of the public, especially considering the dark nights. All three men had been passed for general service. Milnes was put back to March 31st, and the others to April 30th.

At Deal, exemption was claimed for Mr. C. H. J. Graves (29), electrical engineer of the "South Eastern" Hotel, originally rejected, and now passed for general service. It was stated that Mr. Graves could not be replaced, and that if he had to go there would be no alternative but to close the hotel, as it would be impossible to keep open without a supply of electricity. The Advisory Committee said that Mr. Graves should be released for military service, even if the hotel had to be lighted by lamps. The Tribunal allowed two months, with no further application without leave.

At Dover, on January 24th, the Military Representative asked for the withdrawal of conditional exemption granted by the Recruiting Officer to six tramway drivers in the employ of the Corporation. One, it was stated, had given notice to leave, and was going to work for the Admiralty, and the Tribunal decided to grant no exemption to him, leaving the case to be fought out between the Army and Naval authorities. As to the rest, it was urged that the men were in a certified occupation. Mr. Robson said that he looked on tramways as a luxury, but Mr. Carden pointed out that they were recognised by the Government as a public utility service. One was given conditional exemption until a substitute is found, and the certificates of the others were withdrawn.

At Leyton, on January 22nd, Mr. A. Partington, clerk to the Ilford U.D.C., applied for exemption for eight tramway employés. Captain Howard said that the tramways had done all they could to meet the situation, and it was highly creditable to them. The appeals were respited for three months.

The Southend-on-Sea Tribunal, on January 22nd, refused an appeal for the exemption of A. V. Harrison (31), electrician at the Hippodrome, claimed as being indispensable. The calling-up was deferred until April 1st.

At Oxted, on January 24th, Major Chas. Leveson-Gower, J.P., of Titsey Place, Limpsfield, appealed for H. Maynard (36), in charge of the electric water-raising plant, &c., on the estate. It was stated that the installation of the plant cost £3,500, and that Maynard could not be replaced. Conditional exemption was conceded.

At Epsom, an electrical engineer and contractor, aged 36, applying for exemption, said that he was the head of businesses at Epsom and Sutton, and if he had to join up he would have to close down both businesses, it being quite impossible to find a manager to do the mechanical work. Two months were allowed.

At Weymouth, the Town Clerk applied for exemption for the electrical engineer, Mr. J. H. Bolam, whose certificate granted by the Recruiting Officer had been withdrawn. The application was acceded to.

The West Kent Appeal Court has granted two months' exemption, with no further appeal without leave, to A. Stubberfield (27), of Beckenham, foreman in an electric battery factory, passed in Class B1.

At Watford, Mr. Barham, electrical engineer to the U.D.C., applied for exemption for H. Tomkins and L. Cook, engaged at the electric light station. He said that both men had been de-badged, and as he was waiting for certain information from the Ministry of Munitions, he applied for the cases to be adjourned. The Military Representative replied that both were young men, one being 26 and the other 30, and an adjournment was only putting off the matter again. He asked if men could not be found to take their places. Mr. Barham replied that they had tried to replace them, but had failed. The Tribunal decided to adjourn the cases as requested.

The West Kent Appeal Court has again had under consideration the case of Mr. A. Leach, electrical engineer, of Maidstone, previously referred to in the ELECTRICAL REVIEW. Mr. Leach claims having applied for naturalisation in the United States, and he desires to return there; his earlier return has been prevented by his wife's illness, and was borne out by a letter from him to the Home Office in April,

1911. The Court granted three months' exemption conditional upon his receiving permission, and leaving for the United States within that period.

The Woodbridge (Suffolk) and District Electric Light Co. applied to the local Tribunal for exemption for their engineer, aged 27, who has charge of two power stations, on the ground that he is in a reserved occupation. It was mentioned that the company had been invited to supply current to another centre in the district. Three months were allowed, with leave to appeal again.

At Teddington, an appeal was made by the London United Tramway Co. for two tram conductors, a motorman, and a driver, whose certificates of exemption have been withdrawn on the ground that it is no longer necessary that they should remain in civil employment. It transpired that, under instructions from the War Office, the company's 1,500 men had been inspected by the Recruiting Officer at Chiswick, and all men in any fit category for military service had been taken, leaving about 200 motor drivers and a few highly-skilled men, such as electrical experts, &c. Major Smith, of Chiswick, in a letter, expressed the opinion that the few exceptions granted should be respected, and that the four claims should be transferred to the Chiswick Tribunal. The Clerk mentioned that the four men had been exempted by the War Office, and the matter was adjourned for an explanation from the Military authorities.

BUSINESS NOTES.

Book Notices.—"Willing's Press Guide" has now reached its forty-fourth annual issue. It contains a mass of useful information regarding the Press of the world. We have always found it a very handy and reliable work of reference. The printers' errors noticeable here and there are, doubtless, consequent upon the increasing difficulties of war-time.

"Registration of Business Names." By H. W. Jordan. London: Jordan & Sons, Ltd. 6d. net. This booklet sets out the requirements of the new Act, and quotes examples.

"Alternating Currents." By C. E. Magnusson. London: Hill Publishing Co. Price 17s. net.

The Report of the War Refugees' Committee (General Buildings, Aldwych, W.C.) contains a full account of the Committee's work, with a balance-sheet, and illustrations showing scenes outside the offices after the fall of Antwerp, and Belgian soldiers on leave at Christmas, 1915.

The British Dominions General Insurance Co., Ltd., has published its very acceptable "British Dominions Year-Book for 1917." Amongst the articles, first and foremost is one by the Earl of Cromer (whose death we lament as we write) on "The Aftermath of the War," and there are others on "Labour, Commerce, and the Empire," by Edward Salmon; on "Trade Opportunities in Latin America," by Percy F. Martin; on "The War's Three Phases," "India's Future in the Empire," "Trade Before and During the War," "The Civil Engineer and the Future," by Lord Headley, "War Finance and the Future," "National Insurance," and a whole host of other contributions, accompanied by maps, coloured plates, and other illustrations.

'L'Annuaire du Bureau des Longitudes pour 1917." Paris: Gauthier-Villars et Cie. Price 2 fr.

"The Practical Electrician's Pocket Book and Diary" for 1917 (London: S. Rentell & Co., Ltd. Price 1s. 6d. net) is almost out of its 'teens, and needs no commendation; it has been revised by the Editor, Mr. H. T. Crewe, and a chapter has been added dealing with electric furnaces. There are few branches of electrical engineering upon which it does not touch.

"Local War Museums: a Suggestion." By C. Reginald Grundy (Editor of "The Connoisseur"). 3d.

Catalogues and Lists.—The Hillbar Press, 72, Finsbury Pavement, London, E.C.—Folder relating to their supplies for the dry battery trade.

Messrs. David Brown & Sons (Huddersfield), Ltd., Park Works, Lockwood, Huddersfield.—Twelve-page illustrated pamphlet containing particulars of their D.B.S. carburiser for case-hardening.

General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—Leaflet V 2,087, giving prices and particulars of small power electric motors.

Messrs. Grindlay, Ross & Co., Ltd., of 47, Waterloo Street, Glasgow, have issued loose blotters, showing the situation of their premises in the city.

The Langdon-Davies Electric Motor Co., of 110, Cannon Street, E.C., have also circulated loose desk blotter slips.

British Electric Plant Co., Ltd., Alloa.—Four-page leaflet, giving illustrations of their works and of electrically-driven haulage gears.

Messrs. Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Twelve-page illustrated price-list of "Plexsim" electric heating and cooking apparatus for industrial and other use.

Catalogues Wanted for Russia.—Owing to the special importance, at the present time, of establishing commercial connections on a firm basis between the Allied countries, with the object of ousting German intervention and competition, the Russo-British Chamber of Commerce at Petrograd asks us to request all British firms wishing to trade with Russia, now or after the war, to send their catalogues and price lists (not less than 10 copies) to the Chamber at 4, Gorochovaia, Petrograd, Russia. The catalogues will be placed in the special library of the Chamber, and will be distributed to Russian merchants interested in the development of their trade connections with England.

Bankruptcy Proceedings.—G. E. Bonner, electrical agent, 105, Fox Lane, Palmer's Green. Trustee released Jan. 19th.

H. H. Oxley (otherwise Oliver Huxley), consulting engineer, Hanwell. February 10th is the last date for the receipt of proofs for dividend by Mr. E. W. J. Savill, Official Receiver, 14, Bedford Row, W.C.

C. J. Ogilvie, electrical engineer, 43, Dudley Road, Whalley Range. The first meeting of creditors herein was fixed to take place on January 24th at the Official Receiver's offices, Byron Street, Manchester, but there was not a quorum of creditors present, and the matter was, therefore, left with the Official Receiver who will act as trustee.

Calendars.—Mr. Albert E. Mallandain, of 51, Cheapside, E.C., has issued a calendar for 1917, with monthly slips, on each of which is also given a complete calendar for the year.

Messrs. Taylor & Challen, Ltd., of Derwent Works, Birmingham, have sent us a wall calendar for 1917, with monthly slips; on the reverse side of each slip, which turns down when done with, there is a half-tone view of metal presses, &c., supplied by them.

Dissolutions and Liquidations.—Attwater & Sons engine packing manufacturers, &c., Hopwood Street Mill, Preston, and the British Rubber Co., 28, Friargate, Preston.—Messrs. R., F., C., and C. Attwater have dissolved partnership, so far as Charles Attwater is concerned. Debts will be attended to by the remaining partners, who will continue the businesses.

Radium, Ltd., 93, Mortimer Street, London, W., dealers in radium and radio-active substances, &c. (enemy subjects). Creditors must send particulars of debts, &c., to the controller, Mr. C. R. Beeby, 66, Basinghall Street, E.C., by February 24th.

R.E.T. Construction Co., Ltd.—This company is winding up voluntarily, with Mr. A. Page, 28, King Street, E.C., as liquidator.

Krupka & Jacoby, Ltd.—The Controller, Mr. Thomas Wise, has applied for his release.

Durban Municipality and Preference.—The Durban Town Council has taken action with the object of encouraging British trade. The Finance Committee has authorised the general storekeeper to give a preference up to 10 per cent. to goods produced and manufactured in the United Kingdom, as against American goods. Further, in accordance with a previous resolution of the Council, to the effect that Natal Municipal Councils and Local Boards should make a return of those goods which in the past they have been accustomed to purchase from foreign countries, with a view to publication for the benefit of British manufacturers, the Council has forwarded such a return to the Natal Municipal Association. Amongst the goods included in the return are the following:—

Tramway Supplies.—Electrical equipment and spares, trucks, fenders and spares, trolley wheels and bushes, trolley cord, and tramcar seats.

Desk and wall telephones, bitumen, grease compound, metallic-filament, &c., lamps, oil (engine, cylinder and dynamo), transformers (single-phase).

In some instances the return gives the names of the foreign makers from whom some of the above-mentioned goods have hitherto been obtained, and in others details as to sizes and weights are given. Such further information as is available may be obtained by United Kingdom manufacturers and exporters of U.K. goods, on application to the Department of Commercial Intelligence, 73, Basinghall Street, London, E.C.—*Board of Trade Journal.*

Agencies Wanted.—A Johannesburg agent seeks the agency for a British manufacturer of three-phase electric motors. Reference 37/92.

A manufacturer's agent desires agencies for British makers of scientific instruments, meters, telegraph and telephone instruments. Reference 30.

Particulars from Department of Commercial Intelligence, 73, Basinghall Street, E.C.

Registration of Business Names.—Under the new Act, an office has been opened at 39, Russell Square, London, W.C., for the registration of firms and persons whose principal places of business are situated in England and Wales. Separate offices will be opened in Edinburgh and Dublin for Scotland and Ireland. The earliest date on which it is permissible for particulars to be furnished, with a view to registration, is February 22nd. The particulars must be furnished on Board of Trade forms, obtainable at post offices later.

Trade Announcements.—Mr. Philip Herd, of Johannesburg, has entered into partnership with Messrs. Peabody, Rice, and Wilson, and the title of the new firm will be Rice, Wilson & Herd. Mr. Herd has been associated with the South African interests of the B.T.H. Co., Ltd., of Rugby, and the General Electric Co., of Schenectady, for many years. The address of the offices will be unchanged—86-88, Strand Bank Chambers, Commissioner Street, Johannesburg.

The Ainsdale branch of Messrs. T. Wainwright & Sons, Ltd., electricians, Southport, has been closed for the duration of the war, Mr. T. Wainwright, jun., being called up.

The address of Le Carbone has just been changed to Coventry House, South Place, E.C. New telegraphic address: "Lacombe, Ave, London."

LIGHTING AND POWER NOTES.

Australia.—The Victorian Hydro-Electric Co., Ltd., has been granted a licence for a term of two years, at a rental of £25 for the first year and £50 for the second, for the diversion of water from the Kiewa river for a proposed power installation.

The Perth (W.A.) City Council has re-allocated the sum of £20.000, set aside for the erection of a gas retort house, for the purchase of gas and electric plant and extensions.

Canada.—According to the *Canadian Engineer*, the Russian Government has requested detailed information regarding the facilities available in Canada which might be used in Russia for carrying out extensive hydro-electric power schemes now under consideration in that country. The Dominion Water Power Branch has been asked to supply information regarding Canadian experience in hydro-development, also electrical and mechanical manufactures for such projects, and other bodies have been asked to assist in various ways.

The following, taken from the *Canadian Engineer*, shows the amount of electrical energy produced for export and home use by certain Canadian companies :

	Units for export. KW.-hours (thousands).	Units for use in Canada. KW.-hours (thousands).	Total output. KW.-hours (thousands).	Total output. H.P. Years.
Can. Niagara Power Co.	400.521	11,178	411.700	62.999
Electrical Develop. Co.	34.652	395.346	429.998	65.799
Ontario Power Co. ...	199.135	616.834	815,969	124,862
Ontario & Minn. P. Co.	13.144	11.789	24.933	3,815
Cedars Rapids P. Co. ...	358.753	56.031	414.784	63.471
Sherbrook R. & P. Co....	230	8.605	8.836	1.352
Maine & N. Bruns. P. Co.	3.075	242	3.318	507
West. Canada P. Co. ...	11.937	60.468	72.405	11,079
Brit. Col. Elec. R. Co....	330	68.470	68.801	10.528
Totals	1.021.780	1.228.966	2.250.747	344.416

Chile.—Concessions have been granted to Senor Navarro to develop electric power from the Agua Fria, and to Hermanos and Co. to utilise the water of the River Leira for generating electricity for industrial purposes.

Continental.—Russia.—The Baku electrical company called the Elektricheskaya Sila has had to circularise its new subscribers, expressing regret that it cannot connect them for want of material.

The Tiflis Council has obtained permission to issue a loan of 210,000 roubles to extend the central electrical station.

The Irkutsk Council is also authorised to borrow 228.878 roubles, in order to supplement the equipment of and to extend the electricity station, against a deposit with the local bankers of 4 per cent. Government Rentes, equal to 350,000 roubles nominal.

The total cost of extending the electric lighting system and repairing boilers at Vladivostock is estimated at 105.000 roubles, which it is proposed to pay off by increasing the price of current : but permission to go on with the work is being delayed until a 250,000 roubles loan from the local branch of the Siberian Trading Bank has been realised.

Dublin.—Asylum Lighting.—At a meeting of the Joint Committee of Management of the Richmond Lunatic Asylum, the chairman said the electric lighting of the asylum buildings had effected a remarkable saving, the cost being a little over one-third that formerly incurred by gas lighting.

Dundalk.—L.G.B. Inquiry.—Mr. P. C. Cowan recently held an inquiry into the application of the U.D.C for sanction to a loan of £5,000 for the electricity undertaking, some £2,000 of which was desired to repay certain interest and sinking fund charges, being the first instalment in connection with a loan of £21.000 for plant to supply the works of the G.N. Railway of Ireland, which, due to the non-delivery of engines, was not productive for 15 months later than it would have been in the ordinary way. It was urged that the plant was non-productive through no fault of the Council, and it would be unfair to impose the liability on the rates. It was argued that although there was no precedent for such an application in the case of a public body, there was no reason in law why it should not be acceded to. Mr. Cowan said the right to charge interest to capital, when admitted, was usually provided for in local Acts : failing that, there was the alternative of putting the deficit on the rates. To hold the balance of the loan or part of it, as working capital was also a novel point. He advised that £500 should be put on the rates, as he thought they had no right to carry forward adverse balances. It was pointed out that as the undertaking had no working capital, it had to work on the revenue of the preceding half-year, and so was a year behind in repaying to the Council interest and sinking fund moneys : although this was of small account when capital charges were small, the Council could not afford to do it when the charges were £3,000 a year. The inspector did not see how the Council could get relief in the manner proposed, but agreed to report fully ; he also complimented the Council and its engineer (Mr. Spalding) on the power station.

East Ham.—It has been resolved that for the present that no alteration be made in the charges for current.

Epsom.—The U.D.C. has decided to ask the B. of T. to withhold consent to the application of the South Metropolitan Electric Tramways and Lighting Co. for a prov. order for Ewell, as the Council, which already supplies a portion of the parish, is quite capable and willing to extend the supply when the proper time arrives.

Hornsey.—A serious defect recently occurred in the crankshaft of one of the engines at the Council's generating station. The repairs are to be carried out at a cost of about £300. Gales carried away part of a cooling tower. The damage is to be made good at a cost of about £57.

Hull.—Estimates.—The acting electrical engineer, Mr. J. F. Magoris, in his estimates for the financial year ending March 31st, 1918, reckons on a total revenue of £105.714 (£101.104 from sales of electricity), and expenditure amounting to £102.706 (fuel £32.400, salaries £12,600, interest and sinking fund £37.946, rent, rates, &c., £6.710, engines and boilers £5.400, repairs, renewals of mains, &c., £1.400), leaving a balance of £3.008. The estimates were adopted, and referred to the Finance Committee.

Keighley.—Proposed Loan.—The Electricity Committee recommends the T.C. to apply to the L.G.B. for power to borrow £2,000 for laying extra-high-tension cable.

The War Bonus Committee recommends the granting of a war bonus of 2s. per week to officials over 21 years of age whose salaries do not exceed £200, and of half that amount to those under 21 years of age.

London.—Shoreditch.—New Plant.—The B.C. proposes to borrow a sum of £41,000 in connection with a scheme for extending the works and generating plant at Whiston Street. The Council had previously approved of estimates amounting £122.951, of which the L.C.C. has sanctioned £23.045, including the expenditure on converting plant and mains, &c., necessary for taking a bulk supply from the Stepney B.C. The remainder of the estimate (£99.906) was deferred by the L.C.C., owing to the proposal to provide a bulk supply for London.

In view of the increasing demand on the Shoreditch plant, and the loss of the bulk supply from Stepney, the borough electrical engineer has submitted a scheme for the installation of a large turbo-generator set in place of a reciprocating set, which is estimated to cost £41,000, including generating and converting plant, switchgear, cables, &c. The increased efficiency of the new plant will, it is estimated on the basis of the present year's figures, result in an increased profit, after allowing for loan charges, of £3,000 per annum.—*Hackney Gazette.*

Lambeth.—The General Purposes Committee has considered the question of its option in March, 1918, of repurchasing the undertaking of the South London Electric Supply Corporation, Ltd. The Committee has decided that the present moment is an inopportune one for repurchasing the undertaking, and accordingly notice to exercise the option will not be given. The Council has also the option of repurchasing the undertaking on March 16th, 1928.

Islington.—The electrical engineer reports that it is necessary to at once provide an additional feeder. The estimated cost of the work is £4,000, and the Lighting Committee is to proceed with the work forthwith as a matter of urgency.

Stepney.—The accounts of the B.C.'s electricity undertaking for the year ending March last disclose a deficit of £5,864, the first in 15 years. This was due entirely to the abnormal conditions, which Mr. Tapper in a summary estimated to have resulted in some £24.700 extra cost, coal, due to increased price, costing £9,350 more, and due to inferior quality £4,500 more. The ash content increased from 14 per cent. to 26 per cent. of the fuel consumed. The total units generated amounted to 27.800.000, and units purchased in bulk to 2,560,000, making a total of 30.380.000, an increase of over 7,000,000 on the previous year. Practically 25.000.000 units were sold : 4,500,000 for lighting, 9,700,000 for power and heating, 4,500,000 to private consumers in bulk, and over 6,000,000 units for public bulk supply. The total compares with 18¾ millions units in 1914-15.

The generating plant capacity was 17,720 KW., and the maximum load 9,874 KW. : the works cost, at ·558d. per unit, compared with ·46d. in the previous year, and the all-in cost was just over 1d. per unit sold. To meet the deficit and other expenses, amounting to a total of £13.760, £12.626 was transferred from reserve, the balance, £1,133, being in hand from the previous year.

The capital in the undertaking at March last amounted to £662,000, of which, roughly, £120,000 had been repaid, and £22,000 provided out of revenue, &c. This was apportioned as follows :—Limehouse station, £240,000 ; Whitechapel station, £129,000 ; Wapping sub-station, £13,000 ; instruments, tools, &c., £15.600 ; mains, £193.600 ; services and meters, £53.500 ; balance in hand, £17,000.

Stalybridge.—Increased Prices.—The Joint Board has decided to increase the charges for current for heating, domestic and power purposes, as from April 1st next, in order to meet the increased cost of coal, &c.

Tasmania.—A conference was held recently between representatives of the Launceston City Council and the Premier of Tasmania relative to the Council's participation in the Government hydro-electric scheme. Negotiations in respect to the matter began in August, 1915 and the Government offer was rejected. The Council proposed to sell out its undertaking and to erect its own transmission line from the Government power station, and, at the same time, it sought the right to supply all power in the north of the island. Special terms were laid down for the supply of power. The Premier stated that the question to be determined was whether, under existing conditions, the Council would be justified in scrapping £70,000 worth of plant now used in the electricity undertaking, and expending £71,000 to supply the power, or whether it would not be sounder business to continue to meet the local requirements with the existing plant until conditions became nearer normal. He told the conference that the contracts of the Great Lake scheme would practically absorb the whole of the power available. Investigations showed that 15,000 H.P. could be developed from the Arthur's Lakes, and this would be reserved for the development of industry in the northern part of the State. He assured the Council that the Government would endeavour to obtain a customer for a fairly large block of power to locate works at Launceston.

At a meeting of the Launceston City Council, the report of the conference was discussed, and the Council has decided to take up the whole matter of increased power for the electric lighting and tramways undertaking at an early date.

Tyldesley.—The U.D.C. has decided to complain to the Lancs. Electric Power Co. regarding the inconvenience caused by failure of electric supply in the district.

Tynemouth.—Year's Working.—The accounts of the electricity undertaking for the year ended March 31st, 1916, show that 4,528,958 units were sold, as compared with 4,809,841 in the previous year, three-phase supply accounting for 2,671,652 and 2,844,860 units respectively in the two years. The total revenue amounted to £21,652, and after meeting all charges, there was a deficit of £513, as against a profit of £738 in the previous year. The deficit of £513 was met from funds in hand, and a surplus balance of £1,311 still remains.

Walthamstow.—Loan Sanction, &c.—The electrical engineer reports that it would not be possible to erect the steel chimney provided for in the original scheme for the new plant extension, and tenders are to be invited for the construction of a brick chimney. Plans are to be prepared for an extension of the sub-station and the boiler-house buildings. The L.G.B. has sanctioned the borrowing of £18,790 in connection with the extensions at the generating station.

TRAMWAY and RAILWAY NOTES.

Accrington.—The local branch of the Tramways and Vehicle Workers' Union is taking steps with a view to securing a war bonus for women conductors.

Australia.—The Tramways Board has issued a writ against the Melbourne Tramways and Omnibus Co. Ltd., claiming £250,000 for breaches of the covenants of the lease which required that the lines should be handed over in good working order and condition; this, it is contended, has not been done.

Blackburn.—Fare Increase.—The Tramways Committee is recommending a revision of fares, which will affect every section except one; several overlapping stages are to be abolished, and the issue of return tickets discontinued.

Birmingham.—Subway Proposal.—At the last meeting of the Tramways Committee, the question of better tramway terminal facilities was under consideration, from the point of view of surface and underground methods. Finally, the general manager, Mr. A. Baker, was instructed to prepare a definite scheme for subways in the centre of the city.

The provision of trailer cars on certain of the tramway routes of the city has been before the Committee for some months; the difficulties have been gradually overcome, and it is hoped shortly to make arrangements for entirely equipping one route with tractors and trailers, and should this experiment prove satisfactory, the Committee will consider the desirability of reporting to the Council in favour of their introduction.—*Birmingham Daily Post.*

It has been announced that, due to the dislocated service, no contribution to rate relief will be made.

Brighton.—The Corporation is offering to supply the Sheffield Corporation with 75 tons of tramway rails, free on rail at Brighton, at £16 per ton. The Corporation has in stock 160 tons of new rails, in addition to a few old ones which can be used again, and will not require to use them all itself.

Continental.—Italy.—The Piedmont Savings Banks have decided to form a trust to provide the capital needed by the Italian Government for the electrification of the Bussoleno-Turin-Roneo Railway.

Dundee.—A meeting of the Scottish tramway managers was held in Dundee last week; the visitors were welcomed to the city by ex-Bailie Johnston, convener of the Tramway Committee. It was mentioned that in several cases ½d. fares had been abolished, and in one case the revenue had increased by between £4,000 and £5,000 in eight months, while the number of passengers carried had largely decreased; in every case the receipts had gone up. The question of insurance risks, owing to the large amount of unskilled labour employed, was discussed, as well as questions affecting the upkeep of permanent way and plant. The visitors were entertained to luncheon by the Corporation.

Ecuador.—The municipality of Quito is to grant one or more contracts for the construction of electric tramways from that city to any town or towns in the canton. The concessionaire will be granted exemption from the payment of all fiscal and municipal taxes, but will be obliged to hand over to the municipality at least 5 per cent. of the gross receipts from the undertaking during the first five years of operation and thereafter the percentage is to be increased by 2 per cent. for each five-year period. The concession will be for a maximum period of 30 years, at the expiration of which the lines, together with all fixed and rolling stock, will become the property of the municipality. Work must be commenced within a period of two years from the signing of the contract. The municipality will make application for the duty-free admission of such materials required in connection with the projected system as must necessarily be imported from abroad.—*Board of Trade Journal.*

Glasgow.—Debt-free Tramways.—It was recently announced that the City tramway system was now free of debt, all the capital expenditure of £3,835,156 having been repaid or provided for.

Halifax.—Proposed Fare Increase.—Fares are to be advanced to the extent of about 50 per cent., workmen's fares remaining at the present rates, but not to be available after 4 p.m., and children's fares to remain unaltered. Transfer tickets it is proposed to advance 50 per cent. The Sub-Committee also proposes a curtailment of the service, the change involving a 30 minutes' service between 9 a.m. and 12 noon. These changes, if adopted by the full Tramways Committee and the Corporation, will probably come into effect on February 2nd.

India.—Electric Vehicles.—Mr. Milne, of the Simla Municipal Electricity Department, has issued a suggested specification for electrically-propelled cars for use in Simla, which was published in a recent issue of *Indian Engineering.* The main features to be embodied are:

1. Compactness and light weight: mileage per charge being a secondary consideration.
2. Capability of ascending and descending grades of 16 per cent. and short emergency grades of 25 per cent.
3. Capability of turning very sharp corners.
4. Maximum speeds in both forward and reverse directions, to overcome grades.
5. Exceedingly powerful brakes.

Owing to the long grades, it is suggested that regenerative control might be employed, also that the steep grades may necessitate a special battery suspension to avoid spilling electrolyte.

Lancaster.—The electrical 'buses are proving a success: the electric tramways carried 140,458 passengers in December, being 50,884 more than in the previous December, the receipts, exclusive of season tickets, being £485, or £151 in advance of 1915.

Leeds.—Traffic Figures.—Still further increases are reported in the takings on the Corporation tramways, largely due to the decreased local train service and the increase in the railway fares. There was an increase last week of £208 as compared with the same week of last year, and the total takings for the 43 weeks of the financial year, so far, were £414,611, or £35,361 more than for the same period in the previous year. The number of passengers carried during the same period was 2,064,000, which is an increase of 59,000.

Leyton.—Electric Vehicle.—The District Council is purchasing a 2-ton electrically-propelled Edison motor vehicle for the collection and removal of house refuse.

Middlesbrough.—Tramway Purchase Proposal.—It was reported to a meeting of the G.P. Committee, last week, that a meeting had taken place of the Sub-Committee and representatives of the adjoining authorities concerning the proposed purchase of the tramway system belonging to the Imperial Tramways Co. (Middlesbrough, Stockton, and Thornaby), but delay had been occasioned because the other representatives had no instructions from their Councils. It was stated that unless the Corporations took over the system the company would, no doubt, get another seven years' lease.

Preston.—War Bonus.—At the T.C. meeting, last week it was stated that the recent war bonus award to tramway workers would mean an extra expenditure of £1,200 a year.

Salford.—The manager of the Corporation Tramways has received the award of the arbitrators on the recent dispute, which led to a strike on the question of women inspectors. The Committee of Production has found that under the conditions arranged by the Corporation, and as a temporary and supplementary war measure, the objection raised by the men's Union to the employment of female inspectors has not been established.

The Tramways Committee has decided to revise the scale of fares at present in operation, and to revert to the charges of three years ago. At that time the concessions were estimated as being equal to a gift of over £2,000 per year to the travelling public. The alteration will mean an increase of a halfpenny on practically every stage. The shortage of labour and the increased use being made of the tramways, especially in the suburban districts, following upon the advance of railway fares, has led to this decision.

South Africa.—Railway Electrification.—With further reference to our note in the Electrical Review of January 5th, the *S.A. Mining Journal* says the more immediate question is the electrification of short sections such as the Wynberg line, the Sea Point Railway, the Springs-Randfontein line on the Rand, and some of the short-distance railways in the neighbourhood of Durban and Maritzberg. The *Cape Times* says that probably the Simonstown line would have been electrified many years ago had it not been for the technical controversy which had arisen between the merits of the single-phase and direct-current systems, the essential point at issue being the relative costs. In South Africa the more general question upon which expert decision will be required is as to the relative cost of the present system of steam locomotives and that of electric traction. On the Simonstown and Sea Point lines the conditions would appear to be specially favourable for electric traction. All coal used on those sections has to be hauled from the collieries in the North or from Natal, fuel for locomotive use being thus at its costliest point in the Cape Peninsula. The traffic conditions on the same sections correspond more closely than in any other part of South Africa to the conditions ruling around London, where some of the suburban lines have long been successfully electrified. Another point in connection with the suggested electrification would be whether the Railway Department would generate its own electricity or would purchase it from the power companies and local authorities.

TELEGRAPH and TELEPHONE NOTES.

A Relay-Sounder.—The Railways Labour-Saving Device Co., of Davenport, Iowa, has devised a diaphragm attachment to a relay contact point which augments the sound of the moving armature lever to such a degree that a sounder is unnecessary. The instrument is popular in railroad offices and in other places where trouble with local batteries is experienced, and does its work well. Where a telegraph sounder is used, this instrument will well take its place.—*T. and T. Age.*

Australia.—At a recent meeting of the Royal Society Prof. Cooke stated that the Sydney Observatory had been fortunate in obtaining a recent form of Audion detector, with which no difficulty had been experienced in hearing conversations from Darien, Japan, Honolulu, and San Francisco, and even Tuckerton (New Jersey), 10,000 miles away, had been heard talking to Berlin.

Telegraphic and Telephonic Progress in 1916.—Reviewing the events of the past year, the *Journal Télégraphique* states that the following channels of trans-Atlantic communication by wireless telegraphy are now in operation:—Sayville, N.Y.—Nauen, Prussia; Tuckerton, N.Y.—Eilvese, Prussia; Chatham, Mass.—Stavanger, Norway; Marion, Mass.—Naerbo, Norway; Belmar, N.Y.—Carnarvon, Great Britain; New Brunswick, N.Y.—Towyn, Great Britain; Glace Bay, N.S.—Letterfrack, Great Britain; Louisberg, N.S.—Clifden, Great Britain. Trans-Pacific communication between San Francisco and Funabashi by way of a relay station at Honolulu is regarded as realised. Telephonic communication has been opened between Berlin and Sofia, and (by way of the United States) between Montreal and Vancouver, a distance of 6,800 km.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—Feb. 19th. Municipal Council. Meters, maximum-demand indicators, feeder regulators. Specification from E.L. Department, Town Hall.

March 5th. Council. One 7,500-k.v.a. turbo-alternator. See "Official Notices" January 5th.

Adelaide.—March 28th. P.M.G.'s Department. Telephones, telephone parts, line and battery material, &c. Schedules 444 to 453. See "Official Notices" to-day.

Melbourne.—February 14th. City Council. 699,000 arc lamp carbons. See "Official Notices" to-day.

March 21st. Victorian Railways. Half-watt lamps and lanterns. —*Australian Mining Standard.*

Banbridge.—February 3rd. Urban Council. Public lighting of the district with gas or electricity.

Bedford.—Electricity Department. Extensions, comprising buildings, boiler-house plant, turbo-generator, steam and water auxiliaries, switchgear, &c. See "Official Notices" January 19th.

Cheltenham.—February 14th. Corporation. Twelve months' supply of electric light fittings. Mr. J. S. Pickering, Borough Engineer.

Halifax.—February 12th. Corporation Tramways Committee. Stores and materials, including lighting materials, wheel brake blocks, trolley and overhead line materials, &c., for twelve months. Tenders to Tramway Engineer.

Harrogate.—March 5th. Corporation. By-product steam boiler plant. See "Official Notices" to-day.

Keighley.—February 24th. Keighley and Bingley Joint Hospital Board. Electricians' work for 12 months in connection with the Morton Banks Sanatorium and Keighley War Hospital. Tenders to Mr. J. N. Clarkson, Clerk to the Joint Board and War Hospital, 40, North Street, Keighley.

London.—Battersea.—February 6th. Electricity Department. Oils, engine-room stores, meters, joint-boxes, &c. See "Official Notices" January 19th.

Bermondsey.—February 22nd. B. of G. Three, six and twelve months' supply of electric lamps. Mr. E. Pitts Fenton, Clerk, 283, Tooley Street, S.E.

Hammersmith.—The Electricity Committee has recommended the B.C. to invite tenders for annual contracts for electric light sundries, insulated wires, packing and jointing materials, joint-boxes, connections, &c.

Manchester.—February 2nd. Electricity Committee. Cooling towers. See "Official Notices" January 19th.

February 13th. Corporation Tramways Committee. Stores. See "Official Notices" January 26th.

Pembroke (Ireland).—February 5th. U.D.C. Twelve months' supply of electricity stores. The Clerk, Town Hall, Ballsbridge, Co. Dublin.

Portsmouth.—February 6th. Tramways Committee. Six months' supply of stores, including several electrical items. See "Official Notices" January 26th.

Salford.—February 12th. Miscellaneous stores for Tramways Department. General Manager, 32, Blackfriars Street.

South Africa.—Durban.—February 12th. Six four-ton electric travelling portable jib-cranes for the harbour.*

March 8th. Department of Posts and Telegraphs. Installation of an automatic telephone exchange at Pietermaritzburg. See "Official Notices" January 19th.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Australia.—By way of Government support to Australian industries, the Postmaster-General's and other Federal Government departments for the next ten years, the Minister of Defence stated on December 6th in the Senate, are to get all their supplies of copper goods from Metal Manufactures, Ltd., as far as it can supply the articles required. This company proposed to erect works at Port Kembla, N.S.W., for the utilisation of Australian metals in the manufacture of electric cables and general copper manufactures.—*Melbourne Age.*

Ilford.—U.D.C. Accepted offers of coal:—

Oakley, Sollas & Co., Ltd., 200 tons Nailstone 1¼ in. main nutty slack, at 20s. 3d. per ton; A. Blackman & Co., 600 tons Nailstone 1¼ in. main nutty slack, over 12 months, at 19s. 7d. per ton; 50 tons of Measham nuts, 1½ to 2½ in., at 25s. 2d. per ton.

London.—Hammersmith.—The Electricity Committee has accepted the tender of Messrs. Cory Bros. & Co., Ltd., for 50 tons of Hucknal High Hazel ¾-in. slack, at 21s. 8d. per ton, and 50 tons of Gedling High Hazel ½-in. slack, at 18s. per ton.

Islington.—The B.C. has arranged coal supplies as follows:—

A. Blackmore & Co.—5,000 tons Whitwood Silkstone beans, at 22s. 2d. per ton in the Council's wagons.

Myers, Rose & Co.—3,500 tons Shipley double-screened nuts, at 21s. 11d. per ton in the Council's wagons; or in lieu thereof any of the following coals: Manners, Mapperley, Stanley, West Hallam, or Wingfield Manner small nuts.

Cleeves Western Valley Anthracite Collieries, Ltd.—8,000 tons Mapperley Collieries double-screened nuts, at 21s. 1d. per ton in the Council's wagons.

Bowater & Sons.—6,000 tons of double-screened nuts from the Moira Collieries, at 22s. 5d. per ton in the Council's wagons.

The electrical engineer reports that the prices of coal, having regard to the quality thereof, are somewhat lower than those paid for the year 1916. With regard to materials and stores required in connection with the undertaking, the Lighting Committee holds that no useful purpose would be served in advertising for tenders for the year 1917. The electrical engineer is to arrange to continue the contracts or to take other means to secure supplies.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Friday, February 2nd. At 5.30 p.m. At Albemarle Street, W. Lecture on "The Supply of Gaseous Energy," by Dr. C. Carpenter.

Institution of Civil Engineers of Ireland.—Monday, February 5th. At 8 p.m. At 35, Dawson Street, Dublin. Ordinary meeting.

Roentgen Society.—Tuesday, February 6th. At 8.15 p.m. At the Institution of Electrical Engineers, Victoria Embankment. Paper on "Some Properties and Applications of Selenium," by Mr. E. E. Fournier D'Albe.

Liverpool Engineering Society.—Wednesday, February 7th. At the Royal Institution, Colquitt Street. Paper on "The Gladstone Dock," by Mr. W. Hemming Jones and Mr. W. A. Oglethorpe.

Institution of Electrical Engineers.—Thursday, February 8th. At 8 p.m. Paper on "Frequency Changers," by Mr. R. Townend.

(**Western Local Section**).—Monday, February 5th. At 7 p.m. At Merchant Venturers' Technical College, Bristol. Paper on "The Parallel Operation of Electric Power Stations," by Mr. J. S. Peck.

Greenock Electrical Society.—Thursday, February 8th. At 7.45 p.m. At 22, West Stewart Street. Paper on "H.T. Conduit Systems," by Mr. H. J. Roberts.

Salford Technical and Engineering Association.—Saturday, February 10th. At 7 p.m. At the Royal Technical Institute, Peel Street. Paper on "Modern Iron Foundry Practice," by Mr. W. Rawlinson

NOTES.

Federated Employers.—Sir Charles D. Macara has retired from the presidency of the Employers' Parliamentary Association. At the annual meeting of the Association, held at Manchester, he said that he had hoped that the forward movement which he had advocated for so long a federation of employers' organisations of the United Kingdom would be formed on thoroughly democratic lines, the funds for which would be supplied by levies *pro rata* in the same way as other successful organisations had been carried on. But the Association thought otherwise, and he could not acquiesce in the departure they had decided upon. For that reason he would be glad to be relieved of what had been an arduous task. A resolution was passed approving of the amalgamation of the Employers' Parliamentary Association with the Federation of British Industries. It was agreed that there should be a flat rate of subscription, each of the Associations joining the Federation being required to pay £100 for three years.—*Morning Post.*

The Metric System.—On January 25th Mr. E. C. Barton read a paper before the London Chamber of Commerce, advocating the adoption of the metric system of weights and measures in order to facilitate British trade expansion after the war. Lord Desborough, who presided, emphasised the importance of the matter, and a lively discussion followed the paper. Mr. J. H. Skelton illustrated the defects of our existing measures by reference to the extraordinary variety of definitions of the "quarter" of grain, which differs not only between Government Departments, but also with the country of origin and with the kind of grain concerned.

At a meeting of the London City and Midland Bank on the following day, the chairman, Sir Edward Holden, said that one of the greatest hindrances to the extension of our foreign trade was the use of English measures and coinage in commercial quotations. If we were to extend our trade in countries where German influence had hitherto prevailed, we must adopt systems that were most easily understood by purchasers, and he regarded the use of the metric system of weights and measures, together with a decimal monetary system, as of the first importance.

A Bill is to be introduced into the next session of Parliament, with the support of the Association of Chambers of Commerce, for the adoption of a decimal system of coinage, and if this passes into law, as is confidently expected, it is intended to follow it up with a Bill for the adoption of the metric system of weights and measures. The coinage proposals favour the florin as the monetary unit divided into 100 cents, so that all existing gold and silver coins will remain unchanged in value; the cent will be worth $\frac{24}{25}$ of the present farthing. This system is essentially the same as that which we have advocated, in which the sovereign is divided into ten florins and 1,000 mils; indeed, the only material difference lies in the name of the cent or mil.

The Weights and Measures Bill will not make the use of the metric system compulsory in manufacturing processes, but only in sales.

Development of Empire Resources.—An influential Committee has been formed under the title of the Empire Resources Development Committee with the following objects: (1) To advocate (*a*) the conservation for the benefit of the Empire of such natural resources as are, or may come, under the ownership or control of the Imperial, Dominion, or Indian Governments; (*b*) the development of selected resources of the Empire under such conditions as will give to the State an adequate share of the proceeds; (*c*) the appointment in due time of a Board for the conservation and development of the resources of the Empire, so that Imperial effort may be concentrated on assets ripe for development for the common good of the Empire. (2) To take such action as may from time to time appear to be desirable in order to disseminate information in regard to the objects of the Committee, to arouse and maintain public interest, to enlist public sympathy and support, and to co-operate with other Committees and Associations having similar objects.

British Trade with Canada.—Before leaving Canada for his coming official tour in the United Kingdom to discuss with British manufacturers the opportunities for the development of British trade in Canada, Mr. Hamilton Wickes, H.M. Trade Commissioner, issued a statement to the Press (says Reuter) expressing his opinion that there is a valuable market there for an increasing quantity of British manufactures and products of the Empire generally. He points out, however, that the British are not as well situated for developing their trade in Canada as the Canadians are for developing theirs in the British Isles. "This disparity is not the fault of the Canadians, but is caused by the laws relating to insolvency, to the incorporation of companies and to trade marks, and also by Customs regulations. There is a strong tendency, he says, on the part of business men in Canada, and in particular of architects, engineers, accountants, and contractors to favour the United States. Mr. Wickes believes that this state of affairs urgently calls for amelioration in the national interest." This is a matter which is by no means unfamiliar to electrical men, who will be fully in agreement with Mr. Wickes in regard to the need for amelioration.

Norwegian Water Power.—A Committee of the Storthing has requested the Norwegian Government not to allow, in future, foreigners or foreign companies to acquire Norwegian waterfalls, except in special circumstances.—*Times.*

National Insurance (Part II) (Munition Workers) Act, 1916. Decisions by the Umpire:

Contributions are Payable in respect of:

2,107 X. Workmen engaged wholly or mainly in shrinking iron hoops on to the ends of cast-iron pipes. (Application 483.)

2,102 X. Workmen engaged wholly or mainly in making metal reflectors for lighting purposes.

Contributions are Not Payable in respect of:—

2,104. Workmen employed by water companies and engaged in attending to the operation of water-softening plant.

Brown Coal Deposits in Australia.—According to the *Melbourne Age*, a deputation from the Institute of Victorian Industries waited upon the Premier, in December, to urge upon him the development of a scheme for the utilisation of the brown coal deposits of the State. The deputation included Prof. Payne, Messrs. A. M'Nicol and T. J. Greenway, consulting engineers; H. R. Harper, City Council electrical engineer; D. Clark, Chief Inspector of Technical Schools; A. H. Merrin, Chief Inspector of Mines; F. H. Bathurst, and J. Stephens, secretary to the Institute. The interview was held in private. Resolutions were submitted for the consideration of the Government, as follows:

1. That the brown coal deposits of Victoria are of vast extent, and it having once been demonstrated that brown coal can be utilised at a cost to compete with black coal (on which point the Brown Coal Committee considers the evidence to be very favourable), the power potentialities of these deposits are practically unlimited.

2. That the Institute of Victorian Industries urges the Government to take steps towards the immediate development of a scheme for the utilisation of the brown coal deposits of the State, especially in the direction of (*a*) briquette manufacture; (*b*) power production on a large scale.

3. That a working unit be obtained for the making of briquettes in Victoria. In order that an efficient machine be obtained, a suitable man should be sent to the U.S.A. and elsewhere to make inquiries as to latest practice, and advise as to the most suitable plant. At the same time, inquiries should be made concerning the latest practice and most suitable plant for the winning and utilisation of brown coal for all purposes.

4. That the Commonwealth Government be informed that the Institute of Victorian Industries is considering the question of the utilisation of Victorian brown coal deposits for cheap power, which may be applied to the treatment of zinc concentrates.

The speakers at the deputation dealt with various phases of the subject. The Premier said he was greatly impressed by the valuable suggestions that had been made. They had opened up the question of the utilisation of the brown coal deposits on a larger scale than had been previously anticipated. Owing to the quantity of technicalities surrounding the question, he intimated that he would have the speeches of the deputation and the data presented to him printed, in order that the Cabinet might go fully into the propositions made by the deputation.

Exhibition Promoter's Failure.—Walter Cawood, Ltd., London and elsewhere.—The *Financial Times* reports that under a compulsory winding-up order made in this case, the report of the Official Receiver shows liabilities £11,389, no assets of substantial value, and a deficiency of £21,465 as regards contributories.

The company was formed in 1912, with a nominal capital of £12,000, to carry on business as exhibition promoters. It organised the Shipping, Engineering, and Machinery Exhibition and certain other exhibitions, which had every prospect of success. It was intended to hold the Shipping, Engineering, and Machinery Exhibition in 1914, but owing to the outbreak of war it was postponed to 1917. The Dutch Royal Commission would not agree to the postponement, and demanded repayment of the amount paid by them for space rental. A trust was formed to hold the company's funds until it had been finally decided whether the proposed exhibition should be held or cancelled, but in October last a compulsory winding-up order was made by the Court. The failure of the company is attributed by Mr. F. W. Bridges (one of the promoters) to the outbreak of war, the immediate cause being the action of the petitioning creditors in pressing for judgment. In the opinion of Mrs. Cawood (a director), the failure is due to the company not carrying out its contract with the petitioners and to the extravagance of the managing directors with the company's funds.

Volunteer Notes.—First London Engineer Volunteers. Headquarters, Balderton Street, Oxford Street.—Orders for the week, by Lieut.-Col. C. B. Clay, V.D., Commanding:—

Monday, February 5th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30—8.

Tuesday, February 6th. A volunteer fatigue party is required to assist the Quartermaster.

Wednesday, February 7th.—Instructional Class, 6.15. Platoon Drill, Platoon No. 1.

Thursday, February 8th. Platoon Drill, Platoon No. 7. Ambulance Class by M.O., 6.30.

Friday, February 9th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.30—8.30.

Saturday, February 10th.—N.C.O.'s Class, 2.30, under Company-Commander Fleming.

Sunday, February 11th.—Entrenching at Otford. Parade Victoria (S.E. & C. Railway Booking Office), 8.45 a.m.

(By order). Macleod Yearsley, *Adjutant.*

Fatalities.—The adjourned inquest was held last week, at Bradford, on Miss Jeannie Kathleen Regan, the conductress who lost her life in the recent tramway collision near Wyke, when a car, which slipped its brakes at a hilltop terminus, ran into another car going at normal speed in the same direction. The conductress of the runaway car (Mrs. Eva Haryott), who had been alone on the car—the driver being absent delivering a message—gave evidence that she knocked off the hood switch to cut off the current, and then pulled over the air and oil brake, but that did not seem to make any difference to the speed. She found she could not move the hand brake, and therefore assumed it must have been already on. She eventually jumped off the car. She gave evidence on the advice of her solicitor, to refute rumours in the district that she had been "playing about" with the brakes whilst the cars was at Wyke. As a matter of fact, she was on top changing the indicators. There was another rumour that she and the driver had disappeared together. The Coroner said these rumours had led him to adjourn the inquiry, so that anybody who knew anything could come forward, but nobody had done so. The witness said her instructions were not to touch the brakes except in emergency. The oil brake was simple. When she put on this brake she did not release the clip, and it slipped back. On the second occasion it did the same thing. In answer to a question as to why she had not released the clip, she agreed that she was upset and a bit flurried. The jury handed in written replies to questions asked by the Coroner. They found that the brakes had been put on, but not tightly enough to hold the car against the high wind. They did not believe anyone had taken off the brakes, or that the car would have started by itself if the brakes had been properly applied. There had been a degree of negligence on the part of Driver Hudson, deserving censure, but it was not of a criminal character. The jury recommended that more practical tuition should be given to conductresses regarding the application of brakes, and that a more efficient method should be adopted when drivers were changing ends. Conductresses should have practical tuition in brakes. Mr. C. J. Spencer, Bradford tramways manager, said he did not know in what way the method of learning could be improved. If it was possible to put each conductress on a car before turning her out it would be done. The jury said they did not suggest inefficient training of conductresses, and thought Mr. Spencer's promise would meet their wishes. The Coroner hoped the case would be a lesson to the driver, and he would pass it on to other drivers if he saw them leaving their cars. Hudson promised to do so.

At Smethwick, last week, at an inquest into the death of Thomas E. Thompson (40), coal trimmer at the Smethwick power station, the jury returned a verdict of "Accidental death." It appeared from the evidence that Thompson overbalanced and fell into a hopper while shovelling coal from a hopper which was out of use, into one which was charging the boilers. He was buried in slack, and it was 20 minutes before his body could be got out.

The A.S.E. and Trade Union Rules.—In his references to the Manchester Conference, the *Times* Special Correspondent said that not the least important of the resolutions submitted reminded the Government of the pledge to restore Trade Union rules and conditions after the war, and called on the Government to prevent any evasion of its pledge by unscrupulous employers. "The resolution does not explicitly demand immediate restoration. It may, perhaps, be regarded as a statement of an unquestionable right rather than the declaration of a final decision. In this connection one notes that the Amalgamated Society of Engineers, in a resolution of their own, add to an affirmation of the right to complete restoration a frank recognition that, owing to permanent industrial changes during the war, it may not in all cases be practicable to secure absolute and literal restoration of every Trade Union custom. The resolution goes on to declare that if good reason can be shown for regarding restoration as impossible, and if new, and at least equivalent, concessions are given to the Unions, Labour will be ready for negotiation on the matter. How far this attitude on the part of the Union most vitally concerned will commend itself to the Party as a whole, remains to be seen, but the submission of the resolution is, in itself, one of the most striking fruits of the foresight and innate common sense by which the responsible Labour movement is justified."

At the meeting, Mr. J. T. Brownlie, representing the Amalgamated Society of Engineers, moved the following resolution:—

"That this Conference, believing that the attempt to negotiate a binding industrial truce between Labour and Capital might well create more friction than it would prevent, cannot regard the conclusion of such a truce as either practicable or desirable; but that this Conference would welcome the initiation of negotiations between Trade Unions and Associations of Employers in each industry with a view to the settlement by agreement, wherever possible, of the serious industrial problems that will arise after the war. This Conference, therefore, re-affirms its belief in the pre-war methods of negotiation between employers and employed, and affirms its opposition to any system of compulsory arbitration in trade disputes."

The engineers recognised, Mr. Brownlie said (according to the *Times* report), that it would be in the interest of all parties that, at the end of the war, the country should be free from industrial strife. They would welcome negotiations between employers and employed for the settlement of any differences which might arise. But they were not willing to place any difficulties in the way of the use of the strike weapon as a last resort, and they could not accept the principle of compulsory arbitration.

The resolution was rejected by a large majority, and the Conference accepted in its place a plain declaration of hostility to compulsory arbitration.

Localising a Fault.—The following letter has been received:—Being interested in mains work, and having read "Mains Assistant's" letter in your current issue, I venture to suggest a simple, I will not say the best, method of locating a fault such as he describes, which consists of a fall of potential test.

Before doing so, may I be permitted to state that, in my experience in connection with triple-concentric lead-sheathed and armoured cables, nine-tenths of the faults have been found in straight-through or service joint boxes, except in cases where the cable has been damaged. Having proved that all three conductors are shorted and earthed, you must satisfy yourself that no earths are existing on any of the consumers' installations, and I should suggest, in this case, the withdrawing of all the consumers' fuses before carrying out the test.

The apparatus required is a variable resistance (usually a bank of lamps), capable of passing anything from .25 to 3 amperes, and a millivoltmeter with a range of 0-500.

In this case it will be necessary to take a test from each end of the feeder, care being taken that the ends not in use are left entirely disconnected.

The method of procedure is to pass a suitable current from one end A to the fault, say, *viâ* the positive conductor, using either the negative or neutral conductor as a test wire. The same amount of current is then passed through to the fault from the other end B, which must be *viâ* the same conductor as in the first test, a note of the readings, of course, being taken.

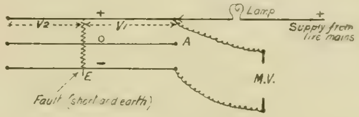
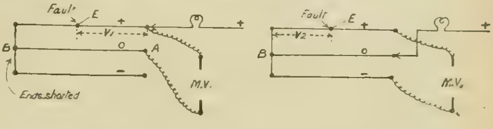


Fig. 1.—Tests for Short and Earth on all three Conductors.

The distance of the fault from A, which is the end first tested, is obtained from the following formula: $L \times V_1 \div (V_1 + V_2)$ = distance of fault from A, where L denotes the total length of the feeder in yards, and V_1 and V_2 the first and second tests respectively.

If only one conductor had been earthed, and no short circuit, it would only have been necessary to test from one end, with the three conductors shorted at the opposite end, as will be seen from the following diagrams:—



First Test. Second Test.

Fig. 2.—Tests for Earth without Short on one Conductor only.

Having calculated the distance, it may be found that the test brings you within 2 yd. of a straight-through or service joint box, which, of course, one would naturally open out.

I do not say it is correct to within a foot, but I have located something like 100 faults on concentric mains with the above tests, and the farthest I have been away is 3 yd. on lengths varying from 50 to 700 yd.

The only time that I find this test difficult to apply is when there happens to be two earths at different points on the same conductor, or when there is excessive leakage from any tramway rails where they run parallel to the cable and the ordinary street distance away.

However, my experience teaches that if you have a sensitive dead-beat instrument, and always clean contacts at the testing points, with fairly heavy testing cables, the above test will not lead you very far astray.—P. Wardle. Carlisle. January 28th, 1917.

British Tungsten Ores.—Some specimens of the important tungsten ores, wolframite and scheelite, have been received at the Imperial Institute from the Federated Malay States. Wolframite, commonly called wolfram, which forms the bulk of the tungsten ore produced, occurs in various parts of the main mountain range in British Malaya, and in Pehang and Trengganu. Scheelite is mined in Perak and Selangor.—*The Times.*

Russian Electrical Energy Tax.—The proposal to impose a tax on electrical energy is once more before the Council of Ministers. The Minister of Finance has submitted his conclusions on the views of the departments that had expressed themselves against various features in the project. The most pronounced objection was that of the former Minister of the Interior, Chvostoff, who found that the taxation of electric lighting in private rooms, along with kinematographs, places of amusement, and business premises, at the rate of 4 copecks per KW.-hour, was unfair, onerous, and inopportune.

Technical Works for Men on Active Service.—We are indebted to the Chloride Electrical Storage Co., Ltd., for a set of their excellent pamphlets on accumulators, for transmission to our correspondent, Corporal S. J. Knight, with the Mesopotamia Expeditionary Force.

Irish Coalfield Development.—In connection with the proposed development, under State aid, of the Wolfhill (Queen's Co.) anthracite coal area, the scheme provides for the erection of a central station at which would be placed suction engines and plant to generate electricity for hauling, winding, pumping, coal cutting, and the driving of aerial ropeways.

Engineers' Wages.—The Clyde District Committee of the Amalgamated Society of Engineers yesterday made application to the Employers' Federation for an advance of 4d. per hour. This is the largest claim ever made by this Society, and is their fourth since the outbreak of war. Up to the present time they have received advances equal to 1½d. an hour. *Daily Telegraph.*

Institution and Lecture Notes.—Roentgen Society.—At the next meeting Dr. Fournier d'Albe, Physicist to the Board of Inventions and Research, is to demonstrate his type-reading optophone, by which blind persons are enabled to read ordinary letterpress by ear. This is done by audible telephone currents, produced by intermittent light of various musical frequencies. The printed sheet is passed over a slab with an aperture, upon which a horizontal beam of light is projected from an illuminated disk, and by means of a set of selenium bridges exposed to light reflected from the type, sounds which vary with the shape of each letter are produced and carried through the telephone. The inventor states that the alphabet can be learned in three or four days, and with practice a speed of 25 or more words read per minute can be acquired. Dr. Fournier d'Albe also proposes to show other properties and applications of selenium, including its direct action in which one lamp is made to light another without a relay.

The meeting will be held at the Institution of Electrical Engineers on Tuesday next, at 8.15 p.m. Visitors interested in the subject will be welcomed on this occasion.

Institution of Electrical Engineers.—The following meetings are announced to be held in London :—

February 8th.—R. Townend, "Frequency Changers."
March 8th. G. A. Juhlin, "Voltage Regulation of Rotary Converters."
March 22nd. -F. R. McBerty, "Machine Switching Telephone Gear."
April 12th. Discussion on "Wayleaves," with introductory paper by Mr. C. Vernier.
April 26th.- G. V. Twiss, "High-Tension Overhead Transmission Lines."
May 17th. -Annual general meeting.

Inquiries.—Makers of the "Hofmann" connector for bare wires are asked for. This is a metal sleeve with two transverse holes; the wires being laid in the sleeve side by side, a drift is driven through each hole between them, forcing them into recesses in the sleeve, and afterwards rivets are put through the holes and closed.

A correspondent inquires the name of the present maker of the "Float" electric lamp. It is required for shipyard use.

Sale of Siemens Shares.—The Public Trustee will shortly offer for sale by public tender 119,660 shares of £5 each, fully paid, in Siemens Bros. & Co., Ltd. An announcement on the matter appears in our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The Rochdale Corporation Gas and Electricity Committee last week accepted the resignation of Mr. C. Clare Atchison, the borough electrical engineer, owing to continued indisposition. In November last Mr. Atchison was given leave of absence, owing to a breakdown in health, and this was extended a month later. He went to Rochdale from the South of England in 1900 as clerk of works in connection with the electricity undertaking, which was then being started, and became the electrical engineer, having also the tramways under his supervision in the early days.

The Southampton T.C. has decided to advance the salary of the tramways manager, Mr. Robson, from £400 to £500 a year.

Mr. J. McElroy, general manager of the Manchester Corporation tramways, has been granted leave of absence in order to take up work under the Admiralty in connection with the organisation of shipyard labour at the request of the Government. Mr. McElroy organised the conveyance of workmen to and from munition works in London.

At the Town Hall, Ilfracombe, recently, Mr. Alfred Rudd, who is on the staff of the Ilfracombe Electric Light & Power Co., Ltd., having been relief stoker and mains man since 1910, was publicly presented with the Royal Humane Society's bronze medal and certificate of honour for conspicuous bravery in saving the life of Dorothea Thorne at Cheyne Beach. Mr. Rudd had previously saved four or five persons from drowning, and had been awarded certificates from the Society. The rescue for which the medal mentioned was granted was a very plucky one. A girl was washed off the steps by the sea at high tide, and would have been drowned had not Mr. Rudd dived in. The sea at the time was too rough to allow a landing near, and he had to swim with her a considerable distance.

General.—The Dublin Corporation Electricity Supply Committee has re-elected Coun. J. J. O'Neill chairman for the ensuing year, and Coun. L. Sherlock deputy-chairman.

Mr. Joseph Mallagh has been appointed engineer to the Dublin Port and Docks Board, on probation for 12 months, at a salary of £650.

The Western Mail says that Mr. James Davies, chief electrical engineer, received a severe shock at Llandebie Colliery, but recovered consciousness under treatment.

The following announcement appeared in the *London Gazette* on January 24th :—"Royal Engineers: Second-Lieutenant (Temporary Lieutenant) Clyde Higgs to be Temporary Captain."

Roll of Honour.—Lieutenant F. E. Jones, R.E., engineer to the Tyldesley (Lancs.) District Council, has been mentioned in dispatches by Sir Douglas Haig for some excellent work in France.

Private C. B. Crossby, Royal Warwickshire Regiment, who has died of wounds received whilst acting as a stretcher bearer, enlisted from the carbon lamp department of the British Thomson-Houston Co., Ltd., of Rugby.

Sapper G. Tilley, of the Royal Engineers, who has been awarded the D.C.M., was before the war a telegraphist at the Leeds General Post Office.

Corporal J. Chadwick, Lancashire Fusiliers, who has been killed in action, was an electrician at Messrs. Bibby and Baron's, Bury. He was 35 years of age.

Sergeant James Smith, Scottish Rifles, who was employed in the permanent-way department of Blackburn Corporation tramways, was wounded in the Loos battle, and had been awarded the Military Medal for assuming command of his company when all the officers had fallen, has been killed in action.

Sergeant P. Galley, of the York and Lancaster Regiment, of the Leeds city tramways department, has been awarded the D.C.M.

The *Times* reports that Lieutenant H. R. Hele-Shaw, R.F.C., previously reported missing on July 19th last, now unofficially reported shot down in aerial action with his machine and killed, aged 20 years, was the only son of Dr. and Mrs. Hele-Shaw, of Coleherne Court, S.W.

Lieutenant T. S. H. Schafer, Northumberland Fusiliers, younger son of Sir Edward Schäfer, Professor of Physiology in Edinburgh University, who has been missing since September, 1915, is now officially assumed to have been killed.

Company Sergeant-Major James Scott, Royal Irish Rifles, killed in action, was in the service of the Belfast tramways before the war.

Obituary.—Mr. J. Toder.—The death occurred on January 22nd, at Hale (Ches.), of Mr. John Toder, late Australian representative for Messrs. Belliss & Morcom, Ltd. He was in his 51st year.

NEW COMPANIES REGISTERED.

British Switchgear, Ltd. (145,852).—Private company. This company was registered on January 25th, with a capital of £40,800 in £1 shares (40,000 pref.), to carry on the business of manufacturers of and dealers in electrical switchgear, switchboards, and other electrical and mechanical machinery and apparatus, &c., and to enter into an agreement with Brook, Hirst & Co., Ltd., and Erskine, Heap & Co., Ltd. The subscribers (with one ord. share each) are: J. M. Scott Maxwell, Baillieston House, Baillieston, Lanarkshire, electrical engineer; H. C. Siddeley, 66, Foxley Lane, Purley, Surrey, electrical engineer; J. A. Hirst, Douacloney, Deganwy, North Wales, electrical engineer; A. Erskine, Brantwood, Oak Drive, Fallowfield, Manchester, electrical engineer. The first directors (to number not less than two or more than seven) are: J. A. Hirst (nominee of Brook, Hirst & Co., Ltd.), J. M. Scott Maxwell (nominee of Electric Control, Ltd.), A. Erskine (nominee of Erskine, Heap & Co., Ltd.), and H. C. Siddeley. A member holding 120 ord. shares may from time to time appoint and remove a director. Qualification, one ord. share. Remuneration (except managing director), as fixed by company. Solicitor: T. M. Dutton, 19, Newgate Street, Chester. Secretary: H. C. Siddeley.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Miniature Electric Vehicles, Ltd.—Particulars of £3,000 debentures, created January 17th, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £1,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Duroglass, Ltd.—Issue on January 12th, 1917, of £300 debentures, part of a series of which particulars have already been filed.

Keynsham Electric Light Co., Ltd. (64,634).—Capital, £5,000 in 3,000 pref. and 2,000 ord. shares of £1 each. Return dated December 19th, 1916. All shares taken up; £5,000 considered as paid. Mortgages and charges: £2,980.

Masham & District Electric Supply Co., Ltd. (138,306).—Capital, £2,000. Return dated May 18th, 1916 (filed August 25th). 902 pref. and 500 ord. shares taken up; £1,082 paid on 902 pref. and 180 ord.; £320 considered as paid on 320 ord. Mortgages and charges: £220.

Electric Zinc Co., Ltd. (127,838).—Capital, £2,000,000 in 400,000 pref. and 1,600,000 ord. shares of £1 each. Return dated December 31st, 1916. Seven shares taken up; nothing called up. No directors have been appointed. Mortgages and charges: Nil.

Aron Electricity Meter, Ltd. (58,650).—Capital, £350,000 in 225,000 ord. and 125,000 pref. shares of £1 each. Return dated January 2nd, 1917. 125,000 ord. and 125,000 pref. shares taken up, £124,948 10s. paid on the pref., including £52 10s. on 104 forfeited shares, £125,000 considered as paid on the ord. Mortgages and charges: £96,000

East India Tramways Co., Ltd. (74,457).—Capital, £100,000 in 15,000 pref., 35,000 ord., and 50,000 def. shares of £1 each. Return dated December 15th, 1916. 7,500 pref., 33,433 ord., and 50,000 def. shares taken up; £1 per share called up on 7,476 pref. and seven ord; £7,489 paid, including £6 on 24 pref. shares forfeited; £83,426 considered as paid on 33,426 ord. and 50,000 def. shares. Mortgages and charges: Nil.

Delagoa Bay Development Co., Ltd. (76,099).—Capital, £166,300 in 10s. shares. Return dated December 5th, 1916. 267,400 shares taken up; 10s. per share called up on 177,400; £88,720 paid; £45,000 considered as paid on 90,000 shares. Mortgages and charges: £188,900.

Northampton Electric Light & Power Co., Ltd.—Issue on January 2nd, 1917 (at 20 per cent. discount) of £1,835 debs., part of a series of which particulars have already been filed.

Pernambuco Tramways & Power Co., Ltd.—Supplemental to trust deed dated January 19th, 1917, modifying trust deed of August 11th, 1913, and extending time for repayment of £1,250,000 debs. secured thereby.

National Electric Construction Co., Ltd. (53,364).—Capital, £125,000 in 10s. ord shares. Return dated September 6th, 1916 170,000 shares taken up; 10s. per share called up on 151,149; £75,574 10s. paid; £9,425 10s. considered as paid on 18,851. Mortgages and charges. £75,000.

Northern Engineering & Construction Co., Ltd. (95,550).—Capital, £3,000 in 2,940 ord. and 60 founders' shares of £1 each. Return dated December 30th, 1916. 1,305 ord. and 40 founders' shares taken up, £305 paid; £1,040 considered as paid. Mortgages and charges. Nil.

CITY NOTES.

East London Railway Co.—During the year ended December 31st the number of passengers carried was 9,358,000, against 8,519,880. At the previously ascertained average rate of 1.27d. for each passenger, the traffic from this source should now yield over £49,500 per annum. Owing to the position of the company as affected by conditions formulated under Government control of railways, it appears that only a portion of the interest accruing on electrification capital will be recoverable. This will affect the company's interests and those of the stockholders prejudicially. The Government, having benefited by the great increases in passenger traffic, are being approached by the directors with a view to the company's case being specially dealt with; that is, by recouping them the amount due and becoming due in respect of the contingent liability for interest on capital expenditure on the electrification of the railway.

Chatham & District Light Railways Co.—For the year ended December, 1916, the revenue was £64,567, and the expenses were £34,341, leaving £30,226. There are deducted rent of Corporation lines, interest on debentures, amount written off investments (£1,330), reserve for depreciation (£6,000), maintenance reserve (£2,000), and other items, amounting in all to £15,975, leaving £14,251, plus £3,150 brought forward. After paying the preference dividend, and a total of 7 per cent. for the year on the ordinary, £307 is payable to the directors, leaving £3,794 to be carried forward. There was an increase of £3,650 in revenue and £2,111 in expenses as against 1915. It has again been impossible, owing to shortage of labour and difficulty in obtaining materials, to maintain the track and rolling stock in the usual state of repair, and £2,000 has been added to maintenance reserve account in order to make some provision for the repairs which will have to be undertaken when the war is over. During the year £17,500 debentures have been purchased and redeemed. Annual meeting: February 12th.

Metropolitan Railway Co.—Dividend upon the ordinary stock for the past half-year at the rate of £1 per cent. per annum, making 1 per cent. for the year, and carrying forward about £14,500, after placing £20,000 to the general renewals fund. Dividend on the Surplus Lands stock at the rate of 2¾ per cent. per annum, carrying forward £2,600, after placing £3,800 to reserve accounts.

Russia.—The E. A. Englund Telephone Equipment Bureau, Moscow, is being formed, with a capital of 1,000,000 roubles.

Westminster Electric Supply Corporation, Ltd.—The directors recommend, subject to final audit, a dividend at the rate of 9 per cent. per annum, less income-tax, for the last half-year (making 7 per cent. for the year).

STOCKS AND SHARES.

Tuesday Evening.

Little is heard in the Stock Exchange nowadays except on such matters as those concerning the new War Loan. This week the time has expired for taking advantage of the Treasury's offer of 3s. 4d. per cent. extra interest to those who paid in their money up to three o'clock on January 31st. Probably next week will be a quiet one, so far as the loan is concerned, and then there will be a grand rush at the finish, with cumulative excitement day by day until February 16th has come and gone. During this period, the remainder of the markets round the House are bound to suffer more or less from the general influence of the loan. A side-issue which receives a certain amount of attention in the markets at the moment is whether the Stock Exchange will be classed as a non-essential industry when the official pronouncements are made. The odds at present favour the idea of its being deemed essential.

The first of the Home Railway dividends made its appearance at the end of last week in the shape of the Metropolitan. The company has declared a dividend of ½ per cent. actual, making 1 per cent. for the year, the same as that for the previous 12 months. The balance forward is £1,500 up, and the renewals fund gets an extra £5,000.

The other dividends which have been declared during the past few days are all on practically the same lines as those of a year ago; and so far as the Heavy stocks are concerned, prices have reacted until they stand now at what is nearly a 7 per cent. basis of yield. As the Metropolitan pays about 4¼ per cent. on the money, the proprietors may have the proud feeling that, judging by the price alone, their stock commands a higher credit than Consols or the new War Loan! The Surplus Lands stock remains at 46, and Metropolitan deferred dividend stock dropped a point to 19.

Underground Electrics were somewhat pressed for sale by those who had bought the bonds cheaper, were prepared to take their profit, and to re-invest the money into the popular stock of the moment. When these sellers had been disposed of, the price recovered from 89 to 89½, which still leaves it lower on the week. The £10 shares remain in the neighbourhood of 2, and the 1s. shares are a trifle under 6s. Weakness in the pre-ordinary stocks of the Home Railway companies is still noticeable.

The Treasury issued a notice towards the end of last week which came as something of a bombshell to those markets which had been dealing with a fair amount of freedom in securities of the American-Canadian electric power order. The bargains have been almost entirely sales on behalf of holders on this side, the purchasers taking the securities for America. The Treasury, in their latest enactment, lay down that no securities must be shipped from this side without special permission; and this, of course, has brought to a standstill the business which had been going on in the classes of shares mentioned.

The list comprises shares in undertakings which probably not one British investor in 5,000 has ever heard of, but the high levels to which prices have recently been lifted in New York, Washington, and Boston proved too strong a temptation for British holders of the shares to resist; and they have been sending them out in quantities of late. A special meeting of the Stock Exchange Committee was hastily called to decided what ought to be done in connection with transactions that have not yet been settled up; and the matter now rests between the House and the Treasury, awaiting the decision of the latter.

More strength is shown by Brazilian Traction shares, which rose to 50, ex the quarterly dividend of 1 per cent.—equal, of course, to 15s. net. This is due to the greatly improved complexion that Brazilian affairs have assumed on the reaffirmation of the expectation that Brazil will be able to resume cash payments of her debts by next August. Such anticipation has been current for some time past, but none too much credence was place in it. Now, however, the President of Brazil has practically endorsed it; and Brazilians are distinctly better in consequence.

A cross-current is the uncertainty felt with respect to the securities which the Treasury has announced it will requisition from holders in connection with its scheme for regulating foreign exchange. Some surprise is expressed at what looks an arbitrary proceeding on the part of the Government, although the requisition would not have been necessary had holders of foreign securities come forward, as they should have done, to lodge the stocks and shares for which the Treasury asked the deposit voluntarily. Those who refrained from sending in their stocks will find themselves in a much less favourable position, as regards interest and repayment, than those who complied with the earlier request.

The Argentine stocks are steady, but there is no recovery in the British Columbia Electric Railway issues.

The market in electricity supply shares remains extremely placid. There is a little business doing in Cities and Counties; otherwise, the group is without feature. Bargains were marked in the early part of the week in South Metropolitan Electric ordinary round about 17s. 6d.

There are not many changes in the market for telegraphs and telephones. Anglo-American Telegraph preferred is once more better, but the deferred sticks at 22¼. The Eastern group has given way a trifle, Eastern ordinary being a point down at 137, while Globes receded to 12. United River Plate Telephones have again eased off. There is a good deal of quiet selling going on on the part of holders who want to invest into the new War Loan; and although (we are glad to see) some of the papers are beginning to sound a note of caution on this point, the tendency is still for the investor to sell what he has, and to buy the new stock.

That note of caution is necessary, because it does not always follow that a sale of existing stock—especially if made at a heavy sacrifice—is necessarily in the interests of this country; and the rather indiscriminate realisations which have been made on the ground of patriotism may turn out to be less advantageous to the country than the sellers intend. Every case, of course, must be taken by itself. We make no excuse for labouring the point, because it is one of great importance; but every intended transaction should be examined with a good deal of scrutiny before it is carried into effect, lest indirectly it may cause more harm than good.

It is interesting to holders of electric lighting shares to notice that the Gas, Light & Coke Co. is paying a dividend of 4 gs. per cent. in respect of the past half-year, this being at the same rate as for the corresponding six months; but the company has had to take £130,000 from its reserve in order to maintain the distribution.

Babcock & Wilcox shares have gone back 2¾. British Westinghouse preference are easier at 2¼. Castner-Kellner at 3 and Henleys at 15¾ are both a little down, and the usual reason for falls in prices nowadays is sufficient to account for all of these declines.

Industrials as a whole are quiet; there is little doing, for instance, in the rubber market. The price of the raw material keeps steady at about 2s. 10½d. per lb., but the American buyers are holding off—possibly in consequence of the renewed submarine activity started by the enemy. The metal markets are quiet, too. There is a rather better tendency in some of the armament shares, without, however, any particular feature calling for comment.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Jan. 30, 1917.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary	5	5	3⅜	—	7 8 2
do. do. do. 4½ Pref.	4½	4½	3¼	—	6 18 6
Chelsea	5	4	3	—	6 13 4
City of London	9	8	11	—	7 5 5
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10	—	7 0 0
do. 6 per cent. Pref.	6	6	9¾	— ⅛	6 3 1
Kensington Ordinary	9	7	5⅜	— ¼	6 10 3
London Electric	4	8	1½	— ⅛	7 2 10
do. do. 6 per cent. Pref.	6	6	4 7/16	—	6 15 4
Metropolitan	3½	3	2¼	—	6 13 4
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 4 0
St. James' and Pall Mall	10	8	6	—	6 13 4
South London	5	5	2⅞	—	6 19 0
South Metropolitan Pref.	7	7	1 3/32	—	6 7 8
Westminster Ordinary	9	7	5⅝	—	6 4 5
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	94½	+ ½	6 7 2
do. Def.	30/-	33/6	22¼	—	6 14 10
Chile Telephone	8	8	7	—	5 14 8
Cuba Sub. Ord.	5	5	8½	—	6 8 6
Eastern Extension	7	8	13⅞	—	*5 15 4
Eastern Tel. Ord.	7	8	137	—1	*5 16 10
Globe Tel. and T. Ord.	6	7	12	—	*5 16 8
do. Pref.	6	6	9⅞	—	6 1 6
Great Northern Tel.	22	22	37	—	5 19 0
Indo-European	13	13	49	—	6 12 8
Marconi	10	10	2 11/16	—	3 14 9
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord.	10	10	2¼	—	4 9 0
United R. Plate Tel.	8	8	6 9/16	— 1/16	*6 2 0
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13⅞	—	*5 15 4
HOME RAILS.					
Central London, Ord. Assented	4	4	64½	—	6 5 0
Metropolitan	1½	1	23	— ½	4 7 0
do. District	Nil	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	Nil	2	—	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	6	6	89½	—1	*6 14 1
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4 15/16	—	6 1
Anglo-Arg. Trams, First Pref.	5½	5½	8	—	9 4
do. 2nd Pref.	5½	5½	2¾	—	—
do. 5 Deb.	5	5	61½	—	7 15 0
Brazil Tractions	4	4	50xd	+1	8 0 0
Bombay Electric Pref.	6	6	10xd	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	62	—	8 1 4
do. do. Preferred	—	Nil	41	—	Nil
do. do. Deferred	—	Nil	33½	—	Nil
do. do. Deb.	4½	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	25	—	Nil
do. 6 per cent. Bonds	—	Nil	22½	—	Nil
Mexican Light Common	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	14½	—1	Nil
do. 1st Bonds	Nil	Nil	27½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	14	15	2¾	— 1/16	5 9 1
British Aluminium Ord.	5	7	27/6	—	5 16 3
British Insulated Ord.	15	17½	11¾	—	7 5 10
British Westinghouse Pref.	7½	7½	2¼	— 1/32	6 13 4
Callenders	15	20	12¾	—	7 17 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	3 9/16	— 1/16	6 18 0
Edison & Swan, £3 paid	Nil	—	7/16	—	Nil
do. do. fully paid	Nil	—	1⅝	—	Nil
do. do. 4 per cent. Deb.	4	4	61½	—	6 10 1
Electric Construction	6	7½	15/16	—	8 0 0
Gen. Elec. Pref.	6	6	9½	—	6 6 4
do. Ord.	10	10	13¼	—	7 5 6
Henley	20	25	15¾	— ¼	7 13 9
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12½	—	*8 0 0
Telegraph Con.	20	20	88	—	*6 5 0

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, January 31st.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Oxalic	per lb.	1/6	..
a	Ammoniac Sal	per ton	£75	..
a	Ammonia. Muriate (large crystal)	,,	£54	..
a	Bisulphide of Carbon	,,	£23	..
a	Borax	,,	£34	..
a	Copper Sulphate	,,	£66	..
a	Potash, Chlorate	per lb.	2/6	..
a	,, Perchlorate	,,	2/-	..
a	Shellac	per cwt.	144/-	2/- inc.
a	Sulphate of Magnesia	per ton	£16	..
a	Sulphur, Sublimed Flowers	,,	£19	..
a	,, Lump	,,	£16	..
a	Soda, Chlorate	per lb.	1/-	..
a	,, Crystals	per ton	120/-	..
a	Sodium Bichromate, casks	per lb.	..	..
	METALS, &c.			
c	Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c	,, Tubes (solid drawn)	,,	..	..
c	,, Wire, basis	,,	..	..
c	Copper Tubes (solid drawn)	,,	1/8 to 1/8½	..
g	,, Bars (best selected)	per ton	£166	..
g	,, Sheet	,,	£166	..
g	,, Rod	,,	£166	..
d	,, (Electrolytic) Bars	,,	£143	£2 inc.
d	,, ,, Sheets	,,	£174	£11 inc.
d	,, ,, Wire Rods	,,	£151	£2 inc.
d	,, ,, H.C. Wire	per lb.	1/5⅞	⅜d. inc.
f	Ebonite Rod	,,	3/-	..
f	,, Sheet	,,	2/6	..
n	German Silver Wire	,,	2/3	..
h	Gutta-percha, fine	,,	6/10	..
h	India-rubber, Para fine	,,	3/2½	½d. dec.
i	Iron Pig (Cleveland warrants)	per ton	Nom.	..
l	,, Wire, galv. No. 8, P.O. qual.	,,	£38	..
g	Lead, English Pig	,,	£31 5	..
g	Mercury	per bot.	£19 15	£1 inc.
e	Mica (in original cases) small	per lb.	6d. to 3/-	..
e	,, ,, ,, medium	,,	3/6 to 6/-	..
e	,, ,, ,, large	,,	7/6 to 14/- & up.	..
d	Silicium Bronze Wire	per lb.	1/10	¾d. dec.
r	Steel, Magnet, in bars	per ton	..	..
g	Tin, Block (English)	,,	..	..
n	,, Wire, Nos. 1 to 16	per lb.	2/11	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons
r W. F. Dennis & Co.

Callender's Hospital Fund.—The annual report of Callender's Hospital and Distress Fund for 1916 is in our hands. As in previous years, a large amount of useful work in small, but invaluable ways, has been done. The year was a remarkable one in the history of the Fund. Owing to the war, many more of the old members have joined the Forces, and patriotic women have taken their places, and are doing their best to fill the gap and meet the extra requirements in munitions and other work. Thus the subscriptions have been well maintained, and the usual sums have been distributed to the various hospitals. The penny weekly subscription realised £288, against £270 in the previous year. The year's total is £1 6s. 6d. less than the record year of 1903, when the Fund was inaugurated. Callender's Cable Co., Ltd., donated £50, and there were smaller sums subscribed by nine directors and officials. The amount distributed to hospitals, nursing associations, &c., was £281, as against £284 in the previous year, and surgical, spectacle and financial aid was given directly in many cases. The report concludes, "We enter the New Year hoping that before it closes our nation and its Allies will rejoice in a victorious Peace, and our Fund experience further success."

Carbon Electrodes for Arc Furnaces.—In an article on arc furnaces for steel-making in the *Iron and Coal Trades Review*, it is stated that British users are at present dependent upon supplies of electrodes from the United States and Sweden, but a factory has been completed in Sheffield by local firms, and its output is to be doubled immediately. Another factory is being built in the Newcastle district, and will probably be ready in the spring. These factories will produce electrodes of amorphous carbon, and users of graphite electrodes will still be dependent on the Acheson plant at Niagara Falls. While power at the Falls costs £5½ per KW.-year, it has been supplied by certain works in this country at £4½ per KW.-year.

Benzol and Electricity.—In the course of a paper recently read before the Midland Institute of Mining Engineers, on "The Rectification of Benzol," the author stated that there seemed to be no doubt that an electric potential was created by the rapid passage of benzol through a narrow pipe, and he consequently urged that all pipes used in conveying benzol should be properly earthed.

THE FILTRATION OF AIR.

One of the most important applications of filtered air is for cooling turbo-generators. These machines are small in size in proportion to their output, and have, consequently, a limited space wherein only comparatively small air channels can be provided for the dispersion of the heat. Since the introduction of mechanically-ventilated generators it has been found that the use of unfiltered air has a deteriorating effect on the insulation, owing to the presence of dirt and dust particles in the atmosphere, which are gradually deposited on the windings, causing local overheating and eventual breakdown of the insulation. The abrasive action also of many thousands of minute dust particles impinging on the end windings wears away the varnish and insulating fabric, with the result that when the machine, in such a condition, cools down in an atmosphere of ordinary humidity, the end windings rapidly absorb moisture, causing serious and unexpected "burn-outs." The importance of filtration is still more evident when the large amount of air required for ventilating large turbo-generators is taken into account. For instance, a moderately large generator would use 20,000 cb. ft. of air per minute, which means a total of 28,800,000 cb. ft. per day of 24 hours. As a rough approximation, it may be assumed that one hundred-millionth of the volume of the air in the vicinity of power plants consists of dust, dirt, and other foreign particles. This would mean that 87 cb. ft. of dust would be blown into the machine during a year of 300 working days. While, of course, the great bulk of this dirt would pass directly through the machine, a portion would be deposited in the air passages, due to the air swirls and eddies. Such deposits of dirt become a considerable handicap to ventilation, as the quantity of air is decreased, due to the partial closing of the ventilating passages, and the cooling effect of the air is greatly diminished, owing to the fact that the air cannot come directly into contact with the heat radiating surfaces.

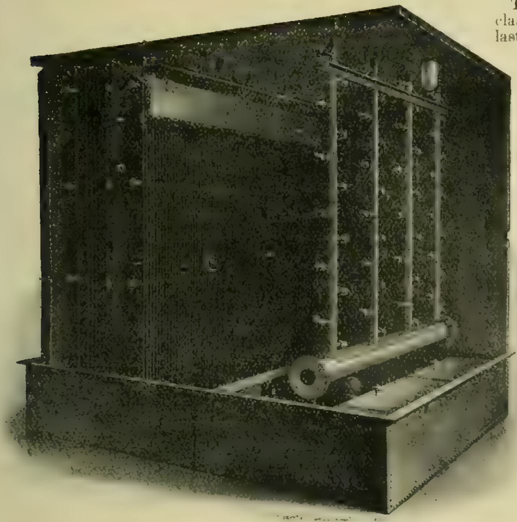


Fig. 1.—Sirocco Air Washer, Side Plate Removed.

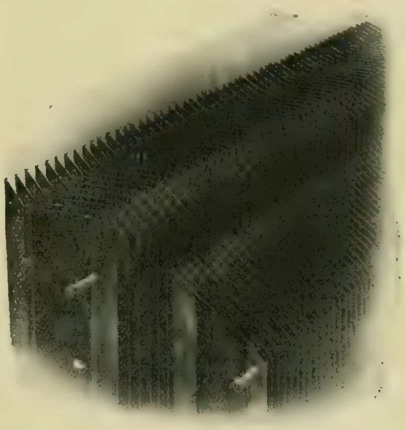


Fig. 2.—Scrubber and Eliminator Plates.

The above advantages of filtered air apply also in the case of forced or pipe-ventilated motors working in a dusty atmosphere. However well they may be protected, the presence of grit and dust in the atmosphere has a destructive effect, not only on the windings, but also on the bearings. By using purified air, the dusty atmosphere is prevented from entering the motor, thereby prolonging its life and allowing it to operate under the most ideal conditions irrespective of its surroundings.

Filtered air is also valuable in the case of air-compressors, as the admission of gritty and dusty air plays havoc with the valves and cylinders, causing trouble and expense, and resulting sometimes in a serious breakdown. Particularly is this the case when the compressor is installed at a colliery, where the general atmosphere contains a large proportion of coal dust.

Dry air filters consist of cloth or fibre screens, while in the wet type of filter the purification is effected by passing the air current through a fine water spray. The dry filter takes up more space than a wet one, and where cloth screens are used there is also the risk of fire. Further, in the dry type, the maximum quantity of air passes through only when the filter is clean, and gradually lessens as the cloth becomes choked up, thereby setting up more resistance to the free flow of the air. These filters also require to be cleaned frequently, which can usually only be accomplished when the machine is out of action.

In the wet type of filter the air is thoroughly washed by passing the air current through a chamber filled with a very fine mist, which causes the bulk of the solid matter suspended in the air to be precipitated into the tank at the base of the machine. The air, after leaving the spray chamber, encounters a battery of scrubber plates, on which any dust or dirt remaining in the air is deposited, and then passes on to a series of eliminator plates, by means of which it is buffeted from side to side, depositing during this process any free moisture upon the eliminators, and leaving the washer in a thoroughly clean and cooled state, with no trace of free moisture. We illustrate in fig. 1 a Sirocco air washer made by Messrs. Davidson and Co., Ltd., of Belfast; the side plate has been removed, showing the spray chamber and the series of scrubber and eliminator plates, which are more clearly seen in fig. 2. In this filter the resistance to the air current is constant, thus allowing the same volume to pass all the time, and as the resistance is low, less fan power is required to pass a given volume of air than in the case of a dry filter. It is also easily cleaned while in operation. The water consumption is very low, as it is recirculated by means of a pump, passing through two sets of filters, so as to prevent any dirt choking the spray nozzles. It is claimed that this washer will remove 98 per cent. of solid matter from an impure atmosphere, and will deliver the air without any free moisture and in a cooled state.

RURAL TRANSMISSION LINES.

In a paper read before the Portland, Ore., Section of the National Electric Light Association and American Institute of Electrical Engineers, by Mr. A. S. Hall, the economical construction of lines in rural districts was discussed.

The author says that new business can be divided into three classes: (1) Competitive, (2) development, and (3) rural; the last may eventually become a large proportion of the total. Up to the present it has not been sought after to any great extent by organised methods, because its possibilities have not been realised, and there was apparently more remunerative business nearer home.

Practically every town in the Pacific North-West is surrounded by an agricultural community, with, in many cases, a population nearly as large as the city itself.

In Hood River County 37 per cent. of the population served is outside the city limits of Hood River; this 37 per cent. furnishes 38 per cent. of the company's supply revenue; it is a safe assumption that when 50 per cent. of the population served is outside the city limits, over 50 per cent. of the gross revenue will come from rural business, because such consumers use more electricity than town consumers.

On the other hand, this 37 per cent. of business uses 51 per cent. of the operating expense; furnishes only 10 per cent. of the revenue from operation, and about one-third of 1 per cent. of the net operating income.

Each class of business is made to stand its own depreciation, operating expense, production expense, and taxes; but were it not for the 37 per cent. of rural business, the city business would have to be increased materially.

The Oregon Commission, realising this, decreased the rural rates and increased the city rate; and if the theory is sound, rural business may be justified, even at an apparent loss. The limiting factor is the quantity of rural business which a given city business can support; any low-priced business can be taken on which can be handled without actually increasing the rate on the original business.

Analysis shows that in the company's rural business 38 per cent. of the gross revenue uses 47 per cent. of the total investment, or 9 per cent. more than its normal share, which carries taxes, interest, and depreciation, so that the excess reacts doubly against the net profits from the business. The problem is how to overcome this handicap; the solution is the adoption of new standards of construction—to which this business is particularly adapted.

Something has been done in this direction. Distributing lines of solid copper are in satisfactory use with 250-ft. spans; possibly copper-clad steel or other combination of metals may increase the span and lower the cost. Steel and reinforced concrete poles may solve the support problem, pole maintenance being high where pole investment is large. Insulated copper is entirely out of place for rural construction.

It has not yet been established what voltage is best adapted as a standard for rural work, nor which scheme of transformer connection is the best to adopt as a standard. Use is made of 110 volts for all single-phase circuits and 220 volts for most polyphase purposes; this offers the most flexibility of any scheme of secondary voltages. In the primary side delta-connected 3-wire, 6,600-volt and 2,200-volt systems are used. There is much to be said in favour of 4,000-volt or 11,000-volt star-connected grounded neutral primary circuit for rural work. It has the advantage of fewer necessary grounds, thereby lower grounding cost, and a further advantage of cutting out the circuit entirely by an automatic switch in case any of the three wires should be grounded, whereas the delta-connected 3-wire primary will sometimes operate with one wire down, at a great danger to pedestrians and traffic. It has the additional advantage of placing the ground on the high voltage side, and by grounding the secondary also the customer is rendered doubly safe. It gives an increase in voltage, hence lower copper cost, using the same transformers. A single wire can be run to handle single-phase distribution transformers, using the earth as a ground return. This has in some cases proved satisfactory. A plan which has saved considerable first cost has been the banking of transformers in multiple on both primary and secondary sides.

One of the greatest problems which must be solved by the manufacturers is the securing of a low-cost transformer. At present strictly domestic rural business is practically prohibited by transformer cost. Efficiency must be sacrificed in favour of first cost, and beauty of design and portability can also be sacrificed. It is possible that a transformer without oil, and with a tank made of sheet metal with ventilating outlets, can be designed to hang from a cross-arm with the leads brought out at the bottom without bushings, which will meet these requirements at half the present cost.

Up to this time the regulatory bodies have prescribed the same voltage variations for rural as for city business, and central stations have worked to these standards, but it is obvious that a greater range of variation will give a corresponding decrease in first cost, and this decrease will enable many customers to secure service which suppliers cannot afford to take on now.

The combination of electric supply and telephone lines on the same poles is another possible solution of part of this first cost item; a number of consumers could be profitably reached with the joint service, who cannot be reached by either service singly.

At Hood River over 50 per cent. of the consumers use motor-driven apple graders; about 20 per cent. use electric pumps. The average farm circuit has 35 outlets; some have 100; in some cases small street lighting systems are used.

By analysis it is found that the stock-raiser, dairyman, and mixed farmer give a better revenue than the apple grower. There is less labour which can be performed by electricity in the apple industry than in the others.

Rural business follows rather proportionally to acreage than population; one farmer using nine different farm machines—including a saw, thrashing outfit, cream separator, churn, cider mill, and hay-handling plant—drives them by a 15-H.P. motor; he guarantees the supply company $35 per month revenue, and frequently pays up to $75; he further states that his installation saves him $150 a month the year round.

The application of electricity to farm machinery is a field which has barely been touched. In the orchards of the principal fruit sections are thousands of spray machines driven by gasoline engines. Anyone going through a modern dairy farm will find a dozen uses for electricity. But this field will be developed rapidly when the power is made available.

The systems of rates adopted for city business have up to this time been applied to rural business, but the attempt to modify these to suit rural conditions has emphasised the need of revised methods of selling rural electricity. No doubt the eventual system for rural work will be flat rates based on maximum demand or demand control, but before this can be brought about to any great extent further investigation must be made into the business already developed.

The engineer must apply his energy to the problems of rural distribution before any great portion of the enormous revenue available can be secured.

The demand for electricity in the rural districts will be greater from year to year, and the means of distribution must be standardised, and we should profit by past experience and standardise before we secure the business, rather than doing it after much money has been spent in working along lines which are not permanent; and on the standards so adapted depends almost entirely the amount of business which a rural district will furnish.

PRINCIPLES INVOLVED IN COMPUTING THE DEPRECIATION OF PLANT.

By F. GILL and W. W. COOK, Members I.E.E.

This paper, of which an abstract was concluded in our last issue, was read and discussed in London on January 11th.

In opening the discussion, Sir Alex. Kennedy said the paper threw a great deal of light on what many of them would have to concern themselves with in 1931. Dealing with works in existence, much the most important question was what was the depreciated value of plant which had been used and had to be sold. Many electricity supply undertakings had to be sold compulsorily at a certain date, and the paper was especially useful in this connection. Depreciation was usually based on the straight line or one of the other methods shown, and he doubted whether it was possible to prove one method better than another provided the required result was obtained. If this was so, he did not suppose the system would be altered. But the second question was a matter of moment, and he believed the correct method was that advocated by the authors. The only previous examples of purchase had been tramway undertakings, in which the straight-line method had always been adopted, and the paper proved how unfair this was to the seller. It had no scientific basis whatever, and, as applied to purchase, he could not see that it had any justification. The authors' tables showed that successive purchasers paid much less by it than by the sinking-fund method. He asked what the authors meant by "life" of plant; to give it a period meant something that was going to be used, and if excessive use beyond the normal occurred the life would naturally become shorter, and this affected the depreciation allowance and income-tax, which was a point to be looked into nowadays.

Mr. J. S. Highfield said it was impossible to deal with the whole paper; he had always found that accountants disliked the slide rule and logarithms, as they didn't get their result in halfpennies. The engineer thought of the plant, while the accountant was more interested in the efficiency of the sovereign. The object of any business was to benefit the persons whom it was intended to supply, then to earn a profit. Every sound engineering business applied a sinking fund of its own to keep up the efficiency of the sovereign. The money was invested in some other business usually involving engineering, where a second fund was provided to meet the inadequacy of the other. Under the heading of renewals, he would class (1) day-to-day repairs, (2) extraordinary repairs, and (3) very long interval repairs. Improvements should also be classified under three headings: (1) Provision of better plant to improve the profit, for which a good balance should be set aside; (2) a sum should be provided to enable larger plant to take the place of existing old plant—as regarded this, it might be noted that the accountant often objected to the scrapping of old plant because it destroyed an asset; and (3) competition might force a reduction in prices, to meet which a fund should be accumulated out of profits and treated as an insurance. It was necessary that growth should take place, and fatal to stand still; extensions had to be provided for, and a sound cash position was necessary, the money being invested outside the business concerned. So far as could be judged, the transfer of an undertaking inevitably meant loss to both parties and to the public.

Mr. J. Swinburne mentioned having experienced some difficulty in grasping the relative values of the straight-line and sinking-fund methods of depreciation; in such a case it was a good plan to explain the case to others. This he did, taking a hypothetical case with a view to showing (if we understood him aright) that there was no real difference, if due credit was given for interest earned by the renewals fund, which was employed elsewhere in the business in the straight-line method.

Mr. J. E. Kingsbury said the importance of depreciation was generally recognised, but enterprises were suffering from the need of a wider knowledge of its application. He asked why, if there was an accurate method of depreciating assets, they should not adopt it?

Mr. E. S. Byng asked how they were to determine physical lives of plant, especially in the case of new types of plant. The division of the depreciation charge under two headings was interesting; he agreed that no ordinary crude method would enable them to obtain reliable figures.

Mr. Lawrence said it was obvious that any common-sense method of providing sinking fund would provide some return profit; this the straight-line method failed to do.

Mr. W. R. Cooper said he was afraid that some people after reading the paper would be inclined to run on too hard and fast lines. He felt that so many factors were involved that it would only be possible to obtain an accurate estimate of depreciation by some form of valuation, and this was the opinion of leading American engineering authorities.

Mr. E. K. Scott thought the common-sense man would work on the straight-line plan, because it was so easy. In practice, the purchaser wanted a curve under the line, and the seller wished for one above it, and mutual adjustment left them near the straight line. He suggested that interest might well be invested in a concern which was closely allied; in the case of an electricity undertaking, say, in a colliery. Many useless assets were preserved by accountants, which were actually costing money to keep.

Mr. Cook, in replying briefly, said the authors regretted that the advocates of the straight-line method had not put in an appearance; he disagreed that the straight-line system was so easy to figure if, say, 19 years was chosen as the period instead of 20. It was not quite clear what was meant by day-to-day repairs, and he thought it was probably better to invest the sinking fund in the business itself, rather than outside.

Discussion at Birmingham.

The paper was discussed by the Birmingham Local Section on Wednesday, January 17th.

Mr. Henry M. Sayers said that it might seem to some a little strange that the authors had put together the return on capital and depreciation provision. This was, however, a correct view. The plant from the accountant's standpoint was a debtor to the proprietor or contributor under two heads. The first was that of return on capital, *i.e.*, profits, whether dividends or interest; the second was that of return of capital in such measure as to maintain the value of the undertaking by adequate renewal, or reduction of capital liability. There was some difficulty in calculating the economic life of plant. It required something of the prophetic instinct, since it involved an estimate or forecast of future developments in the art. The sinking-fund method of accumulating renewals and improvements funds, as advocated by the authors, was undoubtedly the sound and equitable one, and was the one which he had always adopted in calculations. The proof of its equity as between successive owners (or successive periods) was ingenious and convincing. With reference to the distinction between maintenance and renewals, there seemed to be no dividing line in principle. It was, however, convenient as equalising charges in successive periods to draw the line at the life corresponding to the accounting period, whether one year or any other period was adopted. Then renewals of any portions of the plant having a life period not exceeding the accounting period were charged as maintenance, while those of longer life were provided for from the renewal fund. This avoided anomalous differences between the periodic accounts, which, as the authors pointed out, were objectionable and, possibly, inequitable. The absence of the word "obsolescence" from the paper was an additional reason for thanking the authors.

Mr. T. Plummer said the paper had apparently been written to show the superiority and greater accuracy of the sinking-fund over the straight-line method of computing the depreciation allowance for plant, and the authors had made out an exceedingly strong case for the employment of sinking fund calculations in the preparation of ordinary commercial accounts. Mr. Gill had, however, mentioned in his introductory remarks that the paper was not intended to relate to the accounts prepared by municipalities working on borrowed money, and possibly the same applied to a concern run by the State, such as the telegraph and telephone systems. Anyhow, for the purpose of "considering the financial results of the working by the State of the telephone system of the country," the Postmaster-General appointed, in 1913, a strong committee of accounting, actuarial, and engineering experts, and, in preparing the statement of accounts for presentation to Parliament, they assessed "depreciation on the basis of the estimated effective life of the plant." The method followed was on the straight-line basis of equal annual instalments on an equated life of plant of 20 years (as estimated by the Engineer-in-Chief of the Post Office), due regard being paid to residual values. No doubt this decision was arrived at, as against the sinking-fund method, to conform with the usual practice of annual accounting for Government Departments, each year's votes being entirely independent, and to fit in with the system of Parliamentary control. Referring to the "constant maintenance cost" section of the paper, it was not his experience that the maintenance cost of telegraph and telephone plant was constant throughout its life. In the case of line plant, the maintenance cost was at a minimum for the first few years, then, as time went on, arms required straightening and wedging; wires got slack and had to be regulated; insulators, binders, and stays got loose, and had to be tightened up, all this having no connection with mere renewals in the sense of plant replacement. Again, a switchboard multiple gave comparatively little trouble when new, but when it approached the end of its effective life, the jacks got worn, and further troubles arose in the removal of faults in a large multiple field, which considerably added to the maintenance cost.

Coun. E. C. R. Marks said the authors had demonstrated the advantages of the sinking-fund method of providing for depreciation of plant. The particular method adopted was not, however, of such prime importance as the need for making the provision adequate. Engineers, like other people, were in danger of overlooking the needs of to-morrow in their anxieties for to-day. If they could keep the concern running now they were apt to pay too little attention to the avoidance of a funeral for their successors. Engineers were well acquainted with the principle of the indestructibility of energy and of matter. They could never command the confidence of those who financed their undertakings unless they recognised the theory of the indestructibility of capital, and made due provision for wasting assets. It was not always easy to estimate the physical life of a plant. It was always difficult to estimate its economic life, but it was the engineers' duty to do it, just as it was the duty of the medical adviser of an insurance company to estimate the life of an applicant for a life insurance or an annuity policy. When he had done so, the actuaries, accountants, and the like would soon fix up the annual premium required. That was not the doctor's job. Neither was it the engineer's job to settle just how the money set aside to maintain capital intact was to be dealt with. He had quite enough to do to keep his own end up.

Mr. F. J. Moffett said, in the section headed "Constant Maintenance Cost," it was stated that the renewal of each part, as it was required in turn, was provided for by the fund established on the basis of the equated physical life. It was therefore clear that an equated life, arranged for all the plant, provided money for the renewal of every part. He would be glad to know whether the authors proposed that a physical life should be fixed for every component part of an individual machine, and that from these separate physical lives, an equated life for the whole machine should be arrived at in order to calculate the renewals fund. In the case of a D.C. generator this would mean fixing physical lives for each item, such as armature core, pole pieces, yoke, armature winding, field winding, commutator, shaft, bearings, and brushes. If this system were adopted in the case of every machine, the process of calculating the equated life for each machine would be somewhat elaborate, and the allocation of the proportion of the renewal fund due for the renewal of each part as it failed would be a very complicated matter for the management of the firm or their accountants. It appeared to him that a much simpler and more satisfactory arrangement would be that the renewal of all parts, such as brushes, bearings, &c., which wear out in a relatively short period, should be charged to maintenance. It would be a comparatively easy matter to estimate the annual cost of such renewals and add this amount to the ordinary maintenance cost.

Dr. C. C. Garrard said this paper brought home the necessity in modern times of accurate cost-keeping. It was rather surprising to find, even among business men, a very vague idea as to what an engineering or manufacturing cost was. It was very often confounded with an estimate, and was regarded as a variable quantity which could be altered at will, depending upon the method of calculation used. This view was, however, entirely wrong. The cost which had been incurred in making a certain article, or in carrying out a certain operation, was a fixed and unalterable amount. The cost which would be incurred in repeating the work might well be different; once a job, however, was completed, its cost for that occasion was fixed. It might be difficult to find out what the actual cost was, but the value, although unknown, was essentially a fixed quantity. All proper systems of keeping costs aimed at arriving as nearly as possible at the correct figure. This question of cost-keeping was as important in a manufacturing works as it was in an electric supply station or telephone system. A works which had not a proper cost-keeping system as a basis for its official accounts was in the same position as that of a retail shopkeeper who did not know what he had given for his stock.

Discussion at Edinburgh.

The paper was discussed by the Scottish Local Section, at Edinburgh, on January 16th.

Mr. F. A. Newington (Edinburgh) differed from the authors in their definition of renewals. Whether they took wear and tear renewal or total renewal, it seemed to him something which had to be renewed either partially or wholly, and to talk about renewals which were really ordinary items of maintenance was not right. The term renewals should be reserved for the larger parts only. The manner in which municipal undertakings had to pay off their indebtedness was laid down very definitely in the Electric Lighting Acts. There was nothing about renewal or depreciation funds. They were allowed to provide for a reserve fund, and had to pay off the indebtedness by means of a sinking fund in a certain number of years, the interest payable being gradually reduced in ratio with the reduction of the capital originally borrowed. He had hoped that the authors might have devised some scheme by which, instead of payments decreasing annually, as many of them did, the payments should be less in the early days of the undertaking, when it was not earning full revenue

Bailie M'Callum (convener of the Greenock T.C. Electricity Committee) explained that he disagreed with the authors, and also his Town Chamberlain, that the straight-line method was not the proper system for computing depreciation on municipal undertakings.

Mr. W. W. Lackie (Glasgow), in the course of a communication, pointed out that the question of depreciation and its relation to sinking fund was one that still remained undecided. Depreciation of value was met by a sum set aside for sinking fund, if such sum was properly calculated at the probable life of the plant. That was what Messrs. Gill and Cook called physical life. Decreased efficiency should be met by depreciation if the ordinary maintenance chargeable to revenue was not sufficient to keep the plant in its first state of efficiency. Obsolescence did not mean, and did not involve, true depreciation, but it was quite possible that a spending authority owning works might look to the advantage which would be gained by installing new plant, and so getting greater efficiency than could be obtained from antiquated plant. Such an authority would annually set aside a sum for this purpose, and might be found dispensing with old plant in favour of more up-to-date plant, even although the former might not have reached the end of its useful life. It was not legal to create a deficit by setting aside a sum either in the name of depreciation or as a reserve fund. Only such sums as were profit were available for this purpose. The Court of Session in 1880 held that the deduction for wear and tear to be made under the Customs and Inland Revenue Act, 1878, was a deduction for diminished value as a means of earning income, and not as an available asset, and that inasmuch as the plant in question was undiminished in value for the purpose of earning income, no deduction from income-tax charge could be made beyond repairs already allowed for. He considered that there was really no principle involved in computing the depreciation of plant. The examples worked out in the paper were based on a 19 years' life, and he gave the following experience of what had happened in the principal power station in Glasgow recently. Ten years ago a 1,500-kw. generator and condensing plant were bought for £16,000. Depreciation had been written off this plant only, and it now stood in the books at £7,000, *i.e.*, they had written off £9,000 in 10 years. It was proposed to scrap this plant, and put down in its place a 6,000-kw. turbo-alternator costing £28,000. The new plant would save them £20,000 per annum in coal, and would pay for itself in 18 months, or the proportion of the 6,000-kw. set that the 1,500-kw. set represented would be paid in a year. So long as the plant was kept in first-rate condition out of revenue, and one was prepared to write off the difference between what the plant stood at in the books and what it would fetch if sold, the rate of depreciation might be so small as to be met by sinking fund. He argued that no fixed rate of depreciation should be agreed upon over a period of 20 years in an engineering works. One might have a very slack year, when the plant was only used for, say, the equivalent of 2,000 hours per annum, and in a subsequent year the same plant might be run for 6,000 hours per annum. The rate of depreciation would be quite different. In the early days of electricity supply for lighting purposes, they thought that a depreciation of 5 per cent. was liberal; but to-day, with new plant which was run practically continuously, a depreciation of 10 per cent. was required.

Mr. R. B. M'Call (Treasurer, Glasgow T.C. Electricity Department) could not assent to the statement of the authors that a general agreement on this subject was possible, and did not believe that the straight-line method condemned by the authors was so inequitable as alleged. Neither did he agree with the statement that the matter was largely one of fact. While it was true that depreciation of plant was a fact, the period of years in which total loss would occur was unknown, and therein lay the first difficulty in coming to an ordinary agreement. Depreciation was a premium of insurance, and all prudent people could do was to make a reasonable provision for the inevitable, but undateable, casualty by setting aside annually or otherwise a sum towards the probable date when the plant would be done, and new plant would have to be provided. He gave instances where plant had existed for 80 years, much beyond its estimated life; and also a case of a patent which, while quite good at the time, was superseded almost immediately by a cheaper method of producing the article which was the subject of the patent. He thought the authors had wrongly obtruded certain factors into the question, such as the annual return of plant and maintenance, neither of which had to do with the question. If these were eliminated the subject became much simplified, and on the assumption that an annual instalment should be put aside for renewal of plant, all that remained was—should this sum be on the straight-line method or on the annuity or sinking-fund method? He came to the conclusion that the straight-line method was as beneficial to the undertaking on the whole as any other method, because it called for an equal sum each year (not a decreasing sum, as alleged by the authors), and that being so, it was just as equitable as the sinking-fund method, which required more book-keeping, or the annuity method, which required a certain amount of actuarial calculation. He challenged the authors' tables as being based on a wrong hypothesis, and that, therefore, the conclusions come to were wrong. He thought there was no difficulty either in the cases where there were three units of plant each of the same value, but all different lives, nor where the items were of different values; it was only a matter of simple calculation. Where the physical and economical life (obsolescence) entered into the calculation, the economic life, being the shorter of the two, must be the life on which calculations for depreciation should be founded, and that it was not possible to give an equation for the physical life and the economic life of the same unit of plant, although it was quite possible to equate the physical life of one class of plant and the economic life of another class. As to depreciation reserves invested in the business, he held that the result to the undertaking was the same whether they borrowed £100 and continued to pay interest on it while receiving interest on £5 of a depreciation fund set aside, or repayed the loan to the extent of £5, and payed interest on £95. In both cases the interest was paid on a net sum of £95.

Mr. Gill briefly replied.

INDUSTRIAL RESEARCH.

At a meeting of the Newcastle-on-Tyne Local Section of the Institution of Electrical Engineers, on January 22nd, Mr. A. P. M. Fleming delivered an address on "Industrial Research, with special reference to American Research Activities." Mr. Fleming said that during the past two years most of the industries of the country had been put on a war footing, sooner or later, and soon, it was hoped, a readjustment would have to be made to put them on a peace footing. That readjustment involved a number of serious problems, and amongst them would be the re-arrangement of every manufacturing facility on the most efficient and productive lines. This would be necessary, in the first place, to make up for some of the wealth depleted by the war, and also it was necessary to carry out reforms that were needed before the war, and which would be still more urgently needed after the war in order to place them in a position to compete favourably in international markets. The two great assets they had to draw upon were the natural and mineral wealth of the country, and the vast store of mental and physical capacity of the community. Education and research were the two channels by which that treasury might be tapped. Broadly speaking, research meant nothing but the acquisition and application of new knowledge, and it was indisputable that industrial progress depended on the acquisition and application of new knowledge. In engineering, more than in most industries, the importance of research was paramount; especially was that the case with electrical engineering, the progress of which from the time of the birth of the dynamo had been dependent entirely on scientific investigation and application. For instance, he mentioned that the present state of electrical illumination and wireless communication had been the result of the solution of far-reaching problems in physics. While in engineering they acknowledged the importance of research, and engineers appreciated the need of research, it did not, he thought, so appeal to the whole community, and yet the whole community was affected by research. Thus, to the manufacturer it was of the utmost importance. Perhaps its greatest field for usefulness lay in the development of new and improved materials. Another important field was the development of processes for cheapening production. An important phase was that of researches leading to the development of entirely new products, in which priority of manufacture could be secured and maintained. In the past we had sometimes achieved this priority, but had not retained it. The importance of securing and maintaining priority need not be enlarged upon, and in this connection it might be noted that we had far too restricted a vision as to the possible creation of markets, and confined our attention to markets that already existed. To the worker, too, research was of considerable importance, and he suggested that research might be used as a sort of industrial flywheel in those changes from good to bad trade. To the financier research was of importance, inasmuch as it opened to him new fields for the profitable employment of capital. In consideration of the educationist's point of view, the latter was interested in research work, for it would involve increasing demands upon him for the training of men for all classes of work. Referring to international research, the speaker said that prior to the war great strides had been made in Germany in research work, and it was likely that considerable progress had been made during the war; and it was well to remember that, whatever financial burden might be placed on Germany after the war, she would still retain her organising, scientific, and industrial capacity. In the Far East the Japanese Imperial Treasury had devoted considerable sums recently to research, and some industrial competition might be expected from this quarter when the cheap labour and industrial aptitude were taken into account. In the United States much progress had been made in research in recent years. The prosperity of that country resulting from the war had still further enhanced her capacity in this direction, and, despite some handicap from abnormally inflated wages, America would be a most important competitor for the world's markets. The lecturer then showed a number of highly interesting slides illustrative of the importance that was attached to research work in the States. In conclusion, he said that in the organisation of British industrial research, consideration must be given to the character of our markets, and where international markets had to be considered, it was essential that research facilities should be organised for the benefit of the whole industry. Whatever national plans might be developed in this country, it was desirable that they should include provision for co-operation with research activities in other parts of the Empire, so that by this means we might present a united scientific front to the world in support of our industries, not less formidable, and not less effective than that shown in military matters during the present conflict.

The Chairman (Mr. H. W. Clothier) said he thought, in view of what America had done in research, we were fortunate in being able to produce things, and good things, in this country, although we had not had any of the organised research work such as Mr. Fleming had mentioned.

Mr. F. O. Hunt said he thought it spoke well for the brain-power of our people that we had been able to hold up our heads, and he thought that the individual tendency of the British was one of our great assets, one which, in our efforts to organise, we ought to look carefully after that it should not be sacrificed. He referred to the magnitude of the research schemes in the States, and said that working it out very roughly, it came to something like £1,000 per man per year for upkeep. That was a kind of figure that rather staggered the imagination of those who knew how research work was treated in this country. The hostility of the workers to inventions was a matter of history, too, and he thought there was a great opportunity, if only we had an elementary education system worthy the name, of broadening the views of the people in this matter. As to the financial element, he did not think that financiers recognised the possibilities of research work at all. One thing that had struck him very much was the apparent willingness of the authorities in the States to impart knowledge. Here it was well known how jealous firms were of their secrets. The fault of many manufacturers here was that they did not take a long enough view.

Mr. **Turnbull** referred to the manufacture of tungsten lamps, and said that the Germans when they introduced them declared that no one should know the secret of their make, but, by our patent laws, they had been compelled to establish a factory here before they could get a patent.

Mr. A. P. **Pyne** also referred to the German side of the question, and said they must not overlook the fact that a great amount of research work had been done in that country, quite equal to that carried on in America.

Dr. **Thornton** suggested that something of the British position was, perhaps, due to a want of encouragement of research work, and he contrasted the position here with that in the States. An illustration he mentioned was that at Armstrong College, there was this year a grant to his department for apparatus, including repairs and new instruments for research, of £18 per annum. We had managed well enough for 100 years, but these magnificent research endowments in America were only 15 years old, and we could not hope to hold our own in the world's markets in the future unless our leaders of industry realised the extremely efficient competition now being organised.

Mr. **Fleming**, replying to the discussion, said that while he admitted the great value of the individuality of the British, they must realise that research work to be really effective could best be carried out on a large scale, and as individual works were not yet able to bear the cost of a big-scale under taking, he thought it was necessary to modify their views, and adopt some change that would secure the benefits of co-operation, and minimise in every way the loss of individuality. He admitted that the capitalist had much to learn, for he did not realise the importance of the work in question.

THE WORK OF THE B.E.A.M.A.

[The Annual Report.]

The report of the Council of the British Electrical and Allied Manufacturers' Association for the year 1916 has just been issued.

After referring to the anxiety of the electrical and allied industries to place their best service at the disposal of the Empire in supporting its determination to see the way through to victory, the Council states that a present anxiety is in regard to the export trade, the development of which has been considerably hampered by abnormal manufacturing conditions created by the necessities of war.

Practically all the works of members are "controlled," *i.e.*, engaged mainly or exclusively on the manufacture of munitions of war; and it has not been possible to supply the demands of established overseas trade connections, a considerable volume of trade in our Overseas Dominions as well as in neutral markets being diverted into the hands of American, Japanese, and other competing manufacturers. It is believed this lost ground will be speedily regained when British manufacturers are again in a position to re-enter it, and the Empire's purchasers realise what home producers have sacrificed in the common cause.

Meanwhile, the Overseas Committee of the Council in India, South Africa, and Australia continue to use every endeavour to foster in their respective territories those co-operative principles which have been beneficial at home. The Australia Overseas Committee has been successful not only in drawing up general conditions of contract for electrical and engineering work, but in obtaining for them the official approval of the Electrical Association of Australia. As that Association comprises in its membership many of the important buying engineers in the Commonwealth, including the engineers of Government departments and municipalities, there is little doubt that the conditions will in time become the recognised standard for all public contracts. They have already been adopted by several important public bodies.

Progress is being made in the same direction in India and South Africa.

An energetic Overseas Committee, recently formed in Buenos Aires (Argentina), keeps in touch with representatives in Rio de Janeiro (Brazil), where, it is hoped, a separate Committee may soon be formed.

A small Committee has also just been formed in Moscow (Russia), from which useful work is anticipated. The experience gained with the Overseas Committees has shown the desirability of broadening the basis of their constitution, and steps are being taken to enlarge their scope and to make it possible to establish committees in other countries. In addition, useful reports have been received (and circulated to members) from correspondents in Rio de Janeiro (Brazil), Rosario (Argentina), China, France, various parts of Australia and South Africa, &c.

The Council has decided to publish special editions of the *Journal* in the Russian, Spanish, and Portuguese languages, provided adequate advertising support is received from members. It is believed that these issues will be of great assistance in promoting the interest of members in Continental and South American markets.

The Council has issued in handy form a set of British export standardisation rules for electrical machinery and transformers (excluding traction motors). The text of these has been settled as far as possible in accordance with present international standards and after agreement with the sections of the Association mainly interested. It is believed that these rules will, if energetically circulated, tend to displace those issued by other countries for use abroad. Translations into French, Spanish, Italian, Russian, and Portuguese will shortly be available. Members can obtain from the Secretary, at a nominal charge, editions in English or any of these languages bearing their own imprint, for circulation to their foreign agent and customers.

The Association is frequently approached by various Government Departments for information. Members of the Council have discussed with the Foreign Trade Department matters surrounding overseas trade, and the latter department from time to time furnishes advance information of use to members which is duly circulated.

Under direction of the Association's Trade Committee, formed at the end of 1915, propaganda work was undertaken with the object of impressing on public opinion at home the indispensability of a powerful and prosperous engineering industry, both in war and peace.

It may fairly be claimed that if there is by this time general enlightenment on this question, the work of the Trade Committee had some useful share in arousing public interest, and the points which it endeavoured to bring out with prominence are to-day widely understood and appreciated.

On behalf of the Committee, Mr. T. C. Elder delivered lectures before large audiences in Birmingham, Manchester, Glasgow, Newcastle, Liverpool, and Nottingham, and organised a successful meeting at the Mansion House.

At the same time a large number of pictorial leaflets and reprinted reports of the meetings has been distributed, the total publicity effect of which cannot be precisely estimated. The Committee has, however, reason to believe that the mission thus undertaken by the electrical and allied industries has been warmly approved by other branches of engineering. The expenses of the propaganda work were met by sectional contributions.

The Council appointed certain of its members to appear and give evidence before the Committee appointed by the Board of Trade "to consider the position of the electrical trades after the war, with special relation to international competition." Evidence was given on the following subjects: (1) Restrictions of imports by a scientifically-devised tariff; (2) the spending of public money, raised on the security of rates and taxes, in the interests of British industry; (3) railway and shipping handicaps on British industry; (4) the need for a ministry of commerce and industry; (5) education in its relation to industry; (6) the need for standardisation, and the co-operation of Government departments with British manufacturers in this connection; (7) the abolition of legislative handicaps on the electrical and allied industries; (8) the need for the co-operation of finance and industry; and (9) amendments in the laws relating to patents, trade marks, &c. The evidence presented was well received, and the Association's witnesses were complimented by the Committee on its exhaustive character. It is understood that those specific recommendations to which the Association attach the greatest importance are likely to be adopted by the Committee and warmly commended to the Government.

The shortage of ships has necessitated the prohibition of many imports, and the prohibiting regulations fell heavily for a time on the electrical industry among others. Representations made by the Council to the proper department, showing that the import of certain insulating materials was an urgent, if temporary, necessity, resulted in the Association being granted a licence to import, for the benefit of the industry at large, those materials for which there was urgent need.

The Turbine Section of the Association has resolved to establish, at various university industrial centres throughout the kingdom, scholarships for the promotion of the practical study of steam problems, especially as related to turbine work. Similar endowments of scholarship in other branches of industry are now, or will shortly be, under consideration.

The Association's General Committee for Research, created at the invitation of the Privy Council Advisory Committee, has established working Sub-Committees to deal with the improvement of insulating materials, the corrosion of condenser tubes, special waterproof insulation for machines, magnet steel, problems of switching and arcing, turbine blading; and certain applications for grants-in-aid of research have already been lodged, while others are in preparation.

Meanwhile, the preliminary investigations, aimed at ascertaining the most urgent subject matters for further work, are being conducted.

It was hoped that certain researches could have been conducted jointly with the Institution of Electrical Engineers, but this has not so far been found practicable.

(To be concluded.)

A COMMITTEE OF PROVINCIAL ELECTRIC SUPPLY COMPANIES.

A new Committee has been formed, which will be known as the Provincial Electric Supply Committee of Great Britain, with the principal object of providing a central and representative body to afford a ready means of co-operation in protecting and furthering the financial, commercial, and legislative interests of provincial electric supply companies working under provisional orders. The following are members of the Executive Committee, the Committee being limited to directors only :—

H. B. Renwick (chairman), Bournemouth and Poole Electricity Supply Co., Ltd., and other provincial companies.

Sir J. S. Harmood Banner, M.P., Midland Electric Corporation for Power Distribution, Ltd.

F. E. Gripper, Edmundson's Electricity Corporation, Ltd.

G. W. Spencer Hawes, Reading Electric Supply Co., Ltd., and other provincial companies.

J. Atkinson Hosker, County of Dorset Electric Supply Co., Ltd., and other provincial companies.

W. L. Madgen, British Electrical Federation, Ltd.

Sir Henry C. Mance, Oxford Electric Co., Ltd.

R. P. Sloan, Newcastle-upon-Tyne Electric Supply Co., Ltd.

J. G. B. Stone, Electric Supply Corporation, Ltd.

J. C. Wigham, Urban Electric Supply Co., Ltd.

The Committee proposes to direct particular attention to the following matters :—

1. To organise and arrange for united action in protecting common interests as and when occasion arises, and such united action is necessary and desirable.
2. To afford the readiest means for considering such questions as rating, income-tax, assessments, excess profits tax, emergency and other legislation, rates for supply, fiscal and other matters generally affecting the companies' interests.
3. To prepare, collect, and distribute amongst the members statistics or other information of common interest, and to print and issue other literary matters for the use of members desiring to avail themselves of the facilities offered.
4. To afford facilities for intercourse between the directors of the companies represented on the Committee with a view to the consideration of any questions affecting the common interests.
5. To watch over the interests of the companies, and take any steps expedient with a view to correcting mis-statements that may appear in the public Press.
6. To assist in the compilation of official statistics and information on a uniform basis, where such is desirable, and to the benefit of the companies.
7. To appoint sub-committees to deal with any special matters arising, and generally to initiate, organise, and carry out any work having for its object the protection or furtherance of the interests of the companies.

As our readers are aware, the municipal electric supply undertakings, both in London and the provinces, already have their Associations, while the electric supply companies in London are also similarly represented by a committee, as are likewise the power companies of the country. By means of this new Committee the electric supply companies in the provinces, who up to the present have had no representative organisation, will be provided for. That there is need for some such organisation will be obvious when it is borne in mind that many of the provincial companies are small, and have neither money for organisation nor facilities for taking the proper steps to further or protect their interests on any broad legislative or fiscal lines, and they are scattered about in all parts of the United Kingdom. They will now have the means for co-operating through a central representative body. It is appropriate, in this connection, to recall the successful co-operation of the provincial companies in regard to excess profits.

Mr. H. B. Renwick organised the appeal on behalf of the industry, and, in view of the general feeling expressed that a representative organisation should be formed at once, he took the matter up with a view to the formation of a permanent central body. The outcome is this new Committee.

Such an organisation should be of benefit to the small isolated companies. It will be useful to deal with new problems which may arise in times like the present, and to watch over the interests of the electric supply companies if they are affected by further Finance Acts or similar legislation. We understand that the main objects of the Committee will relate to financial, commercial, and legislative work, and the executive committee have been appointed for their experience and ability in this direction.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Published expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

713. "Electric lamps for motor vehicles, &c." C. F. L. King. January 15th.

720. "Electric illuminated rudder indicator." J. Carson. January 15th.

732. "Galvanic batteries." E. A. Ashcroft. January 15th.

740. "Automatic telephone systems." B. B. Johnson & Relay Automatic Telephone Co. January 15th.

749. "Phase transformation of electric currents, and transformers therefor." British Electric Transformer Co. & R. Crosbie-Hill. January 15th.

752. "Electro-magnetic signalling apparatus." G. Henderson. January 15th. (U.S.A.) January 13th, 1916.

767. "Electrically-illuminated indicators for personal wear." C. Hartley. January 16th.

773. "Commutators and collecting rings." W. McLoughlin. January 16th

788. "Carbon holders of electric arc lamps." W. L. Humphries. January 16th.

802. "Cord-grips for lamp wires." C G. M. Bennett. January 16th.

807. "Lamps or lanterns for light projectors, such as searchlights, headlights, &c." H. Scholey (Soc. Anon. des Phares et Lanternes Tub.). January 16th.

819. "Dynamo-electric machines." F. P. Fletcher & H. F. Joel. January 16th.

851. "Semi-automatic telephone exchange systems." Western Electric Co (Western Electric Co., U.S.A.). January 17th.

860. "Electric batteries." H. D. Henry. January 17th.

892. "Electro-medical apparatus." E. E. Greville. January 18th.

894. "Windings of electric motors and generators." J. S. Highfield. January 18th.

910. "Electrical keyboard transmitting apparatus and electrical signalling or advertising systems." H. K. Harris. January 18th.

930. "Auxiliary apparatus for telephones." F. C. C. V. Naeser & N. A. J. Lilliendahl-Petersen. January 18th. (Denmark, January 20th, 1916.)

931. "Electric couplings, and cases therefor." N. J. Austin & G. E. Taylor. January 18th.

934, 935. "Electro-deposition of copper." S. O. Cowper-Coles. January 18th.

936. "Process for production of copper tubes." S. O. Cowper-Coles. January 18th.

937. "Recovery of copper from weak copper sulphate solution." S. O. Cowper-Coles. January 18th.

943. "Electric motor control." A. G. Cooke. January 18th.

955. "Electric switches." K. Hohn. January 19th.

974. "Systems of electric ship propulsion." British Thomson-Houston Co. (General Electric Co., U.S.A.). January 19th.

999. "Dynamo-electric machinery." Electromotors, Ltd., E. Greenhalgh and B. Longbottom. January 20th.

1,017. "Suspender for electric cables, &c." W. T. Henley's Telegraph Works Co. & R. Povey. January 20th.

1,026. "Telephone, &c., receivers." F. Son. January 20th.

PUBLISHED SPECIFICATIONS.

1915.

13,750. Relays or Apparatus for Augmenting the Effect of Small Electric Currents. W. M. Mordey. September 27th.

18,047. Manufacture of Rigid Pieces of Metal Insulated against Electrolysis and Corrosion. P. M. Stewart. December 28th.

1916.

The numbers in brackets are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

250. Fuses for Protecting Electric Circuits. A. Schaaning & S. A. Stigant. January 6th, 1916. [102,824.]

346. Electrolytic Deposition of a Cobalt-silver Alloy. P. Marino. January 7th, 1916. [102,828.]

586. Electrical Converters and Balancers. M. Walker. January 13th, 1916. [102,836.]

1,263. Method of Ignition in Internal-combustion Pumps, Compressors, or Engines, and apparatus therefor. H. A. Humphrey & W. J. Rusdell. January 26th, 1916. [102,842.]

1,884. Process for the Manufacture of Nitrogen Compounds. Norsk Hydro-Elektrisk Kvaelstofaktieselskab. February 23rd, 1915. [100,099.]

2,283. Dynamo-electric Machines. M.L. Magneto Syndicate & E. A. Watson. February 15th, 1916. [102,845.]

2,345. Electric Heat Radiators. A. F. Berry. February 16th, 1916. [102,846.]

4,962. Electrical Driving, particularly for Motor Vehicles. H. Crochat. April 4th, 1916. [102,864.]

5,769. Signalling Systems and apparatus therefor, more particularly for use in Mines. Automatic Telephone Manufacturing Co. & H. Green. April 20th, 1916. [102,868.]

6,982. Terminal Seal for Batteries. E. W Jefferson. May 21st, 1915. [100,534.]

8,633. Alternating-current Commutator Motors. British Westinghouse Electric & Manufacturing Co. June 19th, 1915. [100,743.]

8,794. Electrical Ignition Systems for Internal-combustion Engines. C. F. Kettering & W. A. Chryst. July 16th, 1914. (Divided application on 7,758/15.) [100,747.]

9,099. Means for Controlling Electric Motors. Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.). June 28th, 1916. [102,889.]

10,745. Anodes for Electroplating. G. Jones. July 29th, 1916. (Addition to 17,328/15.) [102,897.]

11,859. Automatic Train-stopping Devices. A. L. Lyttle & C. I. Costello. December 22nd, 1915. (Divided application on 17,923/15.) [102,904.]

13,631. Attachment of Magnetos to the Power Units of Motor Cycles. G. T. B. Sangster. March 22nd, 1916. (Divided application on 4,217/16. [102,913.]

THE
ELECTRICAL REVIEW.

VOL. LXXX. FEBRUARY 9, 1917. No. 2,046.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: February 9, 1917. [No. 2,046.

Page

Fuel Economy 141
The B.E.A.M.A. Report 142
Fuse Failures (*illus.*) 143
After Four Years, by Prof. M. Smith 145
Steam Turbines for Land Purposes, by H. L. Guy (*illus.*) ... 146
Boiler-House Operation and Maintenance (*illus.*) 147
The First London Engineer Volunteers 149

Correspondence—

Variable Speed Polyphase Motors 150
Cheap Water Power 150
Federal Income Tax 150
Accuracy of Steam Flow Meters 151
Profit Sharing 151
Australian Agencies 151
Women and "Shorts" 151
Localising a Fault 151
War Items 152
Legal 153
Business Notes 155
Notes 158
City Notes 161
Stocks and Shares 162
Self-Propelled Electric Vehicles and their Applications (*illus.*) 163
High-Speed Telegraphy (*concluded*) 164
The Work of the B.E.A.M.A. (*concluded*) 166
Co-operative Export Trade (*illus.*) 166
New Electrical Devices, Fittings and Plant (*illus.*) 167
New Patents Applied for, 1917 168
Abstracts of Published Specifications 168
Contractors' Column ... ... Advertisement page xx

THE ELECTRICAL REVIEW.
Published every FRIDAY, Price 4d.
The Oldest Weekly Electrical Paper. Established 1872.
TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE 1—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.
Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.
AUCKLAND N.Z: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.
BRISBANE: Gordon & Gotch, Queen St.
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MILAN: Fratelli Treves.
NEW YORK: D. Van Nostrand, 25, Park Place.
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto 1° 307.
SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.
WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE "ELECTRICAL REVIEW'S
ELECTRICAL & ALLIED TRADES DIRECTORY
(THE RED BOOK),
1917 EDITION,
IN PREPARATION.
H. ALABASTER, GATEHOUSE & CO.,
4, Ludgate Hill, London, E.C.

FUEL ECONOMY.

In the course of an interesting, if somewhat speculative, address by Prof. Arnold Lupton to the South Wales Institute of Engineers, last year, the author estimated that, despite the enormous output of coal from the mines of the United Kingdom during the past century, we still possess no less than 97 per cent. of our original endowment, and that even after making due allowance for an increase in the annual tonnage raised in this country to a value approaching 400 million tons per annum, there is enough coal in our reserves to last for nearly 1,000 years. By that time, it is to be hoped, substitutes for coal will have been found; possibly the key to the stores of energy locked up in matter will have been discovered—Prof. Soddy in 1906 assured us that in a single ton of uranium, costing less than £1,000, there was more energy than would be supplied by all the electricity works in London working for one year, and Sir Oliver Lodge, in 1907, stated that the intrinsic energy of motion in a cubic millimetre of ether was equivalent to 1,000,000 H.P. working for 40,000,000 years—so that posterity need not be exercised in mind over the problem. Prof. Arnold Lupton also outlined other sources of energy that might—we do not say could—be utilised, such as the sun-power of the Sahara Desert, of which 10 million KW. might be transmitted to this country through an iron cable of 5,000 sq. in. cross-section at 100,000 volts, at a cost of 0.36d. per KW.-hour. for transmission, and a total cost of 0.727d. Clearly he is a man of large and optimistic, if chimerical, ideas. Unfortunately, however, we live in the present, and must make the best of the conditions under which we exist, and, even if the conservation of our fuel be of no account on the score of its duration, we must still put forth every possible effort to reduce the consumption of coal, and to utilise it to greater advantage, simply in order to economise labour and capital—in the coal mines, on the railways, and elsewhere—to enable our industries to compete effectively with our foreign rivals, and to improve the conditions of existence throughout this realm.

We turn, therefore, with pleasure to the excellent series of Howard Lectures delivered by Prof. J. S. S. Brame last November, and published in the *Journal* of the Royal Society of Arts last month. The author points out that our improvident use of coal in the past has been due largely to its cheapness. This is a factor which henceforth will be materially modified, for it cannot be anticipated that the price of coal will ever again approach the pre-war level in this country. But our very existence as a great nation depends upon cheapness of manufacture, and hence, if coal is to cost more, we must use less of it. Prof. Brame favours the imposition of a duty on exported coal, with the double object of gradually reducing the quantity exported, and raising funds for the investigation of our fuel resources and the development of methods for their more economical utilisation; an excise duty on exported coal is no new thing, and the policy suggested appears to offer obvious advantages.

It should not be forgotten that great strides have already been made in the direction of economy in recent years, very largely through the influence of electrical engineers, so far as relates to the generation of power by steam, gas, or oil, and that of gas engineers in connection with the scientific utilisation of coal, with no other spur than that of commercial exigencies—backed, it is true, by the innate craving of every true engineer to get the best out of his plant and materials. The progress achieved is recognised by Prof. Brame, who looks to the continued stimulus of sound commercial enterprise rather than to the artificial aid of legislation to produce further economies in the future, though he approves of Government action in promoting research in this and other directions, and in restricting wasteful methods of coal-getting. As regards the use of exported coal as a means of paying for our imports, an argument which may have some weight during the war, when we are drawing freely on the capital of the Empire in every possible direction, it should not be overlooked that by so doing we voluntarily degrade ourselves to the rank of "hewers of wood and drawers of water" for other nations. British work-people are admittedly capable, when trained, of attaining to the highest standards of skilled handicraft in almost any industry that is practised by white men, and are worthy of a better fate than to be the slaves of foreign craftsmen. What we should aim to export is expert workmanship and brains, not manual labour, and our priceless stores of fuel should be a means to that end, and not the end itself.

Touching upon the methods available for utilising coal to better advantage, the author refers to the growing use of coke for raising steam in boilers, and mentions that at Deptford, during a period of one month, 16 per cent. was saved in fuel costs. The increase in production of ammonium sulphate at coke ovens during recent years is of great promise, and would be greatly assisted by the gasification of coal in producers with recovery plant. The mechanical stoker enables small coal to be utilised to advantage, and affords an outlet for fuel which formerly was looked upon as rubbish, though unfortunately a great deal is still left in the pits. Indeed, the record of deliberate rejection of valuable coal, due to the low prices that have obtained in the past, is painful to contemplate. In this connection we may draw attention to the interesting results which have been obtained with fuel of very low grade in the huge power stations on the Rand, and which are described elsewhere in our pages today; under war-time conditions a great many of our power stations at home are operating with coal of equally poor quality.

Whilst he points out that at present, with steam power, we utilise only 10 per cent. of the available energy of coal, and by using gas power the percentage could be doubled, Prof. Brame recognises the superiority of the steam turbine as a prime mover; but he states that the gasification of coal for use under boilers would result in an efficiency of only 55 per cent., as compared with 80 per cent. from coal-fired boilers, and holds that it would not pay to adopt the former practice, owing to the cost of by-product recovery plant. On the other hand, the use of coke for domestic heating in improved grates would result in economy and freedom from the smoke nuisance, and he regards "low-temperature coke" as an almost ideal smokeless fuel. In industrial areas he recognises the enormous economies that can be effected by linking-up power stations, utilising waste heat from blast furnaces, &c., as on the North-East Coast, and thus he is led to advocate unification as the essence of success, though he appears to hold somewhat exaggerated views on the difficulties to be overcome. Finally, the author points out the advantages that could be derived from co-operation between gas and electricity supply undertakings, together with low-temperature carbonising concerns, particularly referring to the Metropolitan area as offering unique opportunities to such a combination.

The same subject was discussed by the Manchester Local Section of the Institution of Electrical Engineers last week, and we cordially hope that the attention which is now being devoted to the matter will bear fruit speedily and in abundance. Nearly five years ago we remarked that the trend of thought among scientists of all professions was: "(1) Burn your fuel economically; (2) Burn it centrally; and (3) Transmit by electricity. Thus the future of our industrial life rests largely with electrical engineers"—and the same holds good to-day.

The B.E.A.M.A. Report.

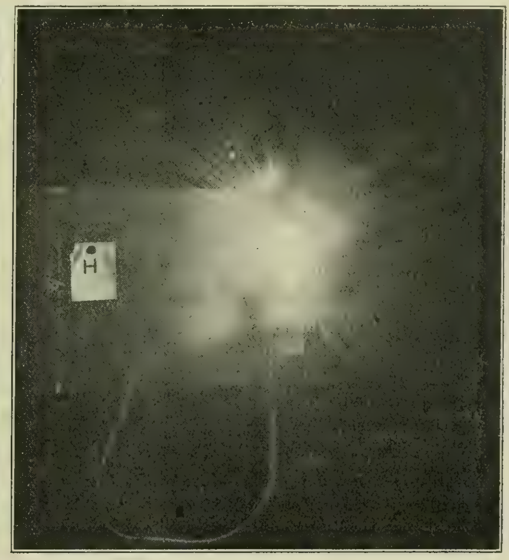
We print in this issue the concluding part of the annual report of the British Electrical and Allied Manufacturers' Association. We believe that it is the first occasion since the outbreak of war on which we have received a copy of the Association's complete report, and we welcome the return to the policy of letting the world at large know as much as can reasonably be told of B.E.A.M.A. activities. The membership of the Association three years ago—before the war—was 125, which represented an increase of 16 firms. But there have been a number of changes due to the war and other causes, and to-day the total is 144, 30 new firms enrolling and one resigning during 1916. We are pleased to note the optimism of the Council in regard to the prospects for regaining export trade which has been temporarily lost owing to overwhelming activities in our factories during the war. We believe that the reasons for that optimism are sound, provided proper measures are taken immediately to keep closely in touch with the Colonial and foreign markets, and to let them know how great is the sacrifice of the British manufacturer to the common cause. The measures of the B.E.A.M.A. in this connection are summarised in our last week's extracts from the report, and they are apparently such as to form a good wartime beginning for a policy of British electrical export trade propaganda which can hardly fail to bring large volumes of business to our industries from all parts of a world stripped of its electrical supplies. Matters of research, standardisation, the call for British equipment for Pekin University laboratories, schemes for the better organisation of all industries, the better education of the public in regard to the indispensability of our engineering industries, and many other matters, have received the attention of the Association's Committees and staff during the year. There have been conferences with Government Committees respecting trade matters, and negotiations, highly successful in their issue, concerning excess profits, while the "industrial solicitor" has apparently had a very busy time dealing with questions raised in relation to Model Conditions of Sale and Contract. Altogether, the report forms very healthy reading. The Association is now engaged upon measures for effecting domestic co-ordination, so that the efforts of all the many Sections may be concentrated where desirable in a new Sectional Committee or Board. Uniformity of policy in matters common to all Sections may thus become possible. A removal from the existing premises to larger ones, owing to the growth of the Association, has been considered, but, like many other things, it has had to be left over until after the war.

The Association is to be congratulated upon its record of a year of great activity, attended by success in many ways. The period has been one of great difficulty for normal industry, but the very difficulties of the situation have themselves afforded abundant opportunities for usefulness on the part of the organisation.

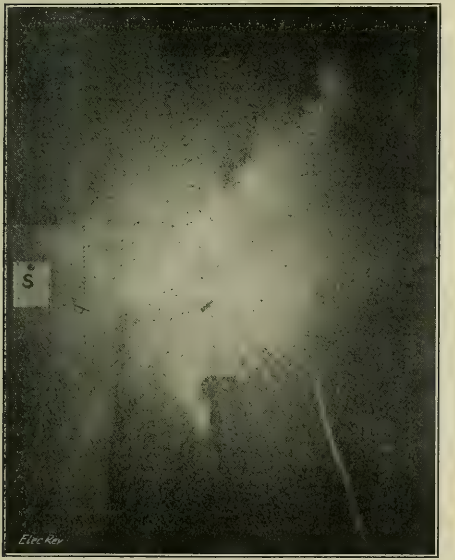
FUSE FAILURES.

Mr. S. W. Baynes, chief electrical engineer of the St. Pancras electric supply undertaking, has communicated to the Press the results of a series of interesting tests on fuses of the open type under working conditions.

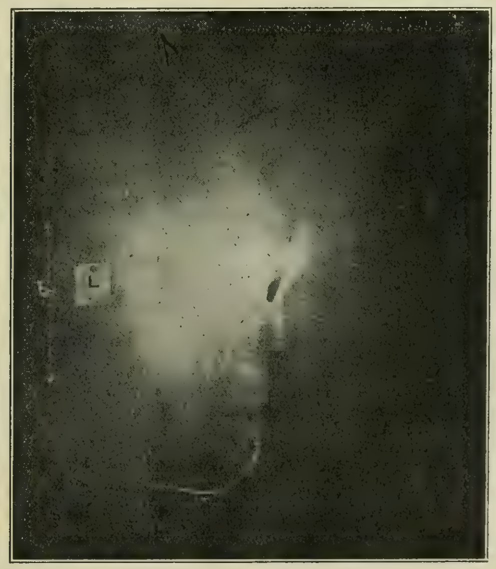
220-volt Short Circuit on 3-in. Clear Break ; 10-ampere Fuse ; Two Strands 5-ampere Lead.



220-volt Short Circuit on 4-in. Break ; 10-ampere Fuse ; Two Strands 5-ampere Lead.



440-volt Short Circuit on 3-in. Break ; 10-ampere Fuse ; Two Strands 5-ampere Lead.



440-volt Short Circuit on 4-in. Break ; 10-ampere Fuse ; Two Strands 5-ampere Lead.

The advent of large turbo-generators giving an unlimited rush of power brought to his notice many serious failures of such fuses, and it was therefore decided to experiment, with a view to ascertaining their controlling power ; a series of interesting views was obtained, some of which Mr. Baynes has kindly placed at our disposal.

With a view to securing normal working conditions, current was drawn from the St. Pancras distributing system (which is supplied in part from D.C. turbine plant), passing through a long feeder and back to the power station, where the tests were carried out, *viâ* distributing mains.

The mains system in use was as follows :—

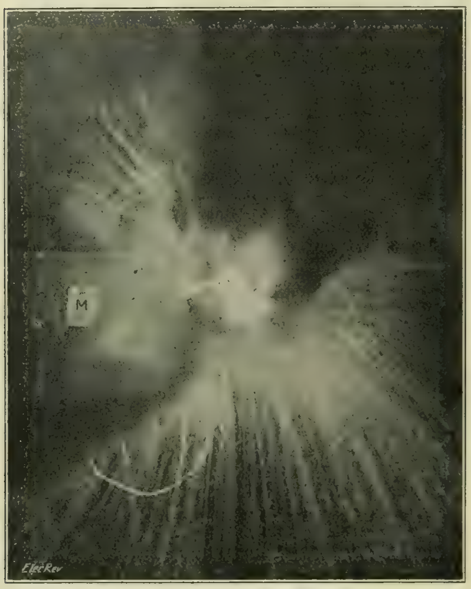
Feeder, D.C., 440 volts across outers ; 220 volts between neutral and outers ; neutral earthed at power station.

Total length of lead and return for :—

440-volt tests –3,460 yards, consisting of 1,730 of 1 sq. in. feeder, 330 of 0·2 sq. in., 1,000 of 0·25 sq. in., 400 of 0·5 sq. in. distributors, excluding length of connecting cable.

220-volt tests—1,730 yards, consisting of 865 of 1 sq. in., 165 of 0·2 sq. in., 500 of 0·25 sq. in., 200 of ·5 sq. in. distributors, excluding length of connecting cable.

The plant on load consisted of a 1,000-kw. direct-current and a 2,500-kw. three-phase turbine set, the latter supplying through two 1,000-kw. Peebles motor-converters, so that there were no transformers in circuit.



440-volt Short Circuit on 4 in. Break ; 40-ampere Fuse : Eight Strands 5-ampere Lead.

440-volt Short Circuit on 4-in. Break ; 50-ampere Fuse : Ten Strands 5-ampere Lead.

Views showing Short-circuited 10-way Distribution Board ; 440-volt Circuit ; 2⅛-in. Break : 10-ampere (Two-strand) Fuses.

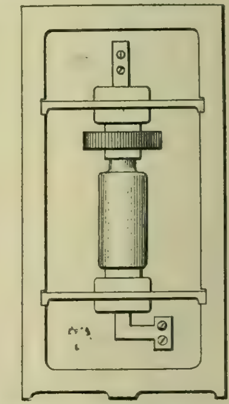


Diagram showing St. Pancras Terminal Fuse Arrangement.

The various views were taken with a 9-in. plank behind the fuses, from which the magnitude of the explosive effect can be gauged. In the case of tests M, P, and S, the arcing continued until the automatic cut-off was tripped at approximately 900, 1,000 and 1,200 amperes respectively ; in several cases this happened, or the arcing continued until the fuse terminals were demolished, and it is interesting to note the high-current densities reached even with light fuses.

A number of cartridge fuses of various makes were submitted to similar tests with results distinctly in their favour, but Mr. Baynes points out that such fuses are also open to the objection that it is easy to bridge across the short break with ordinary fuse wire instead of inserting a new cartridge, thus leading to a calamity at a later date.

He suggests that cartridge fuses should be so designed that is impossible to short-circuit them with ordinary fuse wire.

The destructive effect of the arc, particularly in the neighbourhood of earthed metal cases, has been so great that Mr. Baynes adopted stoneware boxes for the terminal fuses to consumers' supplies, and this practice is general in the St. Pancras supply area at the present time.

We show diagrammatically a single-pole fuse box of the type referred to, the box itself being of concrete from ½ in. to ¾ in. thick, with the fuse terminals carried on iron supporting pieces which slide into grooves moulded in the box. The fuse, of the Zed type, is held in position by screwing down the milled fibre nut at the top. A concrete cover with glass inspection-window is provided. Various patterns of these boxes are made and, we understand, have given complete satisfaction.

Ontario Power.—An action is now pending in the Supreme Court of Ontario for an injunction to restrain the Hydro-Electric Commission and the Attorney-General of the Province of Ontario from proceeding with the Chippewa development on the ground that in the franchises of the Canadian companies, the Government of Ontario has expressly contracted never to take water from the Niagara or Welland (Chippewa) Rivers for the generation of electrical power. Bondholders in the Electrical Development Co. of Ontario will be interested in the result.—*Financier.*

AFTER FOUR YEARS.

Reflections on Chinese Engineers.

By Prof. MIDDLETON SMITH, M.Sc.

At the end of 1916, the first graduation ceremony of the British University of Hong-Kong took place. Despite the military activities of the Colony (every man eligible is a member of the local defence forces—as far as is possible) the daily routine work continues. The highest authorities have said that it is most important to maintain and develop British trade in the Far East, so as to be prepared for the trade war after peace has been signed. Before the commencement of war in 1914, China witnessed competition between the Germans and the British. In no part of the world has competition been fiercer between the two nations than in the Far East. While our enemies used their northern base of Tsingtau, we had Hong-Kong in the south. But there were many more prosperous German merchants in the British Colony than Englishmen in Tsingtau.

In 1912, feeling ran very high among patriotic Britishers in China about the neglect of the trade interests of the Empire. It was this current of public opinion that made possible the creation of the British University in Hong-Kong. The missionary scheme for a sort of International University at Hankow, espoused by Lord William Cecil, did not appeal to commercial men. It has never crystallised, and it seems improbable that the original scheme will ever become real. What practical people in China began to ask themselves, even before the war, were questions like this: "How can we extend British trade?" and "Why don't we educate young Chinese to use British machinery?" The half a-dozen English newspapers in China grew more and more insistent upon the maintenance of British interests.

It is as well to remember these things now that a great change has come over the outlook of the people of Great Britain. Since the fatal August of 1914 everyone has been making sacrifices for the sake of the Empire. But in 1912, when an appeal on patriotic grounds was made to the engineering firms of Great Britain for equipment for the University of Hong-Kong, it met with remarkable success. That was due to the immediate and spontaneous support given by the technical and lay Press, as well as to the response made by the firms to the stimulus. For it proved that most of the British manufacturing engineers were patriotic, at least two years before the general public understood what the German menace really meant. In those days some of us were, in a good-humoured fashion, chaffed about our exaggeration of the German trade bogey. But it only needed a few months of residence in the Far East to recognise its real danger.

When the first Degree ceremony of the University of Hong-Kong took place (December 14th, 1916) there were 12 graduates in engineering who were presented to his Excellency the Chancellor; and Governor of the Colony, as "worthy of the degree of B.Sc. (Eng.) in this University." They were all Chinese. The honorary degree of LL.D. was conferred on Teme Tien Yow, China's pioneer railway engineer.

The Chancellor took the opportunity publicly to thank the British engineering firms who presented equipment and apparatus. As over 200 concerns had given a practical response to the appeal, it was obviously impossible to mention them all. The three, who had given equipment of the greatest value were named. They were the General Electric Co., Ltd. (England), Messrs. Ferranti, Ltd., and the Campbell Gas Engine Co., Ltd. His Excellency stated that British engineering firms had presented £12,000 worth of apparatus, while the shipping companies had brought it all out to the Far East freight free. But, perhaps, the most interesting statement made by his Excellency was the frank recognition of the influence of the Press, for he told us all that the idea of the University of Hong-Kong was first suggested in a local newsaper, the *China Mail*, in the year 1905. An Australian, named Donald, was at that time editor of the journal; but there is every reason to believe that he was inspired to write his now famous appeal for a British University as a result of representations made to him by Mr. W. L. Carter, manager of the local telephone company, who had seen service in the South African war and was a very definite Imperialist. Mr. Carter was present at the first graduation ceremony, in the uniform of a captain of the Royal Engineers, and he must have reflected upon the parable of the grain of mustard seed, for out of the original suggestion had grown the impressive ceremony which proved to the spectators that the first British University in China had commenced to send out graduates into the Far East, and the technical and lay Press have greatly assisted.

The Assistance of the Chinese.—One of the most remarkable things about this University is the enthusiasm and practical assistance of the Chinese for the Western learning which it represents. The President of the Republic sent from Pekin a poem in which, with the flowery expressions of his language, he wished success to the University. His Excellency, the Civil Governor of the adjacent Province of Kwangtung (it is one of the 18 provinces of China proper, and it contains 32 millions of inhabitants) journeyed 100 miles by river to be present at the ceremony. The hall was crowded with the leading Chinese, and, if the building had been large enough, thousands of others would gladly have been present. The most remarkable politician in China, Mr. Liang Shih Yi, was staying in Hong-Kong, although for years his had been the guiding hand on the ship of State in Pekin. He was present, and he will remember this centre of Western learning when he is again in power in Pekin.

The New China.—Europeans in this part of the world often complain that there is little evidence of change in the customs of the Chinese. It is true that the surface of the country is barely scratched. But there has been a real alteration in the outlook of the more influential Chinese. They all appreciate the value of what they call "Western Science." They are essentially men of commerce, and they are beginning to demand machinery, because they believe that it will enable them to make money. At present they are thinking about three distinct branches of engineering work. They want to see a great extension of railways; they wish to have electric light, and they are very keen upon exploiting the mines of their own country. There can be no doubt that during the next quarter of a century there will be a great demand for machinery for all three purposes. What worries a good many Britishers in China is the future. They read about the wonderful munition factories and the splendid works' organisation in the Old Country. Will it be possible to ensure that the machinery which China needs will come from those workshops? It can be arranged, if we have our trade organised in the same way as the supply of munitions for the war is now being planned out. It seems improbable that individual firms will be able to work alone. These new engineering organisations, which are paying so much attention to the trade aspects of applied science, will prove most powerful agents in the maintenance of British trade in China.

It would be churlish to let pass any opportunity for acknowledging the patriotism of the British Engineers' Association and the B.E.A.M.A. in connection with the work of the British in China. There is the motto: "Those who give quickly, give twice." No one can imagine the anxiety which was felt in 1912 about this problem of providing proper facilities for training young Chinese in Hong-Kong in applied science; and the Council of these two Associations at once exerted their powerful influence, when the problem was explained to them. The unforeseen has happened; for nobody in those days thought that the day would come when the Chinese would demand machinery which British workshops would be unable to supply. That is the present state of affairs. But the manufacturers of Britain will be glad enough of this Far Eastern market as soon as the present enormous demand for munitions is over. It is to be most sincerely hoped that they will take full advantage of it. Fortunately, the name of Britain stands high in the estimation of most of the Chinese.

So many readers of the Electrical Review have been interested in the efforts made to train young Chinese in Hong-Kong, that it is possible that they will learn with pleasure of the full advantage that is taken of the up-to-date facilities for instruction. After four years the roll of engineering undergraduates in the University contains over 100 names. The students come from as far South as the Straits Settlements and Bangkok, as far North as Pekin and Chile, and from inland provinces such as Yunnan and Hupeh. The President of the Chinese Republic has founded scholarships, while some of the Provincial Governments have sent students, who are maintained by the public funds.

The course of instruction in engineering takes four years to complete, but it is probable that many of the students will take five years to pass the necessary examinations in order to obtain their degree. Of the 37 who commenced in 1912, 12 graduated in 1916. As all of the instruction is in English, it is, perhaps, not surprising that it takes so much time to complete the course. Many of the students show a desire to go abroad after they have graduated, and, when conditions are again normal in the works of Great Britain, it is hoped to make arrangements for these young Chinese to spend a year or two in some of the large industrial establishments. Two of the first batch of graduates have gone to America, in order to obtain some practical experience. Every facility is given to them in that country, so that they may enter into commercial relations with the manufacturing firms of the United States while there. The object is apparent. There will always be a number of young Chinese in America, because of the terms of the Boxer indemnity. But it is also very much to be hoped that, after the war, some very definite system will be inaugurated, so that the graduates of the Hong-Kong University may go to Britain.

Chinese British Citizens.—There are some millions of Chinese in the Straits, in Borneo, in Hong-Kong, and in other places where the Union Jack flies, who are British subjects. They have all behaved in a most patriotic way during the war. The idea of the aeroplane has appealed to them, and it is significant that they have given a great deal of money for the purpose of providing these machines for the front. They have made their money because of the fair and just rule which British administration provides, and they show their appreciation of it in a practical fashion. But the cult of ancestor worship is deep-seated in the heart of every Celestial. A Chinese millionaire recently died near Singapore. His body is now lying in State in Hong-Kong, and in a few weeks will pass on to the ancestral tomb at Swatow. Many years ago he left that port as a coolie. His sons now work his tin mines, his glass factory, and his rubber plantations, and they tell their friends in China of the advantages of Western science and education. The nation which provides these will obtain the trade connections.

STEAM TURBINES FOR LAND PURPOSES.

By H. L. GUY, A.M.I.Mech.E., Assoc.M.I.C.E.

(*Abstract of paper read before the* Manchester Association of Engineers.)

Some four or five years have passed since a paper on this subject was brought before your notice. It is the intention of the author to consider some of the developments which have matured in the interval.

The broad lines can be gauged by considering the difference in the production of the turbine department of the firm with which the author is associated during the period under review, confining attention to machines over 200-kw. capacity :—

	1910.	1915.
Per cent. of No. of turbines built—		
High press.	42·5	71·3
Mix press.	38·5	13·6
Low press.	8·5	1·5
Back press.	10·5	—
Reducing press.	—	13·6
Per cent. of total full-load capacity—		
High press.	74	83·3
Mixed press....	20·6	7·52
Low press.	3·5	0·18
Back press.	1·9	—
Reducing press.	—	9
Average capacity, kw.	1,550	2,300

The total output in kilowatts for 1915 was more than double that for 1910.

The reasons for these changes in the relative importance of the various types of machines are readily found. It has now been established that a pure high-pressure turbine is more efficient than a combination of a reciprocating engine exhausting into a low-pressure, or mixed-pressure turbine, with the result that high-pressure turbines are being installed where the former types were adopted a few years ago. This represents a distinct advance in the art of turbine construction, because it was still maintained at the earlier date, and with some justification, that the reciprocating low-pressure turbine combination represented the ideal.

Another factor which in many cases operates to ensure the installation of a high-pressure rather than a mixed-pressure or low-pressure turbine, is that it is often a doubtful expedient to couple a new turbine of the latter class to an obsolete, or more or less worn-out engine, which would in any case be scrapped long before the useful life of the turbine had expired.

There are, of course, certain types of modern plant at present driven by reciprocating engines which must be of the non-condensing type, such as rolling-mill or winding engines, and until these machines are electrically driven there will be a suitable field for mixed-pressure turbines in entirely new installations.

The significance of the absence of large back-pressure turbines in 1915 lies in the appearance of the reducing turbines in the latter year, which, by virtue of their greater flexibility, with very few exceptions, have valuable advantages over the former type.

One other characteristic of the change in the turbines produced in these two years is shown in the following table :—

Date.	% of number of machines built. 3,000 r.p.m.	% of number of machines built. 1,500 r.p.m.	Average output of each machine. 3,000 r.p.m.	Average output of each machine. 1,500 r.p.m.
1910	46·8	19·2	588	2,800
1915	76·0	15·2	1,810	5,300

The continuous tendency towards increased outputs at high speeds exhibited by these figures is responsible for many of the changes in design which have taken place. The object of this development is revealed by the curves shown in fig. 1, where the upper two curves show the steam consumption obtained for the steam conditions stated, with turbo-generator sets of various outputs at 3,000 and 1,500 r.p.m., while the lower curves show the variation in cost per kilowatt of turbo-generator sets at these two speeds.

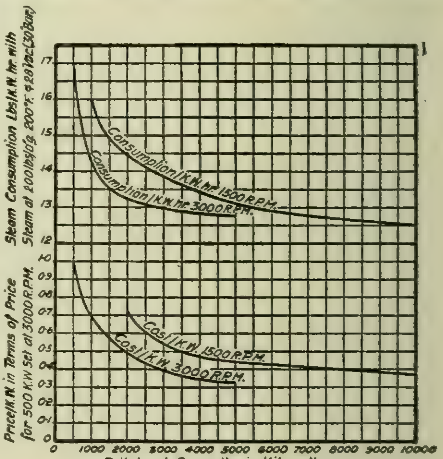


Fig. 1.—Effect of Speed on Steam Consumption and Cost of Turbo-alternators.

It will be seen that at 3,000 kw., the steam consumption with a 3,000-r.p.m. set is 6.15 per cent. better than at 1,500 r.p.m., while the cost per kilowatt is 27.8 per cent. lower. For a 5,000-kw. set, the steam consumption at 3,000 r.p.m. is 2.67 per cent. better than at 1,500 r.p.m., and the cost per kilowatt 26.2 per cent. lower. The curves shown give safe values of the present steam consumption and cost ratios, but it should be remembered that as the number of frames available is not unlimited, these curves should really be stepped lines, and that as various values are set on steam consumption by different purchasers, a manufacturer may use several frames for the same output, which results in different steam consumption, and therefore price per kilowatt being given. The relative sizes of a 5,000-kw. set at 3,000 r.p.m. and at 1,500 are illustrated in fig. 2.

The way in which increasing the output at high speeds reacts on design can be illustrated by considering the effect upon various types of blading.

The output which can safely be obtained at a given speed and vacuum is limited largely by the effect upon the last row of blades. If the safe length of blades is fixed, the volume of steam which can be passed through the last row can only be increased, and with it the output of the machine at a given vacuum, by increasing the velocity of the steam through the blades.

Now the kinetic energy of the steam leaving the last row of blades passes straight into the exhaust, and represents a dead loss in efficiency. This is called the "leaving loss," and must be kept small if a reasonable turbine efficiency is to be obtained. On the other hand, if the leaving loss is reduced by increasing the blade length, the factor of safety in the blade must be sacrificed. In fig. 3, the leaving loss has been plotted for two types of blade fastenings, and two standard blade materials, against the corresponding output of the turbine, assuming that the factor of safety in the complete blade is to be three on the elastic limit. This factor of safety has been chosen as reasonable, and is justified by an extensive experience.

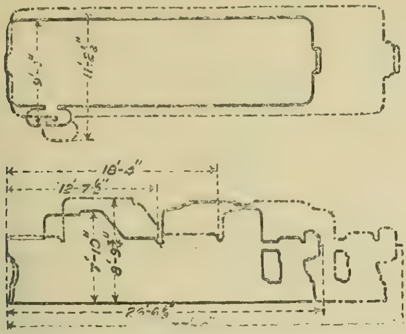


Fig. 2.—Effect of Speed on Size of Turbo-alternators.

Suppose we fix on a leaving loss of 1½ per cent. as being a proper value, then with nickel-steel blading, a turbine of 5,000 kw. output can be built, having a forked blade, or 3,000 kw. with a dovetail blade; with phosphor-bronze the maximum output is 2,250 kw. for a forked blade and 1,350 kw. for a dovetail blade.

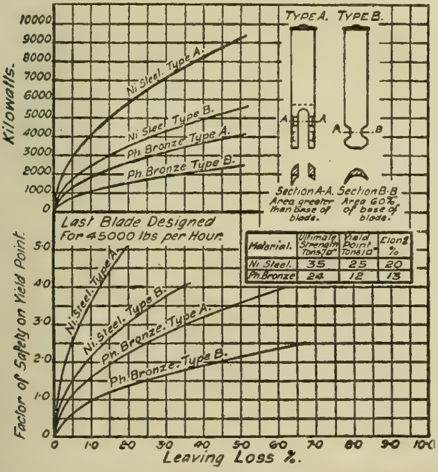


Fig. 3.—Leaving Loss and Stresses in Last Row of Turbine Blades.

3,000 r.p.m., 28 in. vacuum.
Factor of safety = 3 on yield point.
Steam consumption = 13 lb./kw. hour.
Adiabatic heat drop = 381 b.th.u./lb.

If the turbine, having nickel-steel dovetail blades, is rated at 5,000 kw., the leaving loss, and therefore the steam consumption, will be 2.7 per cent. greater than with forked blades, having the same factor of safety of three on the elastic limit. The curve also shows that phosphor-bronze is inadmissible for outputs greater than 3,000 kw., even when forked blades are used. For mixed-pressure and low-pressure turbines, the output given should be reduced by one-half. For vacua other than 28 in. the leaving loss varies as the square of the specific volume of the steam leaving the last row, so that the output for a given leaving loss approximately varies inversely as the square of the absolute pressure. The output which can be obtained with a given factor of safety and leaving loss varies directly as the strength of the material used for the blades, and is independent of their mean diameter.

The same results are exhibited in another way in the lower half of fig. 3, which shows that with a leaving loss of 1½ per cent., the factor of safety on the elastic limit will be 4.5 for nickel steel forked blades, or 1.2 for bronze dovetail blades.

The present position of high-pressure turbines can, perhaps, be most readily appreciated by considering certain typical installations.

The first instance is a 2,000-kw. British Westinghouse Rateau impulse-type turbine, running at 3,000 r.p.m., and installed in a typical industrial power station. The steam conditions are 160 lb./sq. in. g., 160 deg. F. superheat, 28-in. vacuum, and the generator works at 6,600 volts, 50 cycles, 3-phase. The rotor consists of a two-row velocity wheel, followed by seven Rateau wheels, the first blade being 13/16 in. high, and the last 6⅜ in. Six months after the plant was first started up, a 24-hour test was made, under ordinary working conditions. The following results were obtained:

Efficiency of boilers, 69.83 per cent.

Coal per kw.-hour, 2.1 lb.

Steam per lb. of coal, 8.35 lb. The feed water metered included that required for all the auxiliaries, feed pumps, drains, &c.

In January, 1915, a 3,000-kw., 3,000-r.p.m. set supplied to the Charing Cross, West End & City Electricity Supply Co., Ltd., was started up. The turbine was of the impulse type, containing 11 Rateau stages. The steam conditions were 170 lb., sq. in. g., 55 deg. F. superheat, 27¾ in. vacuum.

This was one of the first sets of this speed and rating running in this country. The auxiliary turbine was designed for 220 b.h.p., at 2,500 r.p.m., rather a high output for such a set, due to local conditions.

The guarantees included the steam required for the auxiliary turbine, which exhausted into the main turbine at a stage where the pressure was atmospheric at full load. The official test results corrected to guarantee conditions were as follows:—

Load.	Overload.	Full.	Three-quarter.	Half.
Test result, lb./kw.-hour	15·9	15·9	16·7	19·13

A 5,000-kw. set at 3,000 r.p.m., installed in the Stuart Street power station of the Manchester Corporation, was started up in October, 1915. Between November 22nd, 1915, and November 13th, 1916, this set generated 22,293,400 kw.-hours, or 49.4 per cent. of that possible if it had been on full load for the whole of the time between those dates.

The success of impulse turbines has been in a large measure due to the fact that the pressure and temperature inside the turbine casing are kept low by allowing a much larger expansion in the first than in succeeding stages, with the result that the full boiler steam pressure and temperature are confined to the steam chest and nozzle boxes, which are small chambers, and can when necessary be made of cast steel at a reasonable cost. In turbines whose blades rotate at a moderate peripheral speed, the steam velocity resulting from this large initial expansion can be utilised most efficiently in a velocity wheel having two rows of moving blades, but with a given expansion, as the peripheral speed of the blade increases, the work done in the second row decreases, whereas the friction and windage losses increase as some power greater than the cube of the speed, and a point will be reached when the second row of blades does not perform enough work to rotate it at the required speed, the deficit being made up by the first row.

With the conditions stated and with blades having 30 in. mean diameter, the addition of the second row increases the stage efficiency by 25 per cent., but if the mean diameter is 47 in. the second row makes no contribution to the work done, so that it can be dropped with advantage.

(To be concluded.)

BOILER-HOUSE OPERATION AND MAINTENANCE.

In a paper read before the South African Institution of Engineers recently, Messrs. T. G. Otley and Verney Pickles discussed the methods of boiler operation and maintenance adopted in the power stations of the Rand Power Companies* and the efficiencies obtained; the following is an abstract of their remarks:—

The plants referred to are at the Brakpan, Simmerpan, Rosherville, and Vereeniging power stations, the first-mentioned being the earliest built, and having a parallel boiler-house design originally intended for only two 3,000-kw. sets.

The lay-outs of these four plants are shown in figs. 1-4; the authors advocate that the boiler houses of large stations should be built at right angles to the turbine house, as with 10,000-12,000-kw. turbines, about 280 kw. of turbines is installed per foot run of house, whereas with boilers of about 6,000-sq. ft. heating surface the boiler kw. per foot run is 80-90. Table I contains data bearing on this point.

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* Victoria Falls and Rand Mines Companies. The stations were described in the Electrical Review of March 28th, 1913.

TABLE I. Turbine and Compressor Houses.

—	kw. installed.	Length of turbine house.	kw. per ft. run.	kw. per sq. ft.	Plant installed (turbo-generators and compressors).
					kw.
Rosherville ...	87,000	404	216	2·86	5 × 9,600 T.G. 6 × 3,000 C. 3 × 7,000 C.
Vereeniging ...	43,500	153	273	3·78	2 × 9,600 T.G. 2 × 12,000 T.G.
Simmerpan ...	40,000	327	122	2·10	2 × 12,000 T.G. 6 × 3,000 T.G.
Brakpan ...	31,000	325	95	2·64	2 × 12,500 T.G. 2 × 3,000 T.G.
Total installed	201,200				

Boiler Houses.

—	No. of boilers installed.	*Nominal capacity of boilers at 15 lb. per kw.	Area of boiler houses. sq. ft.	kw. per sq. ft.
Rosherville...	40	89,600 kw.	46,482	1·93
Vereeniging	20	48,000 ,,	24,168	1·98
Simmerpan...	24	42,600 ,,	28,980	1·47
Brakpan ...	18	37,000 ,,	21,840	1·68
Total ...	102			

* The nominal capacity is considerably less than the actual evaporation obtained in practice when burning reasonably good coal at normal draft. For instance, it is possible to obtain an evaporation of 50,000 lb. per hour from boilers rated at only 36,000 lb.

At Simmerpan 16 small boilers are installed in two boiler houses, and eight large boilers in a third boiler house. The kw. installed per sq. ft. in the small boiler house is 1·22, and in the large boiler house 1·78.

At Brakpan the eight small boilers occupy an area which gives kw. per sq. ft. = 1·39, and the 10 large boilers kw. per sq. ft. = 2·00.

At Brakpan, 40 or 50-ton capacity trucks can be shunted up an embankment over the bunkers, four of which contain 120 tons each, and five, 375 tons each; this arrangement, though simple on paper, is most inconvenient in practice, with a consumption of up to 6,000 tons per week, due principally to the impossibility of mixing the coals to obtain most efficient results.

The arrangement is a good one as regards coal handling costs, but shunting charges are heavy.

An outside storage with elevators and conveyors would have reduced shunting, but increased the handling charges. The principal gain would have been in efficiency due to the possibility of mixing the coal, which would have paid a very handsome return on the additional capital cost.

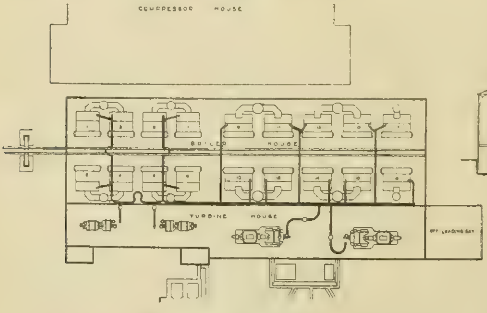


Fig. 1.—Brakpan Station.

An outside coal storage arrangement is provided at Simmerpan, consisting of a concrete and steel bunker having a capacity of 3,240 tons. Gravity bucket conveyors run underneath and deposit the coal to any one of the three gravity bucket elevators and conveyors taking coal to the overhead bunkers of the three boiler houses; several fillers are provided, so that alternate buckets can be filled with different coals. The arrangement has worked perfectly and without trouble.

All coals burnt at Simmerpan are either duff or a mixture of duff and peas. The experience is that such coals can be burnt more efficiently when moistened.

At Rosherville the bunkering arrangements are generally similar to those at Simmerpan, except that the five staithes are in line with the centre lines of the five boiler houses, and that the outside storage is not in the form of a bunker. Gravity bucket conveyors run underneath the coal staithes, and the elevators convey the coal into the overhead bunkers above each boiler house. The gravity bucket type of elevator and conveyor in practice has been found so reliable that the consulting engineer for the Rosherville station deemed it unnecessary to have any considerable inside storage over the boilers.

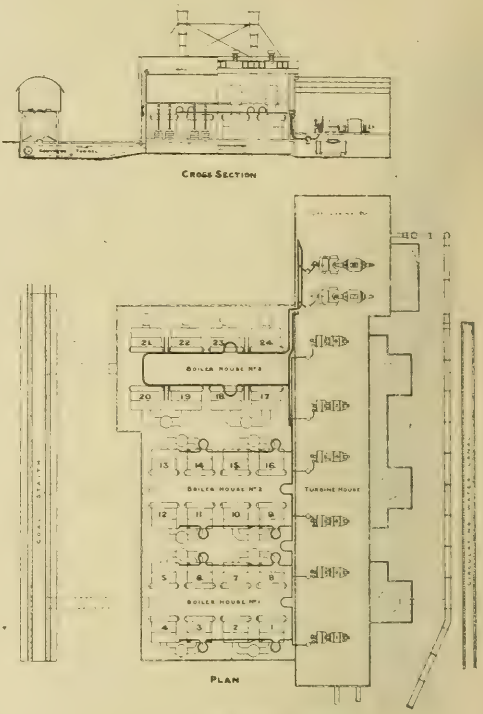
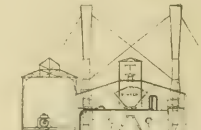


Fig. 2.—Simmerpan Station.

There is considerable difference of opinion as to the advantage or otherwise of large overhead bunkers. In our opinion, the local conditions are the deciding factor. Where land is relatively cheap, there is no doubt that an outside bunker is much the better arrangement, as not only can larger tonnages be more easily stocked, but the cost of the building steelwork is largely reduced, and a lighter and cleaner boiler house results. The tendency in modern practice is, where possible, to store coal outside and have only the minimum inside storage. In this case, the conveyors and supporting structure and the small coal bunkers and chutes connecting them to the stoker hoppers, can be suspended from the roof principals. A further advantage of outside storage with minimum inside bunker is that one can draw upon any particular coal at any time with the certainty that it will reach the boiler to meet sudden changes of load, whereas with large overhead bunkers the choice of coals is somewhat restricted. The first four boiler houses at Rosherville have only very limited inside storage; the fifth boiler house is provided with an overhead bunker capable of holding 800 tons. As the boilers in this house are steamed steadily and continuously, there is no very great disadvantage in the overhead bunker, although it is not necessary, and certainly added considerably to the capital cost of the buildings, and interferes with the natural lighting.



At Vereeniging the outside coal staithes are very similar to those at Rosherville, being arranged in line with the centres of the two boiler houses. Bunkers are also arranged over the boiler houses, each of a capacity of 1,000 tons. In this case, also, the authors say they could have been dispensed with; they interfere somewhat with the light, and added considerably to the capital costs of the buildings. The authors' experience with gravity bucket elevators and conveyors has been almost uniformly satisfactory. They must be kept clean and well oiled; automatic oiling devices are unreliable. The bushes last about four years with continuous running; the material is usually too soft, and some trial case-hardened bushes show no signs of wear after several months' use.

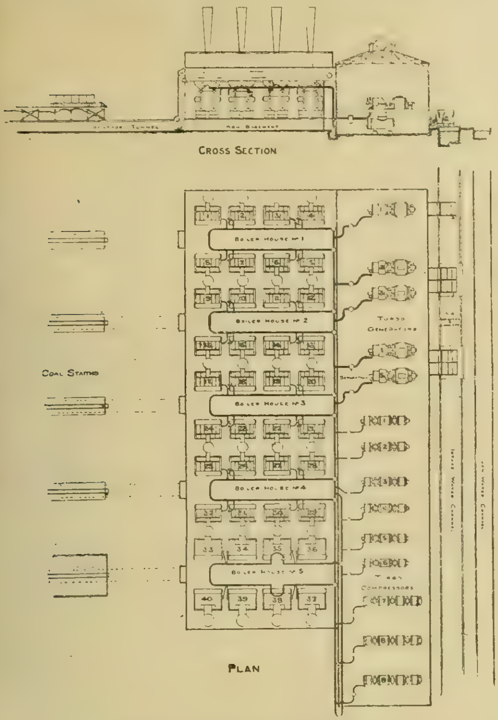


Fig. 3.—Rosherville Station.

Twelve conveyors, totalling 7,210 ft. in length, handled 828,733 tons in 1915 at a cost of .780d. per ton delivered into overhead bunkers.

Knowledge of boiler-house efficiency is wholly dependent upon correct weighing of coal, and very considerable errors can be made when 1,000-1,400 tons per day are handled.

At Brakpan and Simmerpan the coal is measured by levelling the bunkers, which are calibrated to definite volumes per foot depth. For small bunkers this method gives accurate results.

Blake-Denison continuous weighing machines are provided at Rosherville and Vereeniging, and with great care and frequent calibration, and a knowledge of the bias of the machines, a fairly reliable return can be obtained.

The stocks at Rosherville and Vereeniging are checked at the end of each quarter by a careful survey. It is not unusual to find an error of between 1,000 and 2,000 tons either plus or minus. This would represent a continuous error of between 1 and 2 per cent.

The bulk of the coal is delivered in 40 or 50-ton hoppers filled right up; the weights delivered agree fairly well with those on the weigh bill.

At the earlier stations—Brakpan and Simmerpan—measuring drums were fitted; these proved unsatisfactory, as the duff coals do not run freely, especially when wet, so that the drums did not fill properly. All subsequent bunkers were provided with the Babcock and Wilcox coal valve. The authors find that the makers usually provide chutes of too thin a plate—⅛ in. or 3/16 in.—and as a result, they are rapidly corroded away on the bottom side, especially when dealing with wet coal. At Vereeniging the coal chutes are rectangular in section, which renders them much easier to repair. In the earlier installations the discharge end was splayed to about half the width of the stoker hopper; this gave an unequal distribution of coal, the peas or larger pieces of coal falling to the sides, and the duff and powder falling in the centre, resulting in uneven fires. An improvement has been effected by making the width of the splayed bottom equal to the full width of the stoker hopper, but even with these there is a tendency for the larger particles of coal to fall to the side and make a somewhat uneven fire.

(*To be continued.*)

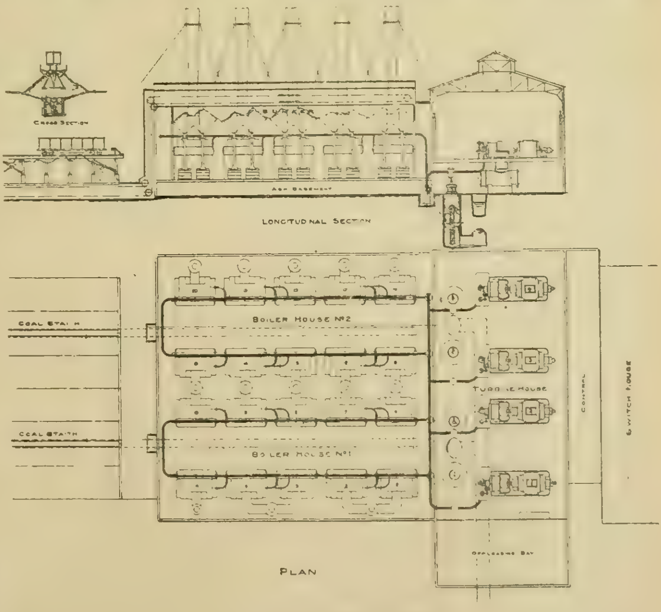


Fig. 4.—Vereeniging Station.

THE FIRST LONDON ENGINEER VOLUNTEERS.

In the course of an article on the work of this Corps during the past year, Macleod Yearsley, Adjutant, states that the First London Engineer Volunteers has reason to be proud of the work which it has done during 1916. The year has been largely one of organisation, and, indeed, an anxious one for those in authority. In January, 1916, there were two Corps occupying jointly the headquarters in Eccleston Place—the Fourth Battalion, Central London Volunteer Regiment, and the Engineering Institutions Volunteer Engineer Corps. They drilled and did much of their work together. The former body had only just been formed from the remnants of the Architects' and London County Council Corps, which formed two Companies. There were many difficulties in the way of good organisation, however, partly because there was in the air a prospect of amalgamation of the 4th C.L.R.V. with the Electrical Engineers, and partly because, in this expectation, no responsible Commandant had yet been appointed. It is not surprising, therefore, that for the early part of the year a spirit of unrest was abroad. Although work was carried on, it was only because the officers were keen and zealous that any real progress was made.

But in May the period of unrest came to an end. The old 4th C.L.R.V. and E.I.V.E.C. became incorporated as the First London Engineer Volunteers, and, for the last six months, the progress of the Corps has been both real and apparent. Under the firm but kindly rule of Lieutenant-Colonel Clay, the work of reorganisation has been successfully accomplished, and the Corps has received the approval of its inspecting officers. The County Commandant, Sir Desmond O'Callaghan, K.C.V.O., who has officially inspected the Corps, both on parade and at its work in headquarters, has expressed himself as "entirely satisfied with all he saw."

The work that has been done during the past six months may be divided into drill and technical work. The former is good, and has improved decidedly during the past three months, an improvement which the institution of N.C.O.'s Classes must tend to increase. The technical work has been largely in the form of entrenching on Sundays, and such elementary instruction in bridging as can be given at headquarters, together with theoretical instruction in the form of lectures. The entrenching work at Otford (in connection with which a very successful camp was held in August) has reached a high order of excellence, and has been warmly commended by the London Defence Authorities. Other technical instruction has not, perhaps, progressed so well, but this is a defect that will be remedied in the near future.

The work of the Searchlight Classes is of great value, and is regarded as a valuable asset to the Corps. Originally the special department of No. 3 Company (the old E.I.V.E.C.), these classes have been thrown open now to the whole Corps, and sappers wishing to join have only to apply to their company officers and to await vacancies, as the number that can be accommodated in each class is limited. Musketry has been well looked after by Mr. A. Gerard, the Instructor of Musketry, to whose zeal and efficiency the Corps is greatly indebted.

Those who are responsible for the programme for 1917 are making every effort to ensure a good, practical, and progressive training, which shall make each man in the Corps a fair practical engineer-soldier in as short a time as possible—*provided he chooses to avail himself of his opportunities.*

Theoretical instruction will be given at headquarters, to be supplemented by practical instruction in camp. Drill will be well looked after, musketry will "carry on," and there will be an additional incentive to good work by reason of the struggle of the three Companies to hold the Commandant's Cup. *But*, it is all good opportunity wasted if full advantage is not taken of it.

Two things are wanted: more recruits and better attendance. As to the former, there are plenty of men, over military age, who ought to be in a Volunteer Corps. They are the men who groan to their friends because they are "too old" to serve their country. Suggest volunteering to them and they reject the proposal with scorn as "playing at soldiers." The real fact is, says the Adjutant, that they are just "slackers," and do not intend to serve in any capacity. But there is a time coming when they will be shaken out of their nests and made to serve. Why do they not come voluntarily before they are forced? This kind of person does *not* serve by "only standing and waiting."

The Corps should double its strength in the next twelve months; and it is a Corps that any man should consider it a privilege to join.

As to attendance at drills, the Commandant has been sorely disappointed at the small uniform parades that have been the rule. If the Corps is to do good work in 1917, the attendance *must* be better.

We may add to the foregoing remarks that this Corps is pre-eminently the Corps for electrical men to join, in order to apply their knowledge to the best advantage. As for present-day volunteering being only "playing at soldiers," this is not only a false impression—it is a gibe which perpetrates a cruel injustice to the men who have given up their spare time, in the face of official discouragement, to training and trench-digging. Fortunately, the recent appeal of the King for more Volunteers, together with the issue of the regulations under which the Volunteers are officially constituted an integral and essential component of the military forces of the country and charged with the duty of its internal defence against invasion, has put an end once for all to the sneers of the lethargic, and those who enlist as Volunteers "for the period of the war," and carry out the prescribed course of training, are undoubtedly serving their country in an honourable and useful capacity.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Variable-Speed Polyphase Motors.

I note with great interest, in your issue of January 12th, the description of a polyphase commutator motor, with variable-speed shunt characteristics, manufactured by the B.T.H. Co. One may presume that this motor is of the "Schrade" type, similar to that now being marketed by a Continental firm.

The writer has studied the question of A.C. variable-speed motors, with and without commutators, for a considerable time, and perhaps a few remarks as to the possibilities and limitations of various types of motors may be of interest to your readers.

Some months ago an article was published in your columns (July 14th, 1916) descriptive of a new variable-pole induction motor, of the writer's design, in which every polarity is available, and which is now being marketed by Messrs. F. Parkinson & Co., Guiseley. This type of machine the writer considers to be the most satisfactory for large outputs, where the cost of a commutating machine having completely sparkless operation would be prohibitive. It seems probable that in the smaller sizes, and for high speeds, where the number of speeds available in a variable-pole machine is small, and the relative cost of the control gear considerable, a commutator machine such as that developed by the B.T.H. Co. is the right solution of the problem. For instance, small 500 to 1,500-R.P.M. motors form an ideal application for the commutator machine. In certain cases, too, the gradual speed regulation attainable would be an advantage. These cases are fewer than would be supposed at first sight. Thus, the two types are complementary to each other, each having its own field, and both being necessary to a complete solution of the problem of polyphase speed variation. There will, of course, be a certain not very wide debateable ground, and in view of its existence, a somewhat more detailed comparison of the two types may perhaps be of interest.

Comparing the particulars given in your issues of July 14th, 1916, and January 12th, 1917, we obtain the table below:—

POWER FACTOR AND EFFICIENCY.

H.P. proportional to speed in both machines.

	Variable pole motor.			Commutator motor.		
Speed.	Top.	Medium.	Low.	Top.	Medium.	Low.
Full-load P.F. ...	85	80	63	1·0	86	67
" efficiency	85%	81%	72%	84%	81%	77%

Bearing in mind that we are comparing a 50-H.P. motor with a 20-H.P. motor, we see that the difference is a great deal less than might be imagined. The commutating machine has better power factor at high speeds, but probably about the same at low speeds, while for machines of equal size the induction motor would probably give better efficiency at all speeds, low or high.

As regards starting and acceleration, we may note that it is as easy to build a variable-pole motor with wound rotor and slip rings as with squirrel cage, and hence the starting torque is identical with that of a standard induction motor, while the current, in a 3 to 1 speed range machine, is reduced to approximately one-third of that required by a standard motor of the same maximum output and speed. Hence, the starting of the variable-speed motor is much superior to that of a standard type. By an appropriate form of control gear, both the rate of acceleration and the current absorbed when changing from one speed to the next are kept under exact control, absolutely gradual acceleration being attained.

A point worthy of note is the extremely low speeds of the 50-H.P. and 30-H.P. commutator machines illustrated. This is, of course, due to the requirements necessary to obtain sparkless commutation in a variable-speed machine on 50 cycles, namely, low speed and a large number of poles. The writer has no hesitation in placing in service single-phase machines of double this capacity, operating at 1,000 R.P.M. on 50 cycles, but these, of course, run in the neighbourhood of synchronism, the commutating condition of variable-speed machines being much more severe. Even in a size so small as 50 H.P. the cost of control gear in a variable-pole machine becomes relatively moderate, while the motor can be built for much higher speeds. Hence, except in those few cases where absolutely gradual speed variation is necessary, it would tend to be preferred, the comparison inclining more and more towards the variable-pole machine the larger the installation. The two types, of course, represent two different dispositions of the switchgear necessary to obtain variable speed, since the commutator is itself essentially a switch. In one case the switchgear is made an integral part of the motor, and is in continuous operation. In the other, the switchgear is separate, and operates only when a change of speed is desired. Between the two, engineers may congratulate themselves that the difficult problem of a variable-speed motor is rapidly approaching solution.

F. Creedy.

Guiseley, *January 30th*, 1917.

Cheap Water-Power.

Can any of your readers offer advice on the following:—I am in charge of an undertaking in a small country town where formerly water power was used for generating the current. On account of the water power being unable to meet the demand, and the transmission line (four miles long) needing complete reconstruction, the water was abandoned in favour of suction gas. The actual water-power generating plant is, however, still in exceedingly good condition, and as, owing to the great cost which removing the turbines from their position would entail, the plant has very little market value, it has been suggested that the available current might be used for some electrochemical process. About 60 KW. at 2,500 volts single-phase, at very low running costs, could be obtained as the plant stands, and I should be glad if any reader could suggest a purpose to which a small quantity of power like this could be profitably put. The power will have to be used on the site, if at all.

Water Power.

Federal Income Tax.

I have pleasure in advising you that the efforts of this Association have been successful in having Section 15 of the Income Tax Assessment Act, 1915, repealed.

You will recollect that Section 15 provided that in the case of a person selling goods in Australia on account of a person not resident in Australia, the principal should be deemed to have derived from such sale a taxable income of 5 per cent. upon the price at which the goods were sold, that the person selling the goods should be personally liable for the payment of the tax to the extent of the tax payable on goods sold by him after June 30th, 1915, and that goods should be deemed to be sold in Australia on account of a person not resident in Australia if any person in Australia received a commission in respect of the sale of the goods, or was paid a salary for obtaining orders for or for influencing the sale of the goods.

Under the provisions of the Act, as now amended, neither the agent nor the overseas principal is taxable on any profit made by the overseas principal on the sale of goods through an agent in Australia.

R. H. Butler, *Secretary.*
The Australian Association of British Manufacturers and their Representatives.

Melbourne, *December 20th*, 1916.

Accuracy of Steam-Flow Meters.

In view of the lack of confidence in steam-flow meters, shown by the discussion on Mr. Lackie's paper at last year's meeting of the Municipal Electrical Association, the following results of some tests we have recently carried out on a steam-flow meter may be of interest to your readers.

This steam-flow meter has been installed in connection with a 3,000-KW. turbo-generator, and as we have a Lea recorder, through which the whole of the condensed steam from the turbo-generator can be passed, we can check the quantity of steam recorded by the steam meter against the quantity of water recorded by the Lea recorder.

The following are the results of several tests, the differences being given as percentages of the full scale reading of the instrument, which is 60,000 lb. of steam per hour:—

Lea recorder, lb. per hour.	Steam-flow meter, lb. per hour.	Difference as percentage of full scale reading.
16,273	15,026	2.1 per cent. −
17,781	16,330	2.4 per cent. −
30,871	30,562	.5 per cent. −
32,460	31,606	1.4 per cent. −
32,560	31,900	1.1 per cent. −
40,905	41,503	.99 per cent. +

J. R. P. Lunn,
Borough Electrical Engineer.

Darlington, *January 30th*, 1917.

Profit-Sharing.

We notice in your issue of January 19th reference to a pamphlet on "Capital and Labour," by Sir William Lever, Bart., in which he advocates profit-sharing as the cure for industrial unrest. With this we are in complete agreement, but how can an industry share profits when none are made? Sir William Lever is, luckily for himself, engaged in an industry which yields enormous profits (and not to one firm only), and did so in competition with Germany. Are we to assume that this is due to the superior intellect and ability of soap manufacturers as compared with electrical manufaturers, or to natural or artificial advantages? As Sir William Lever has been reported as advocating trading with Germany after the war, and a continuation of dumping, and, further, to have said that dumping harms Germany and benefits us, will he explain how an industry which is subject to dumping and State-aided competition is to work at a profit? In considering this point, it is necessary to take a modern industry equally suitable for both countries, and not an old-established one which is protected by goodwill and experience, nor one with any natural advantages.

If our destinies are to be controlled in the future, as in the past, by that little clique of Free Traders whose fiscal fallacies are on a par with the rest of their false conceptions during the last 35 years (*i.e.*, since Germany became an industrial nation), even the best form of industrial co-operation will not ensure industrial harmony.

Mr. John Hodge, our Labour Minister, said last week:—"I am one of those silly people who once went to Germany on a peace mission." Previous to the war, like the silly beggars they were, the Labour men thought Free Trade meant the prevention of war. But the war had dropped the scales from their eyes. He was going to have no more German steel in this country while there was an idle furnace here. So-called Tariff Reform did not mean the lowering of the standard of life, as some people seemed to assume.

Mr. Hodge thus admits that his own opinions have changed, but evidently one of the first essentials is to convert the workers and voters to the necessity for protection for all suitable industries which are subject in any form to unfair competition.

Electrical Manufacturer.

Australian Agencies.

Before returning to Australia I am anxious to obtain the sole representation of a good electrical manufacturing firm—particularly metal filament lamps—for the Commonwealth of Australia, and am appealing to you for your kind assistance. I can furnish any references and guarantees which may be necessary.

At the moment, I believe there is some difficulty in exploiting goods from this country, but British manufacturers should remember that America and Japan are flooding the Australian markets, and unless the home manufacturer shows that he is taking some little interest, even at the present time, in the Colonial firms he may find great difficulty in securing ready markets after the war.

I am in the position to influence quite an amount of business in the Australian market.

Even if very little can be accomplished now, everything can be got ready for that time when business will be very acceptable.

A. H. C.

[Any replies to this letter that we may receive will be forwarded to our correspondent.—Eds. Elec. Rev.]

Women and "Shorts."

I have read the letter under this title in your last issue emanating from the pen of someone, supposedly a male, masquerading under the *nom de plume* of "Exciter," and my first impulse was to wonder how your highly reputable journal printed any such garbage without reference to the facts, which were easily obtainable.

Acting on the urgent demands of the military authorities, Marylebone responded energetically, and, I should say, successfully, in releasing men wherever possible by employing women. The "short" referred to developed in our mains in another part of the borough, and, incidentally, severed the telephone wires between the sub-station, where women are employed, and the generating station. The woman in charge, with commendable initiative, sought the nearest call office, and thereby conveyed the necessary information to the station engineer, securing continuity of supply in record time.

The matter was investigated by my Committee, who congratulated the officers and staff on the result.

The lurid and inaccurate description by "Exciter," in the light of my explanation, can be regarded as just so much silly drivel.

Duncan Watson,
Chairman of Electricity Committee,
Marylebone Borough Council.

London, W., *February 6th*, 1917.

[While we regret the injustice done to the women by "Exciter's" incorrect version of the incident—which we regarded as a jocular effort on his part—we are glad that it has drawn from Alderman Duncan Watson a statement which not only vindicates the sub-station attendant, but also clearly demonstrates her efficiency in an emergency.—Eds. Elec. Rev.]

Localising a Fault.

Your correspondent "Mains Assistant" asks for a simple method of locating, in the future, a fault such as he describes. His testing apparatus seems to be short of a Wheatstone bridge, which, I think, would have solved the difficulty. He states that burning-out and a loop test were for various reasons impossible. The instruments available evidently did not meet the case, as the fault was discovered by chance. He does not state if the resistance of each conductor was known; if so, as the cable was completely shorted, the bridge test would have served the purpose. Further occurrences of a similar nature and method of testing would be interesting.

H. Payn.

B.E.F., France, *February 1st*, 1917.

In answer to "Mains Assistant's" letter under the above heading, appearing in your issue of the 26th ult., I think the simplest and most reliable method to use in testing for a triple short and dead earth on triple-concentric cables is the following:—

Pass a current of about 5 amperes through a bank of lamps, or suitable resistance, from the live main to one core (say x) of the faulty cable, whence it will pass through short to earth, or use a battery connected across x and o cores.

We will assume here that the fault lies beyond the first x consumer.

With a galvo. or sensitive and low-reading voltmeter take the drops, (*a*) across x and o cores of the faulty cable at the testing station, (*b*) across the cut-outs of the first x consumer's service, and (*c*) across x and o at the far end of main. This last reading gives the drop across the fault, and is subtracted from (*a*) and (*b*).

Now, if the results obtained from (*a*-*c*) and (*b*-*c*) are plotted, taking drop vertically and distance from testing station horizontally, then a line drawn through the dots when produced cuts the horizontal at a point which gives the distance to the fault.

I may say here, I think it advisable to take as many readings as there are x consumers as a check.

If the fault lies nearer the testing station than the first x consumer, then the readings (*b*) and (*c*) will be the same, and a test taken from the other end will give the necessary information, or, alternatively, a known resistance can be inserted between the lamps and faulty cable and equated to terms of length of the cable. This method also applies when there are no consumers connected to the main, or no points where readings can be obtained.

Of course, when the current is accurately known, and the drop taken with a voltmeter, then the resistance of the cable from testing station to fault can be found and worked out in terms of length.

The points to be remembered in this test to ensure reliable results are that the short must be steady, and great accuracy is needed in reading the drop, as this is extremely small. If the short is not steady, then using a Megger across the cores is a great help in cleaning and steadying the fault.

Using a battery is, perhaps, the better way, as the drop is steadier than when employing the main, especially in the daytime, when there is a motor load in the vicinity of the fault.

The method described by Mr. Wardle in last week's issue has the disadvantage of not eliminating the resistance of the fault, which, if considerable, will greatly affect the reliability of this method.

W. Leighton Chubb.

Maidenhead, *February 5th*, 1917.

WAR ITEMS.

Exports to China.—In the "London Gazette" for February 2nd there appear additions to the list of persons and bodies to whom exports to China and Siam may be consigned.

Lighting Restrictions.—In a lighting restrictions prosecution at Keighley last week, it was stated in evidence that the defendant had turned on 17 electric lights in order to attend to the boilers at a certain industrial works. The fine was 18s.

Trading with the Enemy.—The "London Gazette" for February 2nd contains further lists of persons or bodies with whom trading is prohibited in Argentine and Uruguay, Brazil, Chile, Denmark, Japan, Morocco, Norway, Peru, Spain, Sweden, &c.

Exports to Australia.—The Ministry of Munitions announces that as from January 31st, 1917, no application for priority certificates for the manufacture and export of goods to Australia will be entertained unless the application has been endorsed by the Director of Munitions, Collins House, Collins Street, Melbourne, Victoria.—*Birmingham Daily Post.*

Ministry of Munitions and Lead.—The Minister of Munitions has ordered that the sale or purchase of lead, except in accordance with a licence or for the purpose of carrying out a written contract existing prior to the date of the Order, is prohibited. Until further notice, too, there must be no use of lead for manufacture without a licence, unless for necessary repairs, involving the consumption of not more than 1 cwt., or for type-casting from lead already in that form or previously purchased for that purpose. Monthly returns of lead in stock, &c., and contracts and orders, will have to be made, unless the total stock in hand or order for future delivery has not exceeded 1 cwt. Applications for licences must be made to the Director of Materials at Hotel Victoria, Northumberland Avenue, W.C.

Ministry of Munitions and Locomotive Engines.—The Minister of Munitions has issued an order that all persons (other than railway companies) owning or having in their possession or under their control any steam or petrol locomotive engine or engines in Great Britain shall within ten days from February 2nd send in to the Deputy Director-General of Railway Material Licences, Ministry of Munitions, Whitehall Place, London, S.W., returns containing the following particulars with regard to such engine or engines:—

(a) Type of locomotive.
(b) Steam or petrol driven.
(c) Name or number of locomotive.
(d) Owner's name and address.
(e) Maker of locomotive.
(f) Date on which locomotive was built.
(g) Gauge of railway.
(h) Maximum height ft. in., and width ft. in., of locomotive.
(i) Work (if any) on which locomotive employed.
(j) Weight and general description.

and to make such further returns concerning any such engine or engines as may hereafter be required by the Deputy Director-General of Railway Material Licences.

German Litigation in War-time!—A remarkable instance of German audacity in commercial matters towards an enemy country is reported from Germany, where, notwithstanding war loans, money is comparatively scarce, except in privileged industries. This probably explains why the Accumulatoren Fabrik, A.G., of Berlin, has brought an action, as is announced in a Frankfort newspaper, against the Società Generale Italiana Accumulatori Elettrici, of Milan, for the fulfilment of conditions embodied in a contract which was entered into between the two companies in 1907, relating to certain payments, and the free allotment of one-tenth of the amount of a new issue of shares. The plaintiff company is said to claim the payment of £31,000, together with interest at 5 per cent. as from March 31st, 1916, and the surrender of shares for £8,000 (200,000 lire), forming part of the new issue which was resolved upon at the general meeting of the Italian company held in August, 1916. A demand of this kind in war-time, and from one enemy country towards another, is beyond the comprehension of anyone—except a German.

Japan and Enemy Trade.—The Tientsin correspondent of the *Morning Post* states (under date December 27th) that the announcement that the Japanese Government will shortly promulgate strict enemy trading regulations has aroused much interest and satisfaction among the Allied communities in North China. A few days ago a Russian decree, forbidding all trade with enemy or blacklisted firms, was published in the Press. "In order to make the Allied action absolutely watertight it only remained for Japan to adopt similar measures. The Enemy Trading Regulations of France and Great Britain have undoubtedly caused the German firms and merchants in the Far East considerable difficulty and inconvenience. The Japanese authorities, although they have not up to the present fallen into line with their Allies in this matter, have always shown themselves willing to assist when the British or French Consulates could show that cargo intended for shipment by Japanese vessels was of enemy origin or destination. But owing to the German habit of employing Chinese 'fences,' it has often been extremely difficult to obtain such proof, and there is no doubt that there has been serious leakage in the economic coffer-dam of the Allies in the Far East. We may now expect all this to be changed. The onus of proving that suspect cargo is not of enemy ownership, origin, or destination, will now fall upon the Japanese shipping companies, and consequently the position of German commercial interests in the Far East ought to become much more uncomfortable."

After the War: Extracts from the Premier's Carnarvon Speech.—In his reference to the work done by the Ministry of Munitions—as a basis for an appeal against premature criticism of Mr. Neville Chamberlain and his National Service Department—Mr. Lloyd George said:—"I have had a good deal of experience of what men of this kind can do, the great business men of this country, when you call upon them. The Mayor was good enough to refer to my work as Minister of Munitions. The only credit I take is this—that I gathered together as fine a body of men of able experience as ever came together in any Government Department, as ever existed in this or any other land. I do not pretend I did the work. They did it. I encouraged them. I stood by them, and now and again I scolded them; but we all worked hard. . . . They had not been there a few weeks dealing with an undoubted shortage, an undoubted deficiency, together with lost opportunities—before we heard censure and criticising. . . They took no notice of it. . . . They knew they were going to confound all these things, not by speech, but by accomplishment. . . . What happened? The great battle of the Somme came. These men had mobilised the whole of the engineering resources of the country. Old workshops grew to life, new workshops were set up—you could see them north and south, east and west, wherever you travelled—old machinery made the best of, new machinery manufactured here and also ordered in America—machinery that will revolutionise industry after the war—and new industries were set up where before the war we had been dependent entirely on Germany. New industries were created, and *we are not going to drop them after the war.*"

Summing up his appeal to the nation to help in every possible way in the coming effort, Mr. Lloyd George said:—"When the smoke of this great conflict has been dissolved in the atmosphere we breathe, there will reappear a new Britain. It will be the old country still, but it will be a new country. Its commerce will be new, its trade will be new, its industries will be new. There will be new conditions of life and of toil, for Capital and for Labour alike, and there will be new relations between both of them, and for ever. But there will be new ideas, there will be a new outlook, there will be a new character in the land. The men and women of this country will be burnt into fine building material for the new Britain in the fiery kilns of the war."

Exemption Applications.—At the Westminster Local Tribunal, the London County Council appealed for over 200 men employed in the tramways department. This department had been in consultation with the Advisory Committee, but disputed the decision arrived at. The Military Representative stated that the authorities had released a certain number of men on condition that the Council would give up a number of men at present certified. If they would not do that the Army must have the others. The L.C.C. Representative: We are almost at the end of our tether. If the tramways are of national importance, we must have the men. A Member: There are too many cars in the afternoon; they are often empty. Why cannot women drive cars? L.C.C. Representative: The police will not let them. The Tribunal allowed 150 men in certified occupations three months' exemption, with leave to apply again. Forty cases were withdrawn, and 30 men, 24 of whom were tram-drivers, were removed from the certified list.—*Morning Post.*

At Southport, the borough electrical engineer, Mr. A. S. Black, appealed for three employés at the electricity works. The Military Representative said the men had been badged, but they were now de-badged. The Chairman said Mr. Black had stated that if these men were taken he could not be responsible for the lighting of the town. The case was adjourned for Mr. Black's attendance.

A Southport appeal, heard at the County Appeals Tribunal, was that of A. Robertson Hunt (39), electrical engineer, of Ainsdale, who appealed against the decision of the Local Tribunal. The latter had refused his claim, but allowed time to the end of March. The appellant said that prior to the war he had business premises in Liverpool, but had since given them up, and he described the nature of his technical work. The Military Representative said he would be very useful in a technical corps in the Army. Exemption to April 1st was given, with no further appeal without leave.

The Shipley Electricity Committee applied at the Local Tribunal last week for three men engaged as boiler firemen, J. Swallow (37), G. Clow (35), and T. Pennington (34). Postponement was granted in each case till June 30th.

At Grantham, on January 26th, the Urban Electric Supply Co. appealed for five employés, viz.: T. H. Heritage (26), station superintendent fitter, conditional exemption to stand; J H. Williams (26), shift engineer, conditional exemption withdrawn for substitution; A. W. Dyke (18), switchboard attendant, conditional exemption withdrawn for substitution.

An electrical engineer of Westcliff, appealing at Southend-on-Sea, said that he had been twice rejected, and was now placed in Class C 3. He felt that if employed where he could use his professional knowledge he would be of more service to his country, and he had applied for such work, including a post at Salonika. He was with the British Thomson-Houston Co., Ltd., of Upper Thames Street, E.C. The Tribunal extended appellant's exemption until March 1st.

The same Tribunal granted until June 1st to a medical electrician (29), wholly engaged at the Queen Mary Royal Naval Hospital at Southend.

At Nuneaton, an appeal was made by Percy H. Howe (28), electrical fitter, who is engaged on Government work. On the suggestion of the Advisory Committee, exemption until July 1st was granted on appellant not changing his avocation.

At Canterbury, on January 29th, Mr. E. J. Philpot, electrical engineer, appealed for two employés, S. Kingham (29), and A. S. Fassum (31). The last-named, he said, was responsible for the maintenance of a number of electrical installations in the district, including the Kent and Canterbury Hospital. He had two other electric wiremen, and was doing work for the military. Kingham was allowed three months, and Fassum was directed to join up on February 28th.

Dr. Watson, of the Alltymynydd Sanatorium, appealed to the Carmarthenshire Tribunal against refusal of exemption by the Local Tribunal to D. Williams, electric light attendant. The appeal was allowed, and conditional exemption granted.

A Brighton firm of electrical engineers appealed for their branch manager (32), three electrical fitters, aged respectively 30, 41, and 34, and an electrical clerk (27). The firm, which has branches at Eastbourne and Worthing, stated that they were doing considerable work for munition factories, hospitals, and the Royal Flying Corps. Four of the men were allowed three months each, and the other appeal was adjourned.

At Exeter, the city electrical engineer (Mr. Munro) supported an appeal by Messrs. Cory Bros., coal merchants, for exemption for J. Gregory (40), in Class B 2, on the ground that the man was indispensable to the undertaking for discharging coal from trucks at the works. Exemption until May 31st was allowed.

Worcester City Tribunal has granted conditional exemption to seven employés of the Tramway Co., all of whom are over 31 years of age; and allowed exemption until a substitute is found for another employé, aged 27.

At Salisbury, the Electric Light Co. were the respondents in a Military appeal against conditional exemption held by an assistant engineer, two engine drivers, and a meter tester. For the company, it was stated that 12 out of 23 men had been released for service, and one more was going. The men appealed against were in certified occupations, and their work required skilled men. One of the drivers, placed in Class B1, had been with the company for 17 years. One driver was allowed until March 1st, and the others until June 1st.

At Hastings, it was stated that the Military had assented to conditional exemption in the majority of the cases in which certificates of exemption held by employés of the Tramway Co. had been withdrawn. The general manager (Mr. Vincent Edwards) said that the majority of the men concerned were employed in the power-house and sub-stations, and they were doing their best to find substitutes for the younger men. At the present time they were employing several discharged soldiers, and trying to train them. He hoped that these would come in time to be suitable men. The Tribunal granted conditional exemption to all the tramwaymen appealed for, and Mr. Edwards said that if the men could do public service they would.

At Reigate, on January 30th, the Military asked for the withdrawal of exemption certificates granted by the Recruiting Officer to nine men with the East Surrey Traction Co., Ltd., including Mr. A. H. Hawkins (34), manager and director. Mr. Hawkins asked the Tribunal to confirm the certificates granted to men who are in reserved occupations, but the Tribunal decided that the best course to pursue was to withdraw all the certificates and review the cases when they came up on their merits.

LEGAL.

Electric Heating Device.

An electric heating device was the subject of an application in the Patents Court, on Wednesday, last week, before the Controller-General, Mr. Temple Franks, sitting with Sir Cornelius Dalton.

Messrs. Benham & Sons, Ltd., of 66, Wigmore Street, W., manufacturers of electrical appliances, applied for licence to use the Patent 26,347, of 1912, in the name of Martin Albrecht, of Gunthernburgalle 100, Frankfurt-a-Main, Germany.

This patent claims electric heating devices or bodies of the kind in which the resistance, suitably insulated, is placed in a metal casing.

The method consists of strongly pressing a thin metal casing around a resistance strip in such a way that the heat produced in the resistance strip by the electric current wlll be transmitted almost instantly to the wall of the casing.

The resistance strips are packed, as usual, between thin mica plates, whereupon the resistance strip, insulated by the mica plates and inserted in a tube having comparatively very thin walls and circular, oval, or, preferably, rectangular in cross-section, is rolled or compressed, so that the walls of the tube will be pressed or rolled with considerable pressure upon the mica plates. To prevent the walls from buckling or yielding and drawing apart, the tube may, in being pressed, be formed with lateral collars or flanges.

The process enables heating strips to be produced with a heating capacity of from 10 to 50 watts per sq. cm. of their surface. They transmit almost instantly the total heat to the liquid.

For the applicants, Mr. Bousfield (of the firm of G. F. Redfern and Co., patent agents) said the applicants had made a speciality of electrical kitchen appliances and such apparatus for use in hospitals. One of these was an apparatus for heating water. The apparatus referred to in this letters patent, while it had its distinctive features, was after a well-known type. Messrs. & Benham Sons, Ltd., had applied for letters patent for this device, but they found in front of them the patent which they now asked for licence to adopt.

The Controller inquired whether the apparatus could be used for cooking purposes ?

Mr. Bousfield replied that its main purpose was for heating water. It might, however, be made in any size. The efficiency was said to be, at any rate, 95 per cent.

Applicants' assistant manager, Mr. Charles Reed Allansby, explained that previously they had made electrical heating appliances by attaching the heating element to the base of the vessel on the outside. Now they desired to immerse the element in the water. They might eventually make specially constructed kettles, with a grooved receptacle for the element, and then water could be boiled without an exterior fire or appliance. They wished to put the apparatus they now had in hand upon the market at once, and would be ready to pay a royalty of 5 per cent. to the end of the war. They anticipated a public demand, and they proposed to employ the method in apparatus they were making for their own use. The article would be made in various sizes. It would be useful for the sterilising vessels surgeons used for their instruments when carrying out operations. The element would be smaller in that case.

The Controller said he saw no reason why the royalty of 5 per cent. should not be accepted as fair, and the Court would recommend that a licence be granted by the Board of Trade.

Fowler *v.* Midland Electric Corporation for Power Distribution, Ltd.

In the Chancery Division, on February 1st, Mr. Justice Eve reserved judgment in an action against this company, of Birmingham, by Mr. G. W. Fowler, of Old Dean Hall, Camberley, executor of the estate of his late aunt, Miss M. J. Fowler. He claimed payment of £1,800, the value of 18 debentures of £100 each, a premium of £45, and interest at the rate of 4½ per cent. from June 30th, 1913, the date when the debentures matured.

The case for the plaintiff was that after the death of his aunt, the company sent her notices of the expiration of the series of debentures of which hers formed a part, and of the issue of a new series. These, of course she did not receive, and the plaintiff claimed that interest on the debentures continued to run until they were paid off: the company first declined to pay any interest from June 30th, but afterwards they said they were willing to pay the income on the money set aside for the payment of the debentures. He also contended that it was the duty of the company to find their creditor within the realm, the debentures not being payable at any particular place. There was an executor who could give a proper discharge for the money.

For the company it was argued that the plaintiff had been in default in not doing certain things which would have put the company in possession of the knowledge they required, that he was responsible for what had happened, and that that was a good reason why no further interest should be paid. The debentures were in the common form in not having any place specified where payment should be made, and it was no part of the company's duty to send people wandering through the land in order to make legal tender of money due to debenture-holders who did not choose to apply for payment in the usual way. If the plaintiff's contention was upheld, it would mean that in the future debentures would have to be framed in a very different way.

His Lordship, in saying that he would give judgment in a few days, remarked that the case was one that would affect many others.

De'Ath *v.* London Electric Railways Co.

At the Surveyors' Institution, Westminster, Mr. Samuel Walker, F.S.I., as Arbitrator, heard a claim for compensation by Mrs. Phoebe De'Ath against the London Electric Railways Co. for damage alleged to be caused by noise from the Bakerloo Extension Tube Railway to her property, 38, Randolph Gardens, Kilburn.

Mr. D. N. McNaughton was counsel for the claimant, while Mr. Eustace Hills appeared for the railway company.

Mr. McNaughton said the complainant complained of the noise and vibration immediately after the railway was opened in January, 1915. A few months later her solicitor made a claim, but, at the request of the company, the matter stood over until January, 1916, when liability was disputed. An Act of Parliament met the nuisance of noise, which, according to the claimant's case, was greatest in the early morning and from 6 to 10 o'clock at night.

Mr. O. De'Ath, husband of claimant, said that when the tube was opened, one of the tenants communicated with him in reference to the noise, and Witness wrote to the company.

Mr. and Mrs. Charles Poynton, tenants of the ground floor since 1911, said a rumbling noise, something like thunder, was made by the trains every day. It varied a great deal, but they heard it more in wet weather.

Mr. J. J. Done, surveyor, said that one evening when he visited the property he noted that 10 trains passed in 15 minutes. The noise they made sounded like thunder as heard in the distance, and it gradually increased and then decreased. Four of the trains were particularly heavy and extremely noisy. On making a test he came to the conclusion that there was not much vibration, but the noise would have an effect on the value of the property, as it would put people off taking the flats, and anyone suffering from influenza would feel especially upset. He valued the property at £900, and came to the conclusion that one-third of the value would disappear sooner or later. He therefore put the compensation at £300. He went to the house three times, and could hear the noise on the top floor, but he had never been able to hear the L. & N.W.R. trains. In his opinion, depreciation would arise when it became necessary to find a new tenant. In future the owner might have a difficulty in letting the property. The market value of the claimant's interest was affected by the noise, as a purchaser would make due allowance on that score.

Mr. H. G. Beard, surveyor and auctioneer, estimated the depreciation in value at £336. On one occasion he counted 11 trains in 15 minutes. In his view, the rents would fall when the old tenants left.

Mr. Eustace Hills, on behalf of the London Electric Railways Co., argued that the noise was negligible, and that, as no damage had occurred for two years, claimant was not entitled to compensation. The L. & N.W. Railway was over 300 yards away, and there were several streets of houses between that railway and the property in question.

Mr. J. G. Head, surveyor and auctioneer, gave evidence on behalf of the Electric Railways. He said he visited the premises on two occasions, and heard the sound of trains, but it would need careful discrimination to say whence the sounds proceeded. He could distinguish the rumbling of trains at intervals of two minutes, but it was very slight, and there were other sounds. For instance, he heard the L. & N.W.R. trains, and the general traffic, and when this occurred the noise of the tube trains was swallowed up. There was nothing which depreciated the value of the property; the noise he heard was not sufficient to make any practical difference in the value. There were these noises all over London, and one got used to them; and his experience in places where houses had been much more severely affected showed that no difference had been made in the value.

Mr. J. Bate, surveyor, of Kilburn, also considered there was no depreciation. He had to listen attentively for the rumbling sound of trains. The facilities of the railway should tend to increase, rather than depreciate, the value of the property.

The Arbitrator, who reserved his decision, has now announced that he finds there is no damage.

Woolley *v.* Watson, Marsh & Co., Ltd.

At the Lambeth County Court, on the 1st inst., Judge Parry had again before him the case of Thomas Woolley, an electrician, who was being paid compensation for injuries received during his employment, at the rate of 15s. a week, under the Workmen's Compensation Act, the respondents being Watson, Marsh & Co. (Brondesbury), Ltd. The facts have previously been reported in this journal, when the case came before the Judge in December, when, acting on the advice of the Medical Referee, he directed that 15s. a week should be paid to the applicant until the date of the present hearing, and that he should in the meantime endeavour to get back to work.

Mr. Kingsbury, for the respondents, reminded the Judge that he urged the applicant to go to work, even though it caused him a little pain. Some correspondence had since passed between the parties, and he should object to any further evidence being given on his behalf by his doctor, who he understood was present in court, as the doctors for the respondents were not present, and the case was last heard before the Medical Referee sitting with the Judge. He understood that applicant had been at work for some days, but feeling some pain, he had stopped. He (Mr. Kingsbury) thought he was capable of performing light work.

Mr. Bloxham, for applicant, said he tried to get light work, and in January was engaged at the Bon Marché, Brixton, packing china, his wages being 5s. a day, or 30s. a week. He stayed there four days, but his leg became so painful that he had to stop work, and had done none since. He had seen his panel doctor, who said the man was unable to work at present. Considering the light employment he had taken up at Brixton, applicant was getting very good wages, and would have stayed if he could.

Judge Parry said the difficulty was what to do in a case of this kind. It was one of those cases in which the man should persevere, even if he had a certain amount of pain at the outset, for, unless he did, the leg would get worse.

Mr. Bloxham said that probably applicant was one of those men who, when they felt pain, did not care to go on.

Judge Parry, after ascertaining that the applicant was 56 years of age, said that the Medical Referee, at the last hearing, said there were some effects of the injury still remaining, and that there was a certain amount of incapacity even yet from the accident. Whilst this litigation was hanging about he did not think the man would try to overcome his difficulties, and suggested that counsel should confer with a view to a settlement.

Counsel adopted his Honour's suggestion, and, after a short conference, announced that they had come to terms, which were to pay applicant 15s. a week up to date, and £25 in settlement of his claim.

Judge Parry said it was an excellent settlement for both parties. The Medical Referee before seemed to think that if applicant made a special effort he would be able to do some work of a light nature. Now was a splendid opportunity for him to do something, considering the condition of the labour market. He entered judgment for applicant for £25 in settlement of all claims in respect to this accident, with costs, but declined to allow the doctor's fee for attendance that day.

Coal Mines Act Prosecutions.

Contraventions of the Coal Mines Act were admitted by William A. McIlvena and John Bond, the manager and electrician respectively of Shettleston No. 2 Pit, at Glasgow Sheriff Summary Court. The respondents were charged with failing, between August 17th and October 6th, to have an armoured non-flexible cable in connection with an electric pump in the Upper Kiltongue Seam of the pit securely attached to a switch-box, and failing to have a properly-constructed bush at the point where the cable entered the switch-box. Bond was charged, further, with failure to keep his log-book in the statutory form. An agent, on behalf of Bond, explained that the proper apparatus for the cable was ordered in August, but did not reach the pit until October. In consequence, Bond was a victim of circumstances over which he had no control.

Mr. J. D. Strathern, depute fiscal, said the regulations upon which the prosecution was founded were framed for the safety of coal mines, and must be strictly enforced. The security of the armouring in question was necessary to protect the insulated covering of the cable from being punctured, and thus allowing electricity to escape. The bush was also essential to prevent such a puncture. In the absence of these safeguards the insulating material of the cable had been punctured, and electricity escaped to the outside covering of a switch-box, and through that to the covering of the flexible cable which workmen had to handle. In consequence, in September last, a man was electrocuted at his work in connection with the pump in question. Both the respondents, he contended, had a heavy responsibility in the matter.

Sheriff Scott Moncrieff imposed a penalty of £5 on McIlvena and of £3 on Bond, the alternative in each case being seven days' imprisonment.

Helical Rollers, Ltd., *v.* Lockwood.

This action, by which the plaintiffs claimed specific performance of an agreement by the defendant to purchase certain patent rights and machinery, including two transformers, came before Mr. Justice Peterson, in the Chancery Division, upon a motion for judgment in default of defence and appearance.

Mr. Sheldon, who appeared for the plaintiffs, said that the agreement, which was contained in letters which were fully set out in the statement of claim, was an agreement that the plaintiffs should sell, and the defendant should purchase, for £200, two patents, two completed machines, and two partly-completed machines, together with the parts of such machines and two transformers. In January, 1916, the defendant wrote that it would be impossible for him to give more than £200, and on March 2nd he wrote that he was prepared to stand by his offer of January, and would be glad to know if it was accepted. On March 8th, the solicitor to the plaintiff company wrote that they were prepared to accept £200 for the patent rights, the two machines, and the two partly-completed machines, and that as they were giving up the lease of their premises on March 25th, they requested the defendant to come to Sheffield and arrange for the removal of the goods. The defendant did not complete the purchase though the plaintiffs had always been ready and willing to carry out their part of the agreement, and they had been compelled to store the machinery, incurring the cost of the rent for such storage

His Lordship said the defendant offered to purchase two machines and two transformers, but he did not see how they came within the agreement.

Mr. Sheldon said he was instructed that they did. They were part of the machines, and were required for the working.

The defendant was not represented, and his Lordship made an order for specific performance, as asked.

Postmaster-General v. P. E. Schweder & Co.

In the City of London Court, on Tuesday, the Postmaster-General made a claim against defendants, stock and share brokers, 28, Throgmorton Street, E.C., to recover £5 18s., being £2 7s. 6d. telephone rent and £3 10s. 6d. for the loss of a standard receiver. The £2 7s. 6d. was paid into Court.

Mr. Alsop, for the Postmaster-General, said the defendants had a private wire from one of their offices to Sir Julius Weil's office. When the office was given up, the telephone apparatus had disappeared.

Mr. Schweder said before the war they were probably the largest users of private and other telephones in the United Kingdom. They had private wires to Liverpool, Birmingham, Manchester, &c., and during five years paid £26,000 in rentals for telephones. Telephone operators came in and out of their office at all hours of the day and night, with and without permission, doing work, and, in his view, the telephone in dispute must have been taken away of course, not dishonestly by one of the Postmaster's servants. He was only defending the action on principle. Although their business was closed by the order of H.M. Treasury, H.M.'s Post Office still made them pay rentals for telephones, and the landlords still required payment of rent. They had taken every care of the telephone apparatus on their premises.

Mr. Alsop said all he had to show was that the standard in question had not been returned, and that he claimed he had proved.

Judge Atherley-Jones, K.C., said it was not his place to sympathise with unfortunate renters of telephones, for he was a telephone renter himself in several places, but he thought the instrument in question had been taken away by inadvertence by H.M. Post Office servants; therefore judgment would be given for the defendants.

BUSINESS NOTES.

Aluminium Developments in France.—It is proposed to increase the share capital of the Electro-Métallurgique Francaise of Froges from £620,000 to £1,000,000 by the issue of new shares, which will be subscribed by the Compagnie Générale d'Electricité, the Electro-Métallurgie of Dives, the Compagnie Francaise des Métaux, the Tréfileries du Havre, and the firm of Giros & Co. As the transaction will be effected at a premium, the new issue of shares will yield over £800,000, which will permit of considerable extensions being carried out at the works at Froges, and will assure to the company valuable customers in the form of the companies participating in the issue. It is considered that the scheme will at last enable the rolling of aluminium to be expanded to the extent which it deserves, and under the auspices of this new industrial organisation.

A Register of British Manufacturers.—Thirty-five Chambers of Commerce of the United Kingdom have agreed to co-operate in producing an official register of all British manufacturers, with a view to wresting trade from the enemy. The register will be printed in five languages—English, French, Russian, Italian, and Spanish—and will be widely distributed amongst Ambassadors, Consuls, and Colonial and foreign Chambers of Commerce, and a carefully-selected list of traders in neutral countries.—*Morning Post.*

Catalogues and Lists.—British Thomson-Houston Co., Ltd., Rugby.—List No. 5,521, describing their pressure governor panels for a.c. or d.c. circuits.

Messrs. T. W. Broadbent, Ltd., Victoria Electrical Works, East Parade, Huddersfield.—Catalogue No. 5 (leaflet No. 4), of eight pages, containing an illustrated description of their type T three-phase alternating-current generator, with tabulated prices, sizes, weights and dimensions. The machines are provided with specially large exciters, so as to have a sufficient margin of continuous current available for lighting purposes; the three-phase current is for power transmission only. Copies of the list will be sent on application.

The British Thomson-Houston Co., Ltd., of 77, Upper Thames Street, London, E.C., have issued two effective show-sheets in colours. One, in which an automobile with brilliant headlights is the main feature, is designed to popularise Mazda drawn-wire lamps for motor-car use. The other—a larger sheet assures the public that Mazdas are lamps that can be depended upon. Both show-sheets emphasise the British manufacture of the lamps. Copies may be obtained by contractors and other trade customers on application.

The Key Engineering Co., Ltd., of 4, Queen Victoria Street, E.C., have issued a vest-pocket celluloid calendar card for 1917.

Cambridge Scientific Instrument Co., Ltd., Cambridge. List No. 196, describing and illustrating their resistance pyrometers for indicating and recording temperatures from 200 to 1,200 C. An inset chart gives the hot-blast temperature record obtained in a large ironworks.

Liquidations.—Immisch Launch and Boat Co., Ltd.—Creditors must send particulars of debts, &c., to the liquidator (Mr. T. H. Underhill, 75, Durham Road, Manor Park, London), by March 5th.

New Superheater Co., Ltd.—A meeting is called for March 6th, at Salisbury House, E.C., to hear an account of the winding-up from the liquidator Mr. S. G. Bruff.

R.E.T. Construction Co., Ltd.—A meeting of creditors will be held at the Institute of Chartered Accountants, Moorgate Place, E.C., on February 12th.

Atlas Electrical Co., Ltd.—A meeting is called for March 5th, at 119, Finsbury Pavement, E.C., to hear an account of the winding-up from the liquidator, Mr. G. E. Corfield.

French Trade with South Africa.—A representative of a syndicate of French firms especially interested in the electrical and mechanical trades has been visiting South Africa in order to investigate on the spot what steps, if any, can be taken to improve trading relations between South Africa and France after the war. It is stated that the object of the syndicate is not to replace British goods in a British Colony by French goods, but to endeavour to obtain for French firms orders for goods which Great Britain and her Colonies cannot supply, and which, heretofore, have been given to German firms. It was thought that South Africa might find in France a market for copper, iron, asbestos, &c. The representative stated that it was probable that the syndicate he represented would establish branches in South Africa where stocks could be carried. Further, it was hoped to establish a line of steamers between France and Africa to take the place of the German East Africa Line. It was also suggested that an exhibition of French goods should be held in South Africa after the war.—*Board of Trade Journal.*

Machine Tool and Engineering Association, Ltd.—The annual meeting of this Association is to be held at Westminster, on Wednesday next. The report for 1916 shows that 24 firms have joined, and the membership is now 157. The financial position is satisfactory. The Association has continued to render assistance to the Ministry of Munitions. Five gentlemen had served on a Committee to advise the Controlled Establishments Section of the Ministry on questions of depreciation, allowance for additional output, &c., in so far as they affected the machine tool trade. Evidence was given before the Board of Trade Committee respecting engineering trade after the war. Suggestions have been made in a report presented to the Committee respecting steps that will be necessary on the part of the Government to assist in further developments of the trade. "A variety of Associations have been formed for the purpose of development of British trade after the war, but up to the present your directors have not seen their way to give support to any of these organisations. The Association directors hope at an early date to make representations to members concerning the prevention of the advertising of German goods after the war in British trade and technical journals."

Trade Announcements.—Messrs. Austin Walters and Son, of Manchester, have a well-equipped department for the manufacture of sheet-metal goods, such as large conical shades, resistance and circuit-breaker covers, and general sheet-metal work for electrical and ventilating engineers.

The premises of Messrs. Booth & Bomford, in Frederick Street, Cardiff, were involved in the fire which occurred there on January 29th. The firm's stock, tools, and fixtures were lost, but the books and papers were saved. Offices have temporarily been taken and business resumed at 9, Queen Street, Cardiff.

Electrical Imports of Uruguay.—According to a recent return, the imports of electrical goods into Uruguay during 1915 only attained a value of £46,140.

L.C.C. Contract Conditions.—The Highways Committee of the L.C.C. recommends in connection with the contracts with the British Westinghouse Electric and Manufacturing Co. and Ferguson, Pailin & Co., Ltd., for alterations and additions to switchgear at the Greenwich generating station, that the payments clauses to be inserted be as follows:—80 per cent. of the value of the machinery from time delivered, or of work executed on the site, 10 per cent. one month after the machinery has been taken over, and 10 per cent. after the expiration of the period of maintenance.

Book Notices.—*The Central* for December contains articles on "The Heat Treatment of Tool Steel," by C. W. J. Taffs; "The Value of a Training in Science in Industrial Work," by Dr. E. F. Armstrong; and "Machine Tools," by G. W. Tripp, as well as Old Student Notes, Reviews, &c.

"*Proceedings* of the Municipal Tramways Association (Incorporated), 1915-16." From the Association: Price 5s.

"Primary Batteries" (new and enlarged edition). By W. R. Cooper. London: *Electrician* Printing and Publishing Co., Ltd. Price 12s. 6d. net.

"Annales des Postes, Télégraphes, et Téléphones." Vol. V, Part 4. December, 1916. Paris: A. Dumas. Price 10 fr.

"Post Office Electrical Engineers' Journal." Vol. IX, Part 4. January, 1917. London: H. Alabaster, Gatehouse & Co. Price 1s. net.

"High-Speed Internal Combustion Engines." By A. W. Judge. London: Whittaker & Co. Price 15s. net.

The Faraday House Journal for the Lent Term contains a note on transmission of power between two A.C. power stations, by L. Romero, an abstract of Dr. Russell's Kelvin Lecture, and many additions to the Roll of Honour of past and present Faradians, as well as other items relating to the pupils of the College, &c.

LIGHTING AND POWER NOTES.

Australia.—The extension of the electric lighting system along the Milson's point line (Sydney North shore) is making substantial progress. The manager of the Sydney E.L. Department states that the supply should be available near the railway stations at Roseville, Lindfield, Killara and Gordon by the end of March or the beginning of April next.

The Sydney Council has decided to give a supply of electricity to the Paramatta Electricity Co.

The electrical engineer is to submit a scheme for providing coal storage in the vicinity of the Council's power house at Sydney.

The Shire of Rylstone, N.S.W., has applied for authority to install an electric lighting and power scheme.

Barrow.—Proposed Extensions.—The T.C. has approved the Electricity Committee's recommendation to extend the electricity works at a total estimated cost of about £25,800.

Bath.—The engineer has drawn attention to the maximum load of 1,318 kw. on December 18th last, with severe lighting restrictions in force, and in view of the probable shortage of plant when conditions become normal, he has been instructed to report on the situation.

Bedford.—The R.D.C. has given its consent to the use of overhead lines in the district by the T.C. for the transmission of energy to a new factory in the rural area.

Continental.—Spain.—According to recently-compiled statistics, the hydro-electric energy represented in the watercourses of Spain amounts to over 5,000,000 h.p. There are at the present time 110 large hydro-electric installations which utilise a total of 281,490 h.p., and a number of small plants which utilise 300,000 h.p., these figures would probably be increased by the end of last year to 500,000 h.p., several important generating plants having been in course of construction. The power reserved to the 110 large installations is 1,020,790 h.p., leaving 739,300 h.p. unappropriated. Numerous concerns utilise water directly as motive power without transforming it into electricity. In Catalona, the weaving industry utilises about 200,000 h.p., half of which is utilised directly. The rivers which flow from the Pyrenees and traverse Catalona aggregate 1,135,000 h.p., but the concessions granted account for only 800,000 h.p. The power furnished by Spanish rivers is shown as follows :—Ebro and its feeders, 1,300,000 h.p. ; Duero, 900,000 h.p. ; Guadalquiver, 750,000 h.p. ; Tagus, 700,000 h.p. ; Guadiano, 370,000 h.p. ; Mino, 250,000 h.p. ; Jucer, 190,000 h.p. ; Segura and feeders, 100,000 h.p. ; other rivers, 600,000 h.p. ; or a total of 5,160,000 h.p. These figures are suggestive of the opening for electric plant which the industrial progress of Spain offers.—*L'Ingegneria Ferroviaria.*

La Federacion Patronal de Industrias Electricas is the name of a new concern which has lately been organised in Barcelona, with a capital of £10,000, to develop electric lighting and power installations in Spain.

Norway. The municipal electric sub-station in Hausmansgata, Christiania, is to be rebuilt, at a cost of 381,000 kroner.

The Divisional authorities of Bolne have decided to raise a loan of 150,000 kroner, with a view to the construction of a communal electricity works, Governmental approval of the scheme having been secured.

The Kvinnherred Divisional Council has approved a concession to the Aktie Selskab Mauranger for the development of the Mauranger Waterfalls. Some 100,000 h.p. is to be secured.

Large extensions of the Stavanger Elektro-Staalverk are planned, it having been decided to double the production, and work up all steel into finished goods. A rolling mill is to be built, and electric driving is to be extended, so as to exclude the use of coal.

Approval has been given to the local authorities of Gjerstad and Bremanger, Norway, to raise loans to develop water power for electrical industries in those localities for lighting and electrochemical industries. The communal administration of Jevnaker, Lunner, Gran and Grandlu has appropriated £134,000 to enlarge the Hadeland electric station. The Bremanger Power Co. will erect a factory for producing carbide and cyanamide, producing 30,000 tons of carbide per year, of which one-third will be used for making cyanamide. A French-American syndicate is considering the erection of a large electrochemical plant in the Telemarken district, using 100,000 h.p. from the Maar Falls in Tinn.—*M. and C. Engineering.*

Cork.—It is expected that electricity will be the lighting medium in connection with the scheme for artisans' dwellings necessitated by the industrial developments on the Cork Park and Marino sites, where motor and engineering works are to be started. The Corporation is taking steps to obtain a Government grant.

Dover.—Loan Sanction.—On account of the additional expenses (£1,300) caused by war conditions, the Government has contributed £500 towards the cost of a new cable ; it has also lent £3,814 to the T.C. to cover the cost of the cable, the interest payable being ½ per cent. over the current interest of the Government loan for the time being, with a minimum of 5 per cent.

Dublin.—At a meeting of the Dublin Corporation, on Monday, a letter was read from Mr. M. Ruddle, city electrical engineer, expressing surprise that a recommendation to supersede him by the creation of a new and, in his opinion, unnecessary, post, should have been brought forward without any opportunity being taken by the Special Committee investigating the administration of the electrical department to ascertain his views, as chief executive officer, of either the expediency or the necessity of such a proposal. His record of service during the 26 years he had had charge of the department should entitle his opinion to have some value. He did not know with what powers it might be proposed to endow Mr. D'Alton, but he did know that if given equal powers, his more intimate knowledge of the department would enable him to secure better results than that gentleman, as a stranger, could hope to achieve. Having spent the best years of his life in the service of his native city, Mr. Ruddle hoped the Council would recognise that he had first claim on any additional powers that might be given. The Council decided to refer the letter to the Special Committee.

Horsham.—Price Increase.—The Lighting Committee of the U.D.C. reports that it has under consideration the desirability of abolishing the maximum demand system, and adopting instead flat rates ; and that in view of the heavy deficiency which will result on the working of the electric light undertaking during the war, it has no alternative but to increase the price of energy as from March 31st next.

Liverpool.—Rate Relief.—The Tramways and Electric Power and Lighting Committee has decided to recommend a contribution towards the relief of the rates of £65,000 from the profits of the electric lighting department for the past year.

London.—Shoreditch.—With reference to our note last week regarding proposed extensions, it is intended to install a 5,000-kw. turbo-alternator at Whiston Street station, together with 11,000-volt, three-phase switchgear, also rotary converters at Coronet Street station, and two three-core ·25 cables to connect up the two stations, the total cost being estimated at £40,950.

L.C.C.—The Finance Committee recommends the sanction of the Council to the borrowing of £23,152 by the Woolwich B.C., for electricity purposes (turbo-alternator, £11,935 ; switchgear, £1,017 ; mains, &c., £10,200).

Manchester.—The Corporation has arranged that skilled men in the electricity department shall receive a minimum war allowance of 6s. 6d. a week.

New Zealand.—The poll of the Christchurch City Council on the proposal to raise £60,000 to extend the Council's electricity scheme, resulted in its favour.

The Tuakau (N.Z.) Road Board has decided to proceed with its electric lighting scheme and other works, for which a loan of £12,000 was recently sanctioned.

Nuneaton.—Proposed Loan.—The T.C. has applied to the L.G.B. for a loan of £1,950 for the provision of a new boiler and feed pump for the electricity works.

Rochdale.—Last week was one of much difficulty in connection with the electricity undertaking, and on Thursday and Friday last many consumers of power had their day supply cut off. Owing to the dearth of men to keep the boilers free of ashes, three out of the six boilers were out of use. During the week a quarter of the spinning department of the D.R. mills were run on a night shift, by arrangement with the Electricity Committee, so as to relieve the day load. Considerable criticism has been made, but it is stated that the Committee has been unable to secure delivery of the necessary ash plant. The tramway service was also affected to some extent.

Sunderland.—Year's Estimates.—The estimates for the year ending March 31st next were presented to a meeting of the Electricity and Lighting Committee on the 1st inst. The statement showed an output of 15,403,354 units, as against an actual output of 15,036,376 in the preceding year. The balance to be carried to the net revenue account was £31,462, slightly more than £800 above the actual balance for the preceding year. Of this sum, £28,309 would be absorbed by repayment of loans and interest : contribution to capital was put at £1,137 ; income-tax, £2,241 ; and the renewals fund, £870. These appropriations would exceed the amount brought forward by some £1,095, which debit balance would be carried forward to the next year's account. Alderman Bruce said that the debit was due in part to increase in income-tax, in insurance, and in interest on loans, and employés' wages were a heavier item. He added that it was estimated that a loss of £1,063 had been occasioned solely through the bad quality of coal supplied to the department during the year.

Tasmania.—In regard to the proposal of the Launceston City Council to consider the question of additional steam plant, Mr. J. H. Butters, chief engineer and manager of the Government hydro-electric scheme states there is no necessity to extend the Council's steam plant temporarily. If all the power mentioned in the Amalgamated Zinc Co.'s contract is actually taken by the company, this, together with other commitments, will absorb all that it is advisable to connect to the Great Lake scheme, but two years' notice must be given by the Zinc Co. of its requirements under the second block, and also any large industry which might be established at Launceston would probably require from 18 months to two years to erect its buildings and equipment. A consumer for a large block of power could at once enter into a contract, which, together with the existing Launceston load, would justify the erection of a line from the Great Lake, and Arthur's Lake to Launceston. Then in the event of the Amalgamated Zinc Co. ordering their second block, arrangements could be made to proceed with the Arthur's Lake scheme concurrently with an extension of the Great Lake scheme, and these two developments would be completed at about the same time, when the Launceston load could be taken from Arthur's Lake and the Zinc Co.'s load from the Great Lake.—*Tenders.*

Tipperary.—Reporting to the Guardians, Mr. J. P. Tierney, consulting engineer, stated that the electricity plant at the workhouse buildings was totally inadequate; the battery had been completely overtaxed, and new plant would be necessary in the laundry.

Todmorden.—Proposed Turbine Plant.—The Corporation has approved a recommendation by the Electricity Committee that the existing generating plant is obsolete, and that a more economical plant should be installed, and has decided that steps be taken to install a 1,000-KW. turbo-generator, with all auxiliaries, at an estimated cost of £10,000, and that application be made to the L.G.B. for sanction to borrow this sum.

TRAMWAY and RAILWAY NOTES.

Accrington.—In accordance with an agreement between the two Corporations, the Blackburn and Accrington Corporation tramcars have commenced to run a through service.

Ashton-under-Lyne.—The Committee on Production has notified that the tramway bonus in the S.E. Lancashire area is to include increases in wages or bonuses granted since the war began.

Bacup.—Arbitration Award.—Mr. J. M. M'Elroy has issued his award in the arbitration betwen the Bacup and Rawtenstall Corporations, on the proposal of the latter to increase the number of stages on the Bacup-Rawtenstall tramway system. The result of the award is that there is no change in stages or fares, Bacup thus winning its case.

Blackburn.—Fare Increase.—The proposal to increase the fares and shorten the penny stages was agreed to by the T.C., an amendment to refer the matter back being defeated by a large majority.

The Corporation, on February 2nd, decided to adopt the award of higher wages for tramway workers; female employés will participate equally in the advance.

Bolton.—The Chief Industrial Commissioner has intimated to the Tramway Committee that the tramway bonus is to be proportionally reduced where time is lost, as in the case of wages.

Colne.—The T.C. has discontinued the 1½d. and 2½d. fares on the tramways, and withdrawn the books of discount tickets, owing to the advance in wages and other charges. Workmen's tickets are to be continued.

Continental.—Norway.—The authorities of Stavanger have unanimously decided to sanction the outlay of 1,275,000 kroner on the construction of an electric tramway in that city.

Darwen.—Fare Increase.—The Tramways Committee has to provide £1,240 a year for electricity, separation allowances, and increased wages over pre-war expenditure, and in order to meet these liabilities the Committee has decided to raise the fares.

Dundee.—The question of the use of electric haulage for jute and other goods was referred to by Mr. T. S. Dick at a city meeting. He estimated that the horse-haulage of a million tons of jute cost £13,541, whereas by electricity the work could be done for £4,464.

Glasgow.—At a meeting of the Tramways Committee, last week, it was announced that the system was now free from debt, all the capital expenditure of £3,835,156 having been repaid. The total of the sinking fund applied to the reduction of debt had been £1,506,267, and now the amount of the department's investments not only equals the balance, but there is a sum of £119,055 at the credit of the depreciation and permanent-way renewals fund.

Halifax.—Fare Increase.—The proposal of the Halifax Tramways Committee to effect material increases in tramway fares is arousing considerable opposition, both in Halifax itself and in surrounding townships which depend largely upon the Halifax tramway service. The Brighouse Corporation, last week, made comparisons between the Halifax and Bradford tramway services (both of which have some contact with the town), and the remarks were not entirely complimentary to Halifax. The Brighouse Council passed a unanimous resolution of protest against the Halifax Committee's proposal.

L. & Y. Electric Railway.—Owing to the failure of the electric current, there was a dislocation of passenger traffic on the Liverpool-Southport electric line on Monday. Practically all the trains were late, and they had to be hauled by steam locomotives.

Liverpool.—Rate Relief.—The Tramways and Electric Power and Lighting Committee has decided to recommend that £125,000 from the profits of the tramway department for the past year be allocated towards the relief of the rates.

London.—L.C.C.—The Highways Committee has appointed a Special Sub-Committee to consider what alterations should be made in connection with tramway services and fares and methods of collection of fares. The Committee has had under consideration the effect of the closing of certain railway stations and the increase in fares.

On the South Bermondsey and Old Kent Road routes additional trailer cars have been put into service during the busy periods of the day. On the Forest Hill and Dulwich services little can be done at present in the direction of providing additional accommodation. Owing to the shortage of drivers, which now exceeds 350, the service on any particular route can only be increased by reducing the services on others.

Additions are to be made to the condensing water system at the Greenwich power station, at a cost of £23,500, to enable the new turbo-generator plant to be fully used. A new agreement has been come to with the London Electric Supply Corporation for a give-and-take stand-by supply at the New Cross and Camberwell sub-stations, up to 3,000 KW.

The Highways Committee reports that the Court of Arbitration of the B. of T., on December 20th, awarded motormen, conductors, and other male employés of the traffic section a further war bonus of 3s. 6d. per week, or 7d. per day; the claim of the female employés was not established.

The Highways Committee has settled 1,175 claims against the Council during the three months ended December 31st last in respect of accidents in connection with the working of the Council's tramways, amounting to £8,747. In 26 other cases, action was brought against the Council; in 14, an adverse verdict was given, and £1,600 and costs had to be paid.

On Monday the Council's conduit tramway services were generally dislocated owing to the melting snow and salt getting into the conduits and causing short circuits. The cars ran spasmodically until 5 p.m., when the whole of the conduit sections were shut down, and many thousands of people were left stranded at the various termini. Those routes using the overhead trolley system were unaffected.

Sunderland.—Year's Estimates.—The estimates for the year ending March 31st next show a total income of £85,352, compared with the actual income for 1915-16 of £79,124. Working expenses are set down at £50,127, against £44,455. Traffic expenses show an increase of £2,500, largely due to the increased wages paid to employés. The estimated balance to be carried to the net revenue account, including bank interest, is £35,447. It is suggested to appropriate £5,000 in relief of the rates.

TELEGRAPH and TELEPHONE NOTES.

Italy.—Unlike the German Mercantile Marine before the war, many Italian and French merchantmen are unprovided with wireless installations. The Direction of the Italian Marine has taken the matter in hand, and, by a recent decree, prescribes that every ship carrying more than 50 persons must be provided with a wireless installation and a trained staff.—*L'Industrie Electrique.*

Telegrams by Telephone.—As the delivery of telegrams by messenger is becoming more and more difficult, the Postmaster-General has again drawn attention to the advantages of receiving by telephone telegrams directed to an abbreviated address. An appreciable saving of time results from this method of delivery. Any registrant who is willing to accept delivery of his telegrams by telephone should communicate in London, Dublin, and Edinburgh with the Secretary, and in the country with the postmaster of the town at which his address is registered, when the necessary instructions will be issued.

Telephone Deposits.—Private subscribers to the British telephone system are being asked to pay larger deposits on the message-rate system, owing to the accounts being sent out quarterly, instead of monthly, for the sake of economy in book-keeping.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—Feb. 19th. Municipal Council. Meters, maximum-demand indicators, feeder regulators. Specification from E.L. Department, Town Hall.

March 5th. Council. One 7,500-K.V.A. turbo-alternator. See "Official Notices" January 5th.

Adelaide.—March 28th. P.M.G.'s Department. Telephones, telephone parts, line and battery material, &c. Schedules 444 to 453. See "Official Notices" February 2nd.

Melbourne.—February 14th. City Council. 699,000 arc lamp carbons. See "Official Notices" February 2nd.

March 21st. Victorian Railways 200 Half-watt lamps and 100 lanterns; also 100 contact couplings.* April 4th. Terminal blocks (complete) for electrical connections.—*Australian Mining Standard.*

March 6th. Council. 1045 Electricity Recording Meters. See "Official Notices" to-day.

Brisbane.—March 28th. P.M.G.'s Department. Cable (switchboard), Schedule 394.

Canada.—March 28th. Toronto Electric Commissioners. Synchronous condensers, 5,000, 7,500 or 10,000 K.V.A. capacity. See "Official Notices" to-day.

Cheltenham.—February 14th. Corporation. Twelve months' supply of electric light fittings. Mr. J. S. Pickering, Borough Engineer.

Halifax.—February 12th. Corporation Tramways Committee. Stores and materials, including lighting materials, wheel brake blocks, trolley and overhead line materials, &c., for twelve months. Tenders to Tramway Engineer.

Harrogate.—March 5th. Corporation. By-product steam boiler plant. See "Official Notices" February 2nd.

Keighley.—February 24th. Keighley and Bingley Joint Hospital Board. Electricians' work for 12 months. (See last issue.)

London.—L.C.C.—The Highways Committee recommends that tenders be invited for the supply of tramway fittings, equipment, &c., for alternative periods of six and twelve months in 1917-18.

BERMONDSEY.—February 22nd. B. of G. Three, six and twelve months' supply of electric lamps. Mr. E. Pitts Fenton, Clerk, 283, Tooley Street, S.E.

Manchester.—March 7th. Electricity Committee. Coal-conveying plant and suction ash plant. See "Official Notices" to-day.

Salford.—February 12th. Miscellaneous stores for Tramways Department. General Manager, 32, Blackfriars Street.

South Africa.—DURBAN.—February 12th. Six four-ton electric travelling portable jib-cranes for the harbour.*

March 8th. Department of Posts and Telegraphs. Installation of an automatic telephone exchange at Pietermaritzburg. See "Official Notices" January 19th.

Spain.—The municipal authorities of Tuy (Province of Pontevedra) have lately invited tenders for the concession for the electric lighting of the town during a period of 25 years. Tenders have also been invited by the municipal authorities of Elda (Province of Alicante) for a similar concession for only three years.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Australia.—MELBOURNE.—City Council. Accepted tenders:—

Two hundred 300-watt gas-filled metal-filament lamps, and six hundred 50-watt ditto. Aust. General Electric Co., £540.

10,000 assorted metal filament lamps. British General Electric Co., £790.

Bolton.—The Corporation has accepted a tender for the supply of an electric tipping-wagon.

Leeds.—Electricity Committee. Recommended tenders:

Babcock & Wilcox, Ltd. Two water-tube boilers and accessory plant for the new generating station, £12,959.

Wm. Airey & Son.—Foundations, £2,090.

London.—L.C.C.—The Highways Committee has accepted the following tenders:

325 tons of rolled-steel bar for magnetic brake shoes, for the Tramways Department.—Frodingham Iron & Steel Co., Ltd.

Maintenance of the battery of 280 cells at the Greenwich generating station for a further period of 10 years, at £116 a year.—Tudor Accumulator Co., Ltd.

Supply of cotton-covered wire (tramways equipment 1916-17, Class T, 6a).—Items 1 and 4, London Electric Wire Co. & Smiths, Ltd. (approximate amount £691); items 2 and 3, B. I. & Helsby Cables, Ltd. (approximately £1,353); item 5, Midland Electric Wire Co., Ltd. (approximately £388).

The Highways Committee reports the purchase of 27,735 tons of coal for use at Greenwich generating station, at a cost of £44,166, during the quarter ended December 31st, 1916.

Manchester.—Electricity Committee. Accepted tenders:

Cable.—Western Electric Co., Ltd.; Pirelli-General Cable Works, Ltd.; C. Macintosh & Co., Ltd.; B.I. & Helsby Cables, Ltd.; W. T. Glover and Co., Ltd.; Liverpool Electric Cable Co., Ltd.; Callender's Cable and Construction Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.

Stoker links.—Babcock & Wilcox, Ltd.

Steel air-ducts.—British Westinghouse E. & M. Co., Ltd.

Salford.—Electricity Committee. Tenders accepted:—

Equipping a blank switch cubicle at the Trafford sub-station, £102; supply of switch cubicle, £153.—British Westinghouse E. & M. Co., Ltd.

FORTHCOMING EVENTS.

Physical Society of London. Friday, February 9th. At 5 p.m. At the Imperial College of Science, South Kensington. Annual general meeting.

Salford Technical and Engineering Association.—Saturday, February 10th. At 7 p.m. At the Royal Technical Institute, Peel Street. Paper on "Modern Iron Foundry Practice," by Mr. W. Rawlinson.

North of England Institute of Mining and Mechanical Engineers.—Saturday, February 10th. At 2 p.m. At the Wood Memorial Hall, Newcastle-on-Tyne. Ordinary meeting.

Birmingham and District Electric Club.—Saturday, February 10th. At 7 p.m. At the Swan Hotel, New Street. Presidential address and smoking concert.

Chief Technical Assistants' Association.—Saturday, February 10th. At 3 p.m. At the Tavistock Hotel, Covent Garden, W.C. Adjourned discussion on "The General Principles in connection with the Lay-out of Power Stations."

Electro-Harmonic Society.—Monday, February 12th. At 6.15 p.m. At the Venetian Chamber, Holborn Restaurant. Concert (ladies' night).

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, February 13th. At 7 p.m. At the Engineers' Club. Paper on "Frequency Changers," by Mr. R. Townend.

(**Newcastle Local Section**).—Monday, February 12th. At 6.45 p.m. Discussion on "The Metric System," to be opened by Mr. G. Stoney.

(**Scottish Local Section**).—Friday, February 16th. At 7.30 p.m. At 207, Bath Street, Glasgow. Eighth Kelvin Lecture, "Some Aspects of Lord Kelvin's Life and Work," by Dr. A. Russell.

Royal Institution of Great Britain. Thursday, February 15th. At 3 p.m. Lecture on "The Mechanism of Chemical Change," by Prof. F. G. Donnan, F.R.S.

Belfast Association of Engineers.—Thursday, February 15th. At 7.45 p.m. At the Municipal Technical Institute, College Square. Paper on "Liquid Air," by Mr. E. A. S. Swinson.

Institution of Mechanical Engineers.—Friday, February 16th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Annual general meeting.

Greenock Electrical Society.—Saturday, February 17th. Visit to Dellingburn power station. (Members to meet at 2.30 p.m.)

Association of Mining Electrical Engineers.—Saturday, February 17th. At 4.30 p.m. At the Royal Technical College, Glasgow. Paper on "Electrical Converters," by Mr. C. S. Buyers.

NOTES.

The Electro-Harmonic Society.—The next concert (ladies' night) will be held at the Holborn Restaurant, in the *Venetian Chamber*, on Monday evening next, February 12th, commencing at 6.15 p.m. The artistes will be as follows:—

Miss Maude Willby, soprano; Miss Mabel Braine, contralto; Mr. Allen Engles, bass-baritone; Mr. Paul Brunet, violin; Mr. Ben Lawes, humorist; Miss Edith Eatherley, entertainer at the piano; Mr. Bernard Flanders, A.R.A.M., solo pianoforte and accompanist.

Appointments Vacant.—Installation inspector (45s.) and fireman used to chain-grate stokers (35s.), for the Southampton Corporation electricity department: Diesel engine driver and switchboard attendant, for the Sale U.D.C. electricity works: charge engineer (£120), for the Ilford U.D.C. electricity department.

Volunteer Notes.—FIRST LONDON ENGINEER VOLUNTEERS.—Headquarters, Balderton Street, Oxford Street.—Orders for the week, by Lieut.-Col. C. B. Clay, V.D., Commanding:—

Monday, February 12th. Technical for Platoon No. 8, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30—8.

Wednesday, February 14th.—Instructional Class, 6.15. Platoon Drill, Platoon No. 2.

Thursday, February 15th.—Platoon Drill, Platoon Nos. 5 and 6. Ambulance Class by M.O., 6.30.

Friday, February 16th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.30—8.30.

Saturday, February 17th. Commanding Officer's Parade, 2.45. Uniform.

Sunday, February 18th.—Entrenching at Otford. Parade Victoria (S.E. & C. Railway Booking Office), 8.45 a.m.

(By order), MACLEOD YEARSLEY, *Adjutant.*

German Electrician Recaptured.—The *Times* states that at Marlborough Street Police Court, on January 31st, Emil Schmidt, 26, a German, described as an electrician, was sentenced to six months' imprisonment, with hard labour, for failing to comply with the registration regulations. Schmidt escaped from an internment camp on December 29th. On January 27th he was recognised by detectives in Wardour Street. He ran away, but was pursued, and captured in Leicester Square.

The Russian Language.—Birmingham Chamber of Commerce has raised £10,000 to endow a chair in Russian at the University, and a lecturer has been appointed to begin the work of the department.—*Times.*

Foreign Trade.—THE JANUARY FIGURES.—The official returns of imports and exports during last month contain the following electrical and machinery figures:—

	January, 1917.	*Increase or decrease.*
IMPORTS:—		
Electrical goods, &c. ...	£176,052	+ £57,150
Machinery	717,626	+ 16,808
EXPORTS:		
Electrical goods, &c.... ...	371,084	+ 91,151
Machinery	1,988,261	+ 508,130

Tramways and Substitution.—With reference to the Note on this matter on page 97 of our issue of January 26th, the *Daily Chronicle* says that to meet the shortage of tramcar drivers the War Office will release from the Army motormen who are not in Class A, in exchange for other tramway workers up to 30 years old who are Class A men.

Engineers' Wages.—Representatives of the workmen engaged in the engineering and allied trades, together with delegates from the Employers' Federation, resumed their conference with Sir George Askwith at the Chief Industrial Commissioner's Department, Westminster, on Monday, when further consideration was given to the question of the method of procedure for dealing with wage applications. The Unions represented included the Amalgamated Society of Engineers, the Steam Engine Makers, Tool Makers, United Machine Workers, Electrical Trades' Union, Scientific Instrument Makers, Pattern Makers, Blast Workers, and General Workers' Union. The proceedings were private, but at the close Mr. Robert Young, secretary of the Amalgamated Society of Engineers, stated that as a result of the conference satisfactory conditions were agreed to for dealing with wages on a national basis. *Morning Post.*

The Metric System.—The Executive Council of the U.D.C. Association on January 15th, at Palace Chambers, Westminster, passed the following resolution:—This Council hereby expresses itself in favour of the decimal system for coinage and the metric system for weights and measures, and advises members of the Association to support the efforts of the Decimal Association in bringing to a successful issue this desirable and much-needed reform.

Germany's After-the-War Trade Schemes.—In a series of Empire Trade Notes issued by the British Empire Producers' Organisation, there appears the following translation of a circular letter which, it is stated, has been posted extensively from an office in Havana:—

"Recently there has been formed in Germany a vast organisation, entitled 'The German Economic Federation for Central, South America, and the Antilles,' to foment export commerce when peace is declared. Its field of action will be on this side of the Atlantic, in all the Spanish-American countries.

"With it will be affiliated the undermentioned Associations already in existence, viz.:—

"Argentine-Germany;

"Brazil-Germany;

"The Hamburg Export Union; and

"The great German steamship companies.

"A newspaper will be published in Spanish and Portuguese to supply all information, scientific, banking and commercial, to the Spanish-American countries, and an annual publication which will give publicity to everything related to the commerce of those countries.

"In Berlin a club will be instituted to which we will admit all the business men and other travellers from the Americas.

"With peace will commence a great maritime activity. Germany is in the position of being able to place at once in active service her steamers, and will have the same tonnage at sea as before the war, even although she should not recover the steamers which are prisoners in enemy ports. The shipping constructed during the war is approximately equal to that which has been captured or destroyed.

"The annual subscription will be *ad libitum* from each subscriber, but not less than—

"Marks: 120 annual subscription from firms.

"Marks: 25 admittance fee from firms.

"Marks: 30 annual subscription from individuals.

"Marks: 10 admittance fee from individuals.

"I invite you to become a member of the Federation, and to that effect I permit myself to enclose a subscription form, begging you to return same with your remarks."

L.C.C. Electrical Workers' Wages.—The Highways Committee reports the award, dated December 29th, of the B. of T. Court of Arbitration to certain grades of employés of the rolling stock section of the Council's tramway department, the advances to date from November 6th.

The wages of engineering employés (excepting toolmakers employed on munition gauge work), millwrights, electricians, coach-body makers, wheelwrights, and mechanical and electrical repair staff at car sheds (excepting light and power attendants) to be advanced 3s. a week. Light and power attendants at car sheds, beltmen and oilers, armature winders, armature banders, magnet and coil winders, plough repairers, wiremen at central car repair depôt, &c., those receiving under 35s. a week to be advanced 4s. a week, and the wages of those receiving 35s. a week and over to be advanced 3s. a week. Women at the central car repair depôt to be advanced 2s. a week.

The Court commends to the favourable consideration of the Council the case of women under 21 years of age who are engaged at the repair depôt, and who are doing women's work.

From January 29th, 1917, the hours of the electrical and repair staff at car sheds (except light and power attendants) employed on night shifts to be reduced from 10 hours to 9 hours, the men to be paid the same amount as if working 10 hours; if at the end of four calendar months the Council finds that the reduction of hours is not reasonably satisfactory, the Council may alter the number of hours from 9 to 10, or to any other period of time between 9 hours and 10 hours (the same amount of pay being continued).

The award to the electrical section is as follows:—

Charge engineers at sub-stations to receive a war bonus of 2s. 6d. a week. Shift workers and certain other employés at Greenwich generating station, men earning under 43s. a week to receive a further war bonus of 3s. 6d. a week, those earning 43s. up to and including 50s. a week to receive a war bonus of 3s. a week, and those earning over 50s. a week to receive a war bonus of 2s. 6d. a week.

Light and power attendants employed in the permanent-way section of the tramway department receiving under 35s. a week to be advanced 4s. per week; 35s. and under 43s., 3s. 6d. a week; 43s. and over, 3s. a week.

The whole of the advances to be regarded as war wages.

Excess Profits Duty.—The Thermo-Electric Ore Reduction Corporation, Ltd., of York Street, Luton, made application to the Commissioners of Inland Revenue for an increase of the statutory percentage as respects the "business of manufacturing and preparing tungsten, molybdenum, chromium, tantalum, vanadium, and their alloys, so far as the same are used in the manufacture of high-speed steel." The Commissioners having referred the case to the Board of Referees, have ordered that the statutory percentage shall be increased to 12 per cent. in the case of a trade or business carried on or owned by a company or other body corporate, and to 13 per cent. in the case of any other trade or business.

Standard Battery Jars for Electrical Vehicles.—At the recent meeting of the American Society of Automobile Engineers, in New York, the recommendations of the Electric Vehicle Committee with regard to battery dimensions were adopted. Two heights of jars were recommended, one type, known as "high-rib" jars, having a sediment space of $2\frac{3}{4}$ in., and the other, styled "low-rib" jars, $1\frac{3}{4}$ in. The dimensions of each type of jar are all constant, except as regards the length, but the number of lengths has been considerably reduced from the total number at present in use. The dimensions proposed for high-rib jars are as follows:—

Height	$13\frac{5}{8}$ in.
Width	$6\frac{1}{8}$ in.
Thickness of wall	$\frac{1}{8}$ in.
Height of rib	$2\frac{3}{4}$ in.
Height above rib	$10\frac{5}{8}$ in.
Lengths	2 in.—$8\frac{1}{4}$ in.

The dimensions for low-rib jars are as follows:

Height	$12\frac{7}{16}$ in.
Width	$6\frac{1}{8}$ in.
Thickness of wall	$\frac{1}{8}$ in.
Height of rib...	$1\frac{3}{4}$ in.
Height above rib	$10\frac{7}{16}$ in.
Lengths	2 in.—8 in.

Tolerances: + or − $\frac{1}{32}$ in. for all dimensions except thickness. Jar walls $\frac{5}{32}$ in. thick are optional, but when used all outside dimensions, including height, should be increased $\frac{1}{16}$ in.

Alquist Gearing.—At the annual meeting of the Society of Naval Architects and Marine Engineers, U.S.A., Mr. W. L. R. Emmet described a new form of gear which has been developed by the General Electric Co. for use in ship propulsion. The design is such as to afford a distribution of strain, and means by which excessive strain would not be imposed upon any part through slight imperfections, distortions, or inaccuracy. The gear is built up of a number of plates machined to a form which gives them the desired degree of lateral flexibility. These plates are put together, engaging solidly at the hub, and also engaging on a narrow edge at the periphery. When so put together, they form a solid cylinder, which can be cut spirally in the ordinary manner. After cutting, the edge engagements are released with a small dividing tool, so that each disk operates independently, and is free to deflect laterally under the side pressure which results from its diagonal engagement with the pinions. The parts are so proportioned that the lateral deflection can at no time involve fibre strain which could possibly cause destructive fatigue.

Gears of this character have been applied to 72 sets in which steam turbines drive electric generators, and contracts have been closed for machinery aggregating 215,200 H.P. for the propulsion of 70 ships. Some of these electric generating sets have been in service for a year and a half.

Gears of the Alquist type are applied in three ways: First, a single reduction has been accomplished by engaging one solid pinion with a flexible gear; second, by engaging a solid pinion with two flexible idlers, which in turn engage with a solid large gear; and third, in a double reduction where a solid high-speed pinion engages flexible gears on two countershafts, these countershafts carrying solid pinions, both of which engage a flexible gear on the same low-speed shaft. In the last two applications the flexibility of the gears serves to equalise the load between all the driving points and the use of a plurality of driving points on the large gear reduces the length of face necessary on that gear.

From experiments made at Schenectady, it would appear that gears are more efficient at low speed than at high speed. Solid gears at low speed involve difficulties, because they diminish pinion diameters and increase pinion lengths, whereas the flexibility of the Alquist gear enables one to compensate easily for all possible degrees of torsional yield in the pinion; and with such gears the peripheral speed can safely be reduced by making the gears longer and of smaller diameter.—*Power.*

Shipyard Labour.—The Secretary of the Admiralty announces that the Shipbuilding Employers' Federation and the Engineering Employers' Federation have nominated the undermentioned gentlemen to represent them respectively on the Advisory Committee which has been constituted in association with the Shipyard Labour Department of the Admiralty:

Shipbuilding Employers' Federation: Mr. G. J. Carter, Mr. W. H. Dugdale, Mr. F. N. Henderson, Mr. Herbert Howell, Mr. M. C. James, Mr. N. E. Peck.

Engineering Employers' Federation: Mr. W. H. Allen, Mr. Thomas Bell, Mr. James McKechnie, Mr. D. S. Majoribanks, Mr. Allen N. Smith, Mr. W. Rowan Thomson.

Tudor Accumulator Co., Ltd.—The date for sending in tenders for the purchase of shares in this company has been extended by the Public Trustee from February 5th to February 26th. An advertisement appears elsewhere in this issue.

Institution and Lecture Notes.—Physical Society of London. At the meeting held on January 26th, a paper, entitled "A Clock of Precision," was read by Mr. C. O. Bartrum. The principal feature of the author's arrangement is the employment of a "slave" clock to do the great part of the work, leaving the master pendulum no function beyond that of controlling the rate of the other. The master pendulum swings freely except for a short period (about one-fifth of a second) every minute, during which it receives an impulse from a small falling pallet electromagnetically released by the slave clock. At the end of its fall the pallet closes a second circuit and is restored to its initial position. These two electric circuits also energise parts of the mechanism in the slave clock by which the latter is kept in time with the master pendulum. The lagging of correction behind error, with the resulting periodic fluctuation in the rate, is reduced almost to the vanishing point by the introduction of a "negative backlash" in the control mechanism. The paper contains a mathematical discussion of the best working conditions and of the possible magnitude of errors which might arise from various causes.

A paper on "The Effect of Water Vapour in the Atmosphere on the Propagation of Electromagnetic Waves," by Dr. Frederick Schwers, was taken as read. It was shown that the lowest layers of the atmosphere (1,000 to 1,500 metres approximately in depth) refract electromagnetic waves towards the earth, so that the greater part of the space waves will reach the receiver, contrary to the conclusion of Kiebitz.

Institution of Electrical Engineers.—At a meeting of the Western Local Section, at the Merchant Venturers' Technical College, Bristol, on Monday last, Mr. J. S. Peck read his paper on "The Parallel Operation of Electric Power Stations." Mr. W. A. Chamen (general manager, South Wales Power Distribution Co.) opened the discussion, and was followed by Mr. G. Morley New (Cardiff tramways), Mr. A. T. Kinsey (Bristol Post Office telephones), and Prof. David Robertson (Bristol University). The contributions to the discussion and Prof. Robertson's remarks on the synchronising torque of two generators with slight phase displacement varying with the total impedance of the two generators and interconnecting link, illustrated by blackboard diagrams, were of a highly interesting nature. Mr. Peck briefly replied.

The Society of Engineers (Inc.). Amongst the premiums awarded by the Council for papers read before the Society during 1916, was the Bernays Premium, to Prof. J. A. Fleming, for his paper on "Engineering and Scientific Research." On February 5th, Mr. Henry C. Adams, President for the year 1917, delivered his inaugural address, in which he pointed out the desirability of some federation of engineering bodies, and outlined a scheme for such a federation, with a general engineering council for its head, and representing all sections of the engineering profession, the specialist societies being co-ordinated, and forming, in effect, branches of the main body. This general council would wield enormous power, both in moulding public opinion and in upholding the status and interests of the profession as a whole. He then dealt with the classification and training of engineers, and the great need for the more general recognition of science in all branches of education, and, in conclusion, he suggested that the time was opportune for the reform of our present system of weights and measures, and the adoption of the metric system.

Diesel Engine Users' Association.—The January meeting of the Association was held at the Institution of Electrical Engineers, London. The president, Mr. Geoffrey Porter, submitted a table of data concerning lubricating oils, and a paper on the chemistry and examination of these oils was read by Mr. E. A. Evans, which will be discussed at the next meeting.

The Faraday Society.—A general discussion on "The Training and Work of the Chemical Engineer" will be held on Tuesday, March 6th, at 8 p.m., in the rooms of the Chemical Society, Burlington House, W. Sir Robert Hadfield, F.R.S., president, will preside. The discussion will be opened by Sir George Beilby, F.R.S., and the following papers will be read:—

Prof. F. G. Donnan, F.R.S., "The Training of the Chemical Student for Work in the Factory."
Mr. Charles R. Darling, "The Training of the Works Chemist in Physics."
Mr. W. R. Cooper, M.A., B.Sc., "A Plea for the Forgotten Factor in Chemical Training."

Among those who have signified their intention of contributing to the discussion are Dr. E. F. Armstrong, Dr. Charles Carpenter, Dr. Dugald Clerk, F.R.S., Prof. E. G. Coker, F.R.S., Dr. S. Z. de Ferranti, Mr. A. P. M. Fleming, Prof. A. K. Huntington, and Dr. F. M. Perkin.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Whilst Mr. C. J. Spencer, the manager of the Bradford City Tramways, is fulfilling his duties for the Admiralty as organiser of labour in shipyards, his duties of management at Bradford are to be shared by Mr. T. Shirk (traffic superintendent) and Mr. J. W. Dawson (assistant engineer).

The Exeter Electricity Committee having received applications for increase of salary from members of the electrical engineer's staff, recommends that the maximum in each case be raised as follows:—First shift engineer, £120 to £140; second shift engineer, £100 to £120; third shift engineer, £100 to £120; foreman engineer, £2 2s. to £2 5s.; the Committee to be empowered to graduate the pay within the scale as it may deem expedient.

The Manchester City Council has decided that the accountancy and secretarial departments of the electricity department shall be separated, and both placed under the control of Mr. S. L. Pearce, whose title shall be chief engineer and manager. He will be the official responsible to the Committee for the efficient working of the electricity department.

The Leeds Corporation is recommended to appoint Mr. Ernest Porter to be superintendent of the new electricity generating station, at £280 per annum; Mr. H. Topham to be engineer-in-charge, at £140; and Mr. C. H. King works foreman, at £182.

The Peterborough Council has resolved to increase the salary of Mr. Rowland, the acting electrical engineer, from £208 to £278 per annum. The Electricity Committee reported that during the time that Mr. Rowland had been acting as city electrical engineer (20 months), following the death of Mr. Gill, who was both waterworks and electrical engineer, with Mr. Rowland in charge of the electrical department, he had carried out the duties of the office to its entire satisfaction. It accordingly recommended that he be now appointed to the office of city electrical engineer: this part of the recommendation, however, was not confirmed.

General.—Lieut. A. Reginald Courtenay, who, until June, 1915, was acting manager of the Publicity Department of the General Electric Co., Ltd., was married on Saturday last, at St. Paul's Church, Onslow Square, to Miss Edith Ashworth, daughter of Dr. J. H. Ashworth, of Cliftonville.

The King has appointed the Marquess of Crewe to be a member of the Committee of the Privy Council for the purpose of the organisation and development of scientific and industrial research.

Mr. Ernest Wigglesworth, head of the fitting shop of one of the departments of the Phœnix Dynamo Manufacturing Co., Ltd., Thornbury, Bradford, and who has just resigned, was the recipient, last week, at a large gathering in the café at the works, of a gold albert, the gift of the firm and the workers in the department. A musical programme followed.

Mr. C. J. Hunt, who until recently was chief contract engineer to Bruce Peebles & Co., Ltd., Edinburgh, has been appointed chief engineer to the company, and Mr. Wm. Oliver, who has for some time been acting chief estimating engineer (in the absence of Mr. R. Shaw, on active service) has been appointed chief contract engineer.

Obituary.—Mr. H. G. Stott.—The death occurred on January 15th, in New Rochelle, of Mr. Henry Gordon Stott, superintendent of motive power to the Interborough Rapid Transit Co. and the New York Railways. The *Electric Railway Journal*, in an account of his career, states that he was born in the Orkney Islands in 1866. After an electrical and mechanical education and training in Scotland he became an assistant electrician on the *Minia* (Anglo-American Telegraph Co., Ltd.), and was an expert in matters relating to cable repair. He was identified with the duplexing of the United States Cable Co.'s main cable (2,750 knots). In 1889 he was assistant engineer for the Brush Co. at Bournemouth, and later he joined Hammond & Co. for cable and power station work at Madrid. In 1891 he went to the States for cable and conduit work for Buffalo electrical companies, and for 10 years he was prominently identified with the industries of Buffalo. In 1901 he took up his post with the Interborough Co. Mr. Stott was president of the American Institute of Electrical Engineers in 1907-8, and was very closely connected with other American engineering organisations. He was an ardent advocate of the metric system, and had written a large number of papers on various engineering problems. Mr. Stott had been ill for many months.

Mr. A. P. Collins.—The death is announced, at the age of 28 years, of Mr. Alfred Percy Collins, electrical engineer at the Taunton Lyceum. Deceased died from heart failure following pneumonia. He was trained at the works of Messrs. Edwards and Armstrong, of Bristol.

We desire to tender our sympathy to Dr. J. A. Fleming, F.R.S., whose wife passed away on 6th inst., at Hampstead, after a very short illness, aged 53 years.

Roll of Honour.—Sergeant Mark Bogg, West Yorkshires, a winner of the Military Medal, is reported to have died of wounds received in action. He was formerly in the Electric Lighting Department of the Leeds Corporation.

Private William Booth, of the Grenadier Guards, who has died in hospital at Caterham, was, before joining the Army, apprenticed to an electrical engineering firm at Halifax.

The Military Medal for bravery in action has been awarded to Sapper David Benton, R.E., who was, as an electrician, at Harrison's Colliery, Wyrley (Staffs.).

The D.C.M. has been awarded to Lance-Corporal G. W. Howes, R.E., who was an electrician at the Brymbo Steel Works, near Wrexham.

The Serbian Silver Star decoration, in recognition of distinguished services rendered during the campaign in that country, has been conferred by King Peter upon Flight-Sergeant A. Forsyth, Royal Flying Corps, who was for some years with the British Thomson-Houston Co., Ltd., at Rugby.

Private Hy. Wogden, of the electric power station staff, Sculcoates Lane, Hull, is reported killed in action.

Lieut. Eric Gordon Waters, attached to the Royal Flying Corps since June last, was killed in France in an aerial combat on January 24th, 1917. He had been with Messrs. Callender's Cable Co. and Messrs. Ferranti prior to joining the Forces in 1914. His death occurred while he was escorting another flyer who was taking photographs. Both were attacked by two hostile scout machines. Lieut. Waters engaged one of them, and during the encounter the Hun dived on him and he was hit, and must have been killed instantaneously. His observer managed to land the machine in our lines. Lieut. Waters would shortly have been given a Flight Command; he was regarded as his Captain's right-hand man.

CITY NOTES.

Llandudno and Colwyn Bay Electric Railway, Ltd. The profit for the year ended November 30th, 1916, after providing for ordinary operation and administration expenses and interest on debenture stock and loans, was £5,317, as against £5,414 for 1915. Exceptional maintenance charges not applicable solely to the year under review, and amounting to £1,496, have been debited to reserve account. The net results have been affected by the difficulties of obtaining labour and the increased cost of materials, and also the curtailment of public holidays and week-end facilities by the railway companies. Adding £432 brought forward, the available total is £5,749. £1,615 is applied in providing for the sinking fund instalment due January 1st, 1917, a dividend of 4 per cent., less income-tax, is to be paid, and £158 carried forward. The full amount of sinking fund instalment due January 1st, 1917, has been charged in the accounts, and this provision is considered sufficient to meet the depreciation of the system. No construction work has been carried out during the year, and certain alterations which the directors have in mind, with a view to improving running conditions, must necessarily stand over until more normal times are reached.

Dublin United (Electric) Tramways, Ltd. Mr. Wm. M. Murphy presided at the annual meeting on Tuesday. He said that the company had suffered a loss of at least £15,000 by the Easter-week rebellion, and it was hoped to get back in compensation a substantial part of that sum. The continuous growth of traffic was shown by the remarkable way in which they recovered themselves during the year, coming out with £1,435 in excess of the gross receipts of 1915. The gross receipts—£335,335—were, he said, the highest in the history of the company. The passenger receipts increased £1,850 over 1915, but as there was some falling off in parcels, the actual increase in gross receipts was £1,435. During the first three months of the year 1916—January, February, and March—the receipts were £4,297 above the corresponding months in 1915, and there was almost a certainty that they would go on growing at the same rate of over £1,400 a month. Then came the fatal month of April, and in the two months of April and May, instead of gaining nearly £3,000 which they had reason to anticipate, they lost £13,898. From the end of May they began to pick up again, and they came out at the close of the year, as he had said, with £1,435 to the good. The expenses were also a record, being £11,478 in excess of 1915. Of this excess, the single item of coal accounted for £5,219, though the quantity consumed, owing to saving effected by various mechanical and electrical economies, was less by 1,230 tons. They had now £60,000 in hand for relaying of tracks when material was available. The meeting passed a resolution approving the conversion of the whole of the fully-paid preference shares into preference stock, and the conversion into stock of 66,000 ordinary shares issued and fully paid, to be called ordinary stock. The balance of the authorised capital, viz., 4,000 ordinary shares of £10 each, may also be converted into ordinary stock when issued and fully paid.

Yorkshire (West Riding) Electric Tramways Co., Ltd. At the annual meeting, held in London last month, Sir H. S. Leon, who presided, said that the expenditure for the year was £47,474, and the total income £90,364, leaving £42,890. The income increased by £9,277 (11 per cent.), or on a car-mileage basis 1.233d. per car mile. The receipts per car mile were 12.267d., against 11.034d., and the working expenses 6.445d., against 4.882d. The net receipts from the Pontefract lighting undertaking at £544 increased by only 5 per cent. The increase in revenue was satisfactory, but increase in expenditure more than counterbalanced the gain. In all probability expenses would always remain higher than in pre-war times, a fact which they must face with resignation. In the aggregate, the working expenses increased by £11,595, equal to 32 per cent., or 1.563d. per car mile. The percentage of expenses to receipts was 52.54 per cent., against 44.25 per cent. for 1915, and the percentage of net revenue to receipts was 47.46 per cent., compared with 55.75 per cent. They carried 1,285,791 more passengers (increase 11 per cent.), and had run 4,305 more miles (increase 0.2 per cent.). The report was adopted. At an extraordinary meeting which followed, the chairman explained the scheme for dealing with the arrears of cumulative preference share dividends. Each £5 preference share (August, 1905) is entitled to £2 3s. 2d. of the new stock; the shares issued in September, 1905, to £2 2s. 7d.; those issued in November, 1905, to £2 1s. 11d. The average per cent. was £43 2s. 1d., and the total amount was £99,703. Roughly, anyone holding 35 shares had £75 of the new stock. The proposal was adopted. A meeting of preference shareholders followed, at which the proposal was approved. A vote of thanks was passed to the directors, and to Mr. England, the manager.

Lanarkshire Tramways Co. For the year ended December, 1916, the revenue was £126,630, and the expenses were £78,762, leaving £47,868. After deducting contributions payable to local authorities, debenture, and other interest, £11,000 placed to reserve for depreciation, £2,500 put to maintenance reserve, £2,230 written off investments, and adding £958 brought forward, there is a balance of £23,602. 6½ per cent. dividend absorbs £22,295, the directors take £549 (percentage of the profits), and £758 is carried to revenue new account. The revenue shows an increase of £20,586, and the expenses an increase of £12,671, as compared with the revenue and expenses for the year 1915. It has been impossible, however, owing to shortage of labour and difficulty in obtaining materials, to maintain the undertaking in the usual state of repair, and £2,500 has been transferred to maintenance reserve account in order to make some provision for the repairs which will have to be undertaken when the war is over. Contributions payable to local authorities are £1,135 in excess of the amount for the year 1915. During the year £3,100 debentures of the company were purchased or redeemed. It is not proposed at present to fill the vacancy on the board created by the death of Sir George Franklin.

Sunderland District Tramways, Ltd.—The report for the year ended October 31st last states that after charging the expenses of operation and administration for the year ended October 31st, 1916, and providing for depreciation of rolling stock, &c., there remains a balance of £11,946. Interest on the prior lien bonds and first mortgage debentures absorbs £7,100, sinking fund instalment £500, depreciation of investments £500, transfer to general reserve account £1,514, leaving £2,983. The directors recommend the payment of interest at the rate of 3 per cent. per annum (less income-tax) on the first income bonds, leaving £881 to be carried forward. The traffic receipts show an increase of £2,486, but, owing to the war, the working expenses have been proportionately higher, the net result of the year's operation being an increase in the profit of £1,087.

Metropolitan Railway Co.—In the interests of economy, the next report will only be issued to proprietors who apply for it—if the war lasts. The report for 1916 now issued is curtailed in several sections. The total net income was £609,126, plus £13,041 brought forward. Interest, rentals, appropriations to renewals, &c., were £305,228, dividend on the preference stocks £237,794. After paying 1 per cent. for the year on the ordinary stock, £14,492 is to be carried forward; £20,000 has been carried to general renewals fund, as against £15,000 in 1915. As regards the company's claim for consideration in respect of new lines brought into use since 1913, the Government has now agreed that the company is entitled to a payment for interest on the capital so expended. The annual meeting was held yesterday.

St. James' & Pall Mall Electric Light Co., Ltd.—The directors recommend a balance dividend on the 7 per cent. preference shares for the half-year ending December 31st, 1916, of 3s. 6d. per share, and 5s. 6d. per share on the ordinary shares, making, with the interim dividend, a total of 8 per cent. for the year.

Cambridge Electric Supply Co., Ltd.—Total profit for 1916, £7,096, plus £2,753 brought forward. Debenture and other interest require £1,783, £1,000 is placed to depreciation fund account, the dividend for the year is 5 per cent., and £2,607 is to be carried forward. Annual meeting: February 28th.

City of Buenos Aires Tramways Co. (1904), Ltd.—The directors recommend a balance dividend of 1s. 3d. per share (making 5 per cent. per annum), less income-tax. £5,500 is to be transferred to the general amortisation fund and £108 carried forward.

Edison Swan Electric Co., Ltd.—Separate meetings of the holders of the 4 per cent. first and 5 per cent. second debentures are to be held on February 12th, to consider the scheme of arrangement between themselves and the company.

National Gas Engine Co., Ltd.—The directors recommend a final dividend of 3¾ per cent., making 7½ per cent. for the past year, also a bonus of 9d. per share, free of tax, on the ordinary shares.

Yorkshire Electric Power Co.—Net profit for 1916, £29,112, as against £21,209 for 1915. After paying 3 per cent. on the ordinary shares and transferring £12,000 to reserve, £3,866 is to be carried forward.

Calcutta Electric Supply Corporation, Ltd.—The number of units sold to consumers during the four weeks of December, 1916, amounted to 1,751,753, compared with 1,393,927 units in 1915.

Parsons' Marine Steam Turbine Co., Ltd.—Dividend, 10 per cent., free of income-tax, for the half-year.

STOCKS AND SHARES.

Tuesday Evening.

United States developments have been the prevailing consideration in the Stock Exchange this week. Even interest in the War Loan subsided for the time being after January 31st had passed, and intending applicants argued that there was no particular hurry for them to send in their cheques for a few days. Next week, of course, there will be a big rush for the loan, and the meetings which are being held during the present days are certain to provide a good deal of extra money.

At the same time, the observer cannot help feeling that where the appeal is being made so strongly to the small investor, more might be done in the way of elucidating details. For instance, those in close touch with the matter know that one of the chief objections, which hundreds of small investors have to parting with their money for the loan, is the feeling that they will not be able to touch their capital for twelve years, whether they want to or not.

The stream of selling to take up war stock has diminished to a noticeable extent, and markets are beginning to recover here and there. Underground Electric incomes, which make a fair example of the stocks which were being sold, are up again to 90½. The Treasury's modification of its announcement with reference to the prohibition of securities being sent abroad has released business to some extent in the stocks affected; but, even now, the official statement is so ambiguously worded that the explanation does not wholly satisfy some of the people concerned. Nobody would wish to harry the Treasury with carping criticism, but, at the same time, the business-man does feel that it is a pity for these announcements to be so hastily hotchpotched for immediate issue that they have to be modified or explained a few days later.

The entrance of America into the area of the war made very little difference in the Stock Exchange on this side. There was a small slump at first in Wall Street, immediately followed, however, by substantial recovery. Opinion in the London Stock Exchange views the position with satisfaction, the chief bull point about it being that the financial resources of America will undoubtedly prove a great asset for the cause of the Allies.

Some think that Germany intended to force the United States into the war in order that Germany might be able to obtain better terms over peace proposals; and there is a half-fear expressed that President Wilson may play into the hands of the foe by advocating a much milder policy in this respect than would be acceptable to those nations which have suffered so much during the past two and a half years, throughout which the United States has made money hand-over fist out of the commercial side of the business.

To come from the abstract to the concrete: the London electricity supply companies' list is rather better, for which, no doubt, the main cause is the Westminster Co.'s dividend of 9 per cent., making 7 per cent. for the year—the same as that which was declared for 1915. This came as a pleasant surprise, and rumour immediately gossiped about a similar result being achieved in the cases of the Charing Cross, the County, and the City of London Companies. Prices, however, are left much as they were. South Metropolitans are wanted, and instead of being 17s. 6d., as they were this time last week, the price is nearer 18s. 9d., with buyers about.

The Edison Swan Electric Co. has issued a circular to its debenture stock holders, outlining the heads of a scheme for providing further working capital for the purpose of the business. A scheme of arrangement has been drawn up as between the company and its debenture stock holders and members, in which proposals are put forward that shall re-organise the present capital and, at the same time, provide the company with £100,000 additional money. The board appeal to the stockholders to support the scheme, and, to facilitate its confirmation, ask that proxies shall be signed and returned by Saturday in this week at the latest.

We understand unofficially that the Treasury has raised objections to more capital being issued, notwithstanding the particular activities of the Edison Swan Co., and the fact that the fresh money is required for the development of this part of the business. Possibly official sanction will be less difficult to obtain after the War Loan lists are closed.

Central London stocks remain dull, apparently because of a fair-sized block which is overhanging the market, and which is said to be on behalf of a deceased account. Metropolitans are ¼ better, and Districts also have a harder tendency; while Underground income bonds have risen, as we mentioned earlier, to 90½. The railway market as a whole is cheered by the increase in the Hull and Barnsley dividend from 2 per cent. to 3 per cent., made possible by the Government's willingness to pay interest on capital expenditure laid out since the war started.

Marconis are enjoying a more active market and better prices, the ordinary having risen to 2⅞, Americans to 17s., and Canadians to 9s. 3d. The improvement is said to be due partly to shortage of shares, as disclosed by buying orders based upon the expectation of the Government bonus becoming known before long; while another suggestion advanced is that the latest outbreak of German frightfulness will render the Marconi system more essential than ever. Whatever may be the reason, the market is certainly more active that it has been during the past few months, and there is some talk of the rise not having yet exhausted itself.

American-Canadian stocks fell with an abrupt jerk at the end of last week, what time Yankee rails came hurtling down on the President's message to Congress. They shared in the partial recovery, and on balance there is not much change in the prices of issues connected with the light and power companies. Brazilian Tractions were slightly tarred with the same brush, the price giving way on the prospect of Brazil joining the United States in breaking off diplomatic relations with Germany. The fall on the week, however, is no more than a point, and the preferred shares have not been affected. Argentines are steady.

The Mexican group, after showing firmness, eased off. It was stated last week that half the American Army had been massed on the Mexican frontier, and that the other seven men were about to follow! As a matter of fact, however, no definite news is forthcoming, and the little rise which occurred in some of the railway stocks, and which had a strengthening effect upon various Mexican industrials, shows signs of petering out.

The miscellaneous market, on the whole, is on the dull side. Electric Constructions stand out with exceptional firmness at £1, but falls have taken place in British Aluminium ordinary, Callenders, Castner-Kellners, and Edison Swan fully-paid shares. British Insulated are better at 11⅞. The rubber share market is quiet, with next to nothing doing; while in the armament and the copper sections, movements are irregular and narrow.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1914.	Dividend 1915.	Price Feb. 6, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary ..	5	5	3¾	—	7 8 2
do. do. do. 4½ Pref..	4½	4½	3¼	—	6 18 6
Chelsea	5	4	3	—	6 18 4
City of London	9	8	11	—	7 5 5
do. do. 6 per cent. Pref.	6	6	9¾	— ¼	6 8 1
County of London	7	7	10	—	7 0 0
do. 6 per cent. Pref.	6	6	9¾	—	6 3 1
Kensington Ordinary	9	7	6⅝	—	6 10 3
London Electric	4	8	1½	—	7 2 10
do. do. 6 per cent. Pref.	6	6	4 3/16	— ⅛	6 19 1
Metropolitan	8½	8	2¼	—	6 13 4
do. 4½ per cent. Pref.	4½	4½	3⅝	—	7 4 0
St. James' and Pall Mall ..	10	8	6	—	6 13 4
South London	5	5	2⅞	—	6 19 0
South Metropolitan Pref. ..	7	7	1 3/32	—	6 7 8
Westminster Ordinary	9	7	5⅝	—	6 4 5
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	94½	—	6 7 2
do. Def.	30/-	33/6	22	— ¼	6 16 4
Chile Telephone	8	8	7	—	5 14 3
Cuba Sub. Ord.	5	5	8¼	—	6 8 6
Eastern Extension	7	8	13⅞	—	*5 15 4
Eastern Tel. Ord.	7	8	157	—	*5 16 10
Globe Tel. and T. Ord.	6	7	11⅝	— ⅛	*5 18 0
do. Pref.	6	6	9⅞	—	6 1 6
Great Northern Tel.	22	22	35	—1	6 2 8
Indo-European	13	13	49	—	5 12 8
Marconi	10	10	2⅞	+ 3/16	8 9 6
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord. ..	10	10	2¼	—	4 9 0
United R. Plate Tel.	8	8	6⅜	— 3/16	*5 5 6
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13⅞	—	*5 15 4
Home Rails.					
Central London, Ord. Assented	4	4	62½	—2	6 8 0
Metropolitan	1½	1	23¼	+ ¼	4 6 6
do. District	Nil	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	Nil	2	—	Nil
do. do. "A" ..	Nil	Nil	6/-	—	Nil
do. do. Income	6	6	90½	+1	*6 12 7
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4 13/16	—	6 1
Anglo-Arg. Trams, First Pref.	5½	5½	8	—	9 4
do. 2nd Pref. ..	5½	5½	2¾	—	—
do. 5 Deb. ..	5	5	61½	—	7 15 0
Brazil Tractions	4	4	49	—1	8 3 4
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	61	—1	8 4 0
do. do. Preferred	—	Nil	43	—1	Nil
do. do. Deferred	—	Nil	32½	—	Nil
do. do. Deb.	4½	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	25	—	Nil
do. 6 per cent. Bonds	—	Nil	22½	—	Nil
Mexican Light Common ..	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	14½	—	Nil
do. 1st Bonds ..	Nil	Nil	27½	—	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	2 1/16	— 1/16	5 11 6
British Aluminium Ord. ..	5	7	27/-	—6d.	5 13 6
British Insulated Ord.	15	17½	11⅞	+ ⅛	7 7 4
British Westinghouse Pref. ..	7½	7½	2¼	—	6 13 4
Callenders	15	20	12½	— ½	8 0 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	8½	— 1/16	7 1 0
Edison & Swan, £3 paid ..	Nil	—	7/16	—	Nil
do. do. fully paid ..	Nil	—	1⅜	— ¼	Nil
do. do. 4 per cent. Deb.	4	4	61½	—	6 10 1
Electric Construction	6	7½	1	+ 1/16	7 10 0
Gen. Elec. Pref.	6	6	9½	—	6 6 4
do. Ord.	10	10	13½	—	7 5 6
Henley	20	25	15¾	—	7 13 9
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12½	— ¼	*8 3 4
Telegraph Con.	20	20	88	—	*6 5 0

* Dividends paid free of income-tax.

SELF-PROPELLED ELECTRIC VEHICLES AND THEIR APPLICATIONS.

In a paper recently read before the Institution of Engineers and Shipbuilders in Scotland, by Mr. L. Broekman, the author pointed out that electric vehicles can be classified under two principal heads:—

Utility Vehicles.—Industrial vans and wagons.
Public service conveyors and road appliances.
Road tractors, couple gear, and locomotives.
Workshop trucks and tractors.
Passenger Vehicles.—Commercial and inspectors' runabouts.
Ambulances and motor chairs.
Omnibuses and taxi-cabs.
Pleasure cars.

He considers that a sweeping reform in the means at our disposal for road transport of merchandise has long been overdue, pointing out that some means must be taken of quickening the circulation in our busy areas. Individual owners have obtained improved service, especially for remote deliveries, by using petrol motors, but for short-distance work, entailing frequent stopping and restarting, such vehicles are not suited nor economical, hence horse haulage has been little reduced for such work.

Some 80 per cent. of the freight movement in the streets still depends on horses, and such traffic, with rare exceptions, progresses at the rate of from two to three miles an hour, if at all, and the author asks how we are to speed-up such traffic to meet coming commercial activity unless energetic measures are promptly taken to abolish, counteract, or remedy the obstructions to rapid flow of traffic.

The point raised by Mr. Broekman is interesting; we some time ago suggested in these columns* that one remedy would be to impose a definite speed limit, which all vehicles in crowded streets should be capable of attaining, such a procedure being much more logical in connection with an intrinsically valuable artery of communication in a crowded city than the imposition of speed restrictions on a country road, which has a low "communication value."

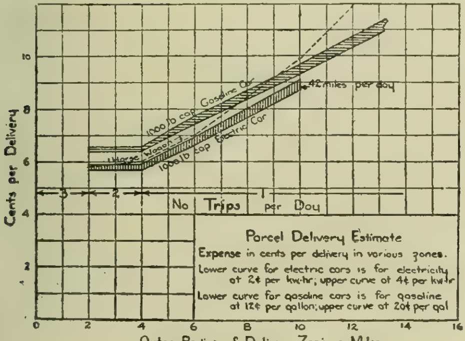


Fig. 1.

He rightly says that so long as horses are allowed for city haulage—and team owners with their allied forces will naturally put up a big fight to keep them there—real betterment is out of the question, and suggests three remedies:—

1. Officially to divert the swifter traffic from main thoroughfares, reserving direct routes for slow haulage.
2. Use a far larger number of motor vehicles.
3. Freight clearance to be effected by double shifts, day and night.

No. 1 appears to us to suggest a reversal of the usual procedure, and to put an unmerited premium on slow-moving traffic.

The author then discusses at length the well-known advantages of the electric vehicle as the best fitted to supersede horse traction, pointing out that its silent operation and freedom from fire risk are much in its favour for night work. Increased mileage can be provided for either by boosting charges or battery exchange. Commercial vehicles usually have battery capacity for 40 miles on a single charge, and experience proves that from 30 to 35 miles per day is the usual demand for average city and suburban work.

To increase the battery capacity above this would only add weight and cost needlessly.

The ratio of working days in commission to total number of working days during a period comes out at the fine average of 95 per cent. for the "Electric," as compared with petrol lorries, 90 per cent.; steam lorries, 85 per cent.; and horses, from 65 to 85 per cent.

The 500-volt tramway motor has run 250,000 miles with only minor repair due to wear; the usual pressure for delivery vehicles is 60 or 80 volts, and, being practically constant, racing by sporting drivers is made impossible, which coupled with sturdy, simple design accounts largely for immunity from breakdown.

The battery can be drawn on for lighting purposes during loading and unloading, and power appliances, such as winches, capstans, tipping gear, &c., can be operated from it. The diagrams in figs. 1 and 2, showing relative cost of service, are based on the road transport report issued by the Mass. Institute of Technology; the actual figures are, of course, based on American conditions before the war, but show the advantages of electric haulage at that period in the States, which advantages are increased considerably since the cost of petrol and fodder has increased.

One outstanding advantage of the electric vehicle is that all debit items can be determined beforehand to a small fraction of a penny. The change over from horses to motors can do no good unless the daily performance of each vehicle is arranged and scheduled to a time-table; routes, stops, and loading times appointed and checked against reports, labour-saving devices brought into use, and the movement of drivers and helpers speeded up. Garage supervision is also of vital importance, for if the electric ever fails at all, it is not through service in the streets, but through slackness at the garage. Drivers' reports and garage records should be insisted upon; fig. 3 shows some monthly charts of a large public supply company in New York. It will be noticed that the energy consumption for October shows a considerable increase for the larger vehicles, probably due to snow, &c.

The high speed of the petrol motor on the open road gives it a field of usefulness which is freely admitted, but does not clash with the battery vehicle which is intended for town and suburban service, where the legal limit of 12 miles an hour is rigidly enforced; this distinction should be clearly realised. High speed, on the other hand, means extra repairs and maintenance, and led to the introduction of sealed governors on petrol motors, definitely limiting the speed.

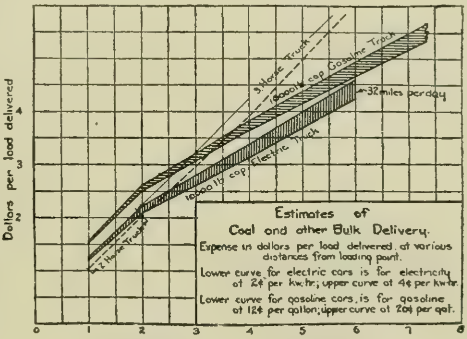


Fig. 2.

In traffic the electric vehicle, due to self-starting and rapid acceleration, gets there as quickly as the speediest vehicle. Weight operated against the battery vehicle in the early days, but now there is probably not much difference as between modern petrol and electric vehicles, and the latter have a superior weight distribution.

The total friction losses account for only about 70 watt-hours per ton mile; the mean energy consumption on give-and-take roads of fair surface is about 120 watt-hours per ton mile (vehicle and load) on the day's performance.

For a two-ton capacity vehicle, running under an average load of one and a half tons all day, this works out at less than 1 h.p. per hour per vehicle mile, which is clear proof that the tare weight is not a serious drawback.

The author points out that on the cost basis, comparing five-ton battery and petrol vehicles costing £1,105 and £875 respectively, and allowing 10,000 miles a year, the electric delivery would cost £558, and the petrol delivery £591, showing a saving of £33 in operating cost, which equals nearly 15 per cent. per annum on the additional capital, and does not include the 5 per cent. additional service reliability. As regards the latter, data regarding pleasure cars obtained six years ago shows one electric was towed in for every 8,500 miles, and over an average distance of 1 3/10 miles, while one petrol car was towed in for every 3,000 miles, over an average distance of eight miles.

The paper contains descriptions of several of the leading commercial electric vehicles, such as the Orwell, G.V., and Electromobile; the accumulator is discussed at some length, attention being drawn to the development of the "ironclad exide," and the use therein of armoured pencils homogeneously connected in parallel rows to form plates, and to supersede the flat positive electrode; also to the advantages of the Edison nickel-alkali accumulator.

Of the 70 watt-hours per ton-mile average required to overcome frictional losses, from 40 to 50 watt-hours are absorbed in tires alone; the tire maker's usual guarantee of 10,000 miles per annum is habitually exceeded by electric vehicles.

Comparative figures of cost published in the *Power Waggon* relative to a large organisation using 107 horsed vehicles and 130 horses, show an average performance per month per vehicle of 383 miles of half-ton loads, costing £24 11s., and equal to 30.6d. per ton-mile; 52 electrics carried an average per month per vehicle of 749 miles of one-ton loads, costing £38 13s., or 12.37d. per ton-mile. The ratio is thus 2.47 : 1 in favour of electric vehicles.

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* Elec. Rev., March 27th, 1914.

A section of the paper deals with special applications, such as refuse collection, street sprinkling, coal-tipping wagons, tower and pump wagons, road rollers, fire appliances, shunting locos and tractors, couple-gear tractors for attaching to existing horse vehicles, battery trucks and tractors for small loads, electric pleasure cars, taxi-cabs, omnibuses, &c.

The author states that American data shows that the entire upkeep and running costs to be debited against an electric pleasure car if attended to at a garage and brought to the owner's house daily, are for 6,000 miles a year, 6¼d. per mile, and for 12,000 miles yearly, 5d. per mile.

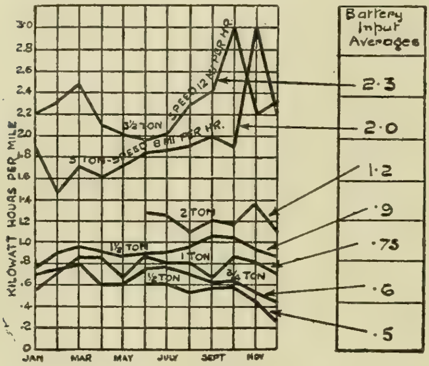


Fig. 3.

If present-day inducements are considered dispassionately, electromobiles for personal use are a thoroughly sound proposition.

In Detroit, a petrol motor manufacturing centre, the average costs of electric taxis over two years work out at only two-thirds of those for petrol cabs, and people show a preference for them.

The paper concludes with a series of detailed tables showing approximate running costs for vehicles of 15 cwt. up to five tons carrying capacity, which will be useful for reference to vehicle users.

In the discussion on this paper (for which we are indebted to the *Transactions* of the Institution of Engineers and Shipbuilders in Scotland), Mr. W. W. Lackie (President) said that only four years ago the Glasgow Corporation purchased its first electric vehicle, and after running 27,000 miles it was in as good a condition to-day as it was at the beginning of its career; it had given such satisfaction that three other vehicles had been purchased, and all had given excellent results. The ease with which electric vehicles could be manipulated, even by men without previous experience of driving them, had appealed to him. The Glasgow vehicles had been in use for 300 days out of 365. The Glasgow cleansing department had recently purchased an electric vehicle for removing waste material, and he had no doubt that the citizens would appreciate the quietness with which the work was carried on during the night.

Mr. J. Hally Craig agreed with the general remarks by Mr. Broekman in introducing his subject, though he thought it possible to make out an even stronger case for the electric vehicle. For example, Mr. Broekman took the coefficient of reliability at 95 per cent.; his experience showed that a much higher figure was obtained. A three-ton lorry in use by the Vale of Leven Co-operative Society, Ltd., was in service delivering bagged coal to consumers, and its customary duty was five trips per day, starting out with three tons. The first calendar year of its service it actually delivered coal on 307 days—the remaining 59 days were Sundays and holidays. One afternoon, and the following morning, the vehicle was out of service owing to a trifling mechanical, not electrical, defect, and this record showed a reliability coefficient of 99.65 per cent. On the other hand, he believed that the reliability coefficient for steam vehicles, taken by Mr. Broekman at 85 per cent., would be much below this in practice, and he cited a case where a user with seven steamers only obtained 1,099 days of service in the year, an average of 157 days each. He agreed that for heavy tonnage and straight-away runs of some distance steam lorries, especially when equipped with trailers, were a factor in transportation economics. When the steam lorry was equipped with rubber tires, up to five tons the electric vehicle was competitive, and held certain advantages, but larger steamers without rubber tires and with trailers operated at a lower cost per ton-mile than any other form of land transport. The figures showing the mean current consumption of a number of vehicles of different sizes in New York was most interesting. In New York street surfaces were generally very good, with only a few slight gradients, yet the current consumption of the fleet belonging to the Glasgow Corporation electricity department compared favourably. Most prospective users were obsessed with the idea that a high maximum speed was a desideratum; he instanced a case where a certain delivery round, usually covered by a Ford runabout in 55 minutes, was undertaken by a 30-cwt. electric bread-van and covered inside of 65 minutes, though the maximum speed of the former was three times that of the latter. This result was, of course, due to the superior acceleration of the electric vehicle after stops. To charge interest on the total outlay during the whole life of the vehicle, regardless of the proportion written off annually as depreciation, was against accepted procedure, and was merely unduly favouring whatever vehicle was lower in first cost. This effect might be seen in the tables where the charges for interest were nearly twice what they should be, thus unduly favouring the cheaper lead battery. The L.G.B. had recommended public authorities who owned electric vehicles to depreciate them at 10 per cent. He believed that 15 per cent. all round might have been taken for petrol vehicles. At low mileages there would be more frequent stops, with running of engines idle, and additional starting strains. Again, 10 or 12 per cent. for steam vehicles was not enough; the steam vehicle was more at the mercy of the attendant, who by a few minutes' inattention could very seriously shorten its life. He could not say how many vehicles with lead-acid batteries had since gone into service, but he could say that over 650 road wagons, delivery vans, and industrial trucks had been equipped with the nickel-alkaline battery. Of these over 250 were trucks, locomotives, and tractors, and the remainder road vehicles. There were now actually in use in Glasgow 14 road wagons, and several more were on order.

Mr. G. L. Black remarked that during the past 12 months not a single day had been lost owing to electrical defects by any of the four vehicles owned by the Glasgow Corporation electricity department. These vehicles comprised two vans, one of half-a-ton, and the other of one-ton capacity; and two lorries, one of three tons and the other of half that capacity. During 12 months they ran 5,015, 7,666, 4,278, and 6,648 miles respectively, the electrical energy put into the batteries being 0.59, 0.6, 1.3, and 1.1 kw.-hour per mile run. The latest addition was a five-ton tipping wagon for the removal of ashes. It worked on a rather difficult route, part consisting of a gradient of 1 in 21, and required a battery input of 2.6 kw.-hour per mile run. In time of snow it was found that the electrical energy required was about 60 per cent. above the normal. A pleasing feature about these vehicles was the very small amount of attention the motors required, and consequent low cost of repairs.

Mr. F. W. Purse remarked that the Carlisle Corporation was proposing to acquire an electric as soon as possible.

HIGH-SPEED TELEGRAPHY.

(Concluded from page 119).

Having reviewed the automatic high-speed systems, the Committee makes the important announcement that for ordinary commercial telegraph work between the main centres of the British Post Office service the inventions based on the multiplex method are superior. Multiplex systems conduce to economy in staff and in office equipment, they are subject to less serious stoppages and delays than automatic systems, and necessitate less spare plant and less costly maintenance, and they are economical in respect of lines and of paper tape for transmission.

The fundamental principles of nearly all multiplex instruments are based on the Baudot system, invented over 30 years ago. The production of this system may be regarded as marking an epoch in the history of telegraphy. The leading features of the Baudot system are (1) its method of obtaining synchronism, (2) its direct transmission from keyboard to line, (3) its cadence and speed, (4) its direct printing on slip.

(1) "Synchronism" is a feature of all multiplex systems, essential to the maintenance of correspondence in speed between the distributors placed at the sending and receiving ends of the line. The Baudot maintains synchronism by means of a centrifugal friction governor, a mechanical correcting device, and a special correcting signal. In the Western Electric multiplex this special signal is dispensed with, and the message signals are utilised for correction of phase. The relative merits of these approved methods of correction are still undecided.

(2) and (3) In the Baudot as usually worked, the sending operators depress combinations of five keys (similar to the white keys of a piano) according to the five-unit Baudot alphabet and transmit the signals direct to line. Each arm of the Baudot is worked regularly at a uniform speed of 30 words a minute, and each operator knows by observing the "cadence" or rhythm of the system when the distributor gives him the use of line wire.

(4) The Baudot prints in type letters on a receiving tape, which has to be gummed on telegraph forms. In this respect it differs from other systems which print direct on the forms themselves.

The Baudot has been in use for a considerable time on an underground loop between London and Birmingham, where it has been worked on the duplex principle with quadruple, and latterly with sextuple, that is to say, with four arms in each direction, and latterly six arms in each direction. There is quadruple duplex Baudot working (two circuits) on underground wires between London and Glasgow, and quintuple duplex working between London and Liverpool. Baudot has also been installed between London and Brighton. Experience has definitely proved that at least eight channels with 30 words a channel can be provided on a loop or on a single aerial line. As all multiplex systems are now worked duplex, it is of interest to record that this was first accomplished with the Baudot apparatus in 1906 on a method devised by Mr. A. C. Booth, of the engineering staff of the Post Office.

The speed for which the Baudot apparatus has been designed and constructed, viz., 30 words per minute for each operator, could be increased without a radical modification of the system, but experience has shown that a much greater increase of speed can be obtained by the use of type keyboards and perforated slip instead of hand operation, and it is suggested that one or more of the modern forms of keyboard should be applied to the Baudot.

Mr. Donald Murray's multiplex system has been in use on a London-Manchester wire for four years, working double duplex. It has given good results, and in some respects, notably in the design and working of the keyboard perforator, it is admirable. But its electrical method of controlling synchronism is not so satisfactory as the methods adopted with other multiplex systems. Although the use of the keyboard admits of a speed of 40 words per arm per minute, the limitation of the present equipment to double duplex does not afford a complete basis for comparison. This will not apply to Mr. Murray's new multiplex, which, however, is not yet available, as its manufacture has been unfortunately delayed by war conditions.

The Western Electric multiplex apparatus is the most generally satisfactory system for busy lines which we have examined. A quadruple duplex installation of the system has been working since March last between London and Manchester. The average number of telegrams per operator per hour is consistently well over 40, and has reached 49. The apparatus has dealt with about two-thirds of the whole traffic between London and Manchester on a single circuit. There are not many circuits in the kingdom capable of keeping the apparatus fully fed; but we think that the question of extending the use of the system should be proceeded with without delay, and that the further question of giving greater scope for its use by the making up of "forked" circuits linking up several towns should be pursued as soon as possible. The Western Electric apparatus embodies all those principles which are regarded as desirable; it works with a free keyboard perforator and cross-perforated sending tape, it employs the five-unit code, and it prints direct on the "page." It also adopts a method of controlling the synchronism by the use of the actual message signals, which has proved to be efficient. In view of the Post Office experience with the quadruple duplex installation, we also consider that an early trial should be given to the "short line printer" and the "two-way service" installations of the Western Union. It seems likely that both, representing as they do printing telegraphy on the scale of the ordinary simplex or duplex Morse circuit, would go some way towards restricting the use of the Morse at the smaller telegraph offices.

It has been stated in evidence that certain devices in the Western Electric multiplex infringe Mr. Donald Murray's patent rights in this country. This is a question of law on which the Committee cannot express an opinion. Contracts for the supply of telegraph apparatus always contain a clause under which the Postmaster-General is freed from all liabilities which might otherwise attach to him under decisions as to the patent rights of inventors.

The Automatic Telephone Manufacturing Co.'s system, as described to us, appeared to possess striking and original features. If the apparatus fulfils the inventor's hopes it should be of use in the Post Office service.

As Wheatstone working will probably be long retained for news and for traffic caused by abnormal events, we do not anticipate that existing Wheatstone plant will be allowed to fall into disuse to any serious extent. There is sufficient diversity in the traffic requirements of the various telegraph circuits and routes of the Post Office service to admit of the profitable use of all existing apparatus until worn out.

The prospect of an extension of multiplex methods makes it necessary again to consider the position of the leading operator, called in France the "dirigeur." The "dirigeur" is virtually the supervising officer of a multiplex circuit, and he has to be a man of good technical capacity, able to apply his technical knowledge, and to act promptly. The Committee does not think that the performance of this work can be expected from the general body of sorting clerks and telegraphists, or that the scale of pay of sorting clerks and telegraphists provides adequate remuneration for the duties. When once the simplicity of the Morse system is abandoned in favour of more rapid and more economical apparatus, which is necessarily more complex, provision must be made for the employment of a limited number of officers with higher technical attainments and higher pay than ordinary telegraphists.

In the event of any general extension of multiplex methods, it will be necessary to consider how far such systems are applicable to existing methods of news distribution. There is no doubt that if Wheatstone methods for news could be gradually superseded by multiplex, so as to avoid unnecessary duplication of plant, a great advantage would be gained. But the extent to which the outgoing Press work of the kingdom centres in London, and goes outwards to the provinces, the high speed of the ordinary Wheatstone circuits, and the fact that the forked wires of the present arrangement serve a larger number of towns than multiplex systems have yet been proved capable of serving simultaneously and satisfactorily, are considerations which suggest the possibility of great difficulties in the way of such a process. There is no doubt that the news service at present provided is good.

Creed receiving apparatus is well suited to the needs of a large newspaper office, which under ordinary Morse methods has to pay high bonuses to the staff lent to it by the Post Office in order to procure a large output; as there is no apparatus other than the Creed which converts the Wheatstone receiving tape into type printed characters, the newspapers have no third possibility to consider. News does not reach small towns quite as soon as it reaches large ones, but the installation of Creed receiving apparatus at small offices would be impracticable on the ground of expense.

The following is a summary of the leading conclusions of the Committee:—

1. Systems on the multiplex principle are definitely superior to the automatic high-speed systems on the large majority of main circuits for ordinary inland commercial telegraph work.

2. The extension of systematic Wheatstone working should be discontinued, and the question of displacing it by multiplex circuits taken up gradually.

3. Of the multiplex systems at present available, the Western Electric has given the best results. We recommend that a number of quadruple duplex installations of this apparatus be ordered. We think that seven or eight such sets should suffice, as, although present conditions favour the rapid application of systems with the greatest output, it is desirable to avoid too great a dislocation of working, and to allow time as far as possible for other makers to demonstrate their capabilities.

4. Page or column-printing is preferable to tape-printing on the busiest routes, and the Western Electric Co.'s page-printing on a continuous roll of paper, cut off after each message, is quite satisfactory. Mr. Murray's system, with a separate sheet for each message, has been given a trial on his Manchester multiplex, but a fuller trial of his improved method will be necessary. We do not think it desirable that either page or column printing should be adopted throughout the service to the exclusion of tape-printing.

5. The five-unit alphabet as a code for printing telegraphy is better than the Morse code, news traffic and submarine cable communications being left out of account.

6. The application of type keyboard signalling instruments to the present Baudot circuits is desirable.

7. Creed receiving apparatus can most profitably be used in the Post Office service for news work.

8. The application of printing methods to the less important circuits should be kept steadily in view, and early trials of the one-way and two-way installations of the Western Electric and of the light line printer of the Automatic Telephone Manufacturing Co. should be made. We are impressed with the possibility of two-way working with one operator at each end, both to signal their messages simultaneously to the other end and then both to gum the tape. An hourly load can be carried in this way equivalent to the average Morse load with two operators at each end, and having the additional advantage of printing the telegrams.

9. The introduction of multiplex methods for news work will call for serious consideration in the near future.

10. The application of multiplex systems to give simultaneous communication on one wire between each one of three, or possibly more, offices should be kept in view as multiplex methods are extended.

11. The pay and prospects of officers selected to be "leading operators" of multiplex circuits should be reconsidered.

The Committee consisted of Mr. Cecil Norton (Chairman), Sir J. Gavey, Mr. John Lee, Mr. W. M. Mordey, Mr. A. M. Ogilvie, Sir W. Slingo, and Mr. A. B. Walkley, with Mr. G. O. Wood (Secretary).

Electric Smelting at Heroult.—The Noble Electric Steel Co., San Francisco, has operated its electric smelting plant at Heroult, California, continuously since April 15th, 1916, turning out a ferromanganese product. The furnace now in use is described as the Frickey open delta, split-phase arrangement of electrodes. The ore smelted varies, but much of it runs 46 to 48 per cent. metallic manganese, 14 to 16 per cent. silica, and 2 to 3 per cent. iron. The furnace product contains 80·5 to 81·5 per cent. manganese. The plant capacity is 9 tons per day, but this is to be increased. This company in 1915 began developing and mining chromite ore; part of the ore is smelted at the Heroult plant by methods practically similar to those employed in ferromanganese smelting. The furnace product is a ferrochromium containing 60 per cent. chrome oxide and 30 to 32 per cent. iron oxide.—*Mining and Engineering World.*

THE WORK OF THE B.E.A.M.A.

[The Annual Report.]

(*Concluded from page* 140.)

The Association is represented on the British National Committee of the International Electrotechnical Commission, and on the Sectional Electrical Committee, and a number of subcommittees and panels of the Engineering Standards Committee; also on the Committees of the I.E.E. dealing with wiring rules and with marine (other than Admiralty) work. and on the Electric Vehicle Committee. The B.E.A.M.A Standardisation Committee continues its co-operation with the Engineering Standards Committee in the preparation and revision of the new British Standardisation Rules, and has prepared detailed recommendations for the revision of the Engineering Standards Committee's report No. 72. Other work of the Association Committee (assisted by representatives of the interested Sections of the Association) includes the following subjects:—

Motor Starters, under which a specification has been prepared to serve as the basis for the E.S.C. rules now in preparation.

Transformers for Meters and Instruments, under which a specification has been prepared for incorporation in the revised E.S.C. specifications for meters and instruments.

Graphical Symbols, under which the recommendations made have been very fully adopted in the new E.S.C. draft rules.

Switchgear Symbols, under which the section of the Association's rules dealing with this subject has been revised and considerably enlarged.

Marine Generating Sets, under which a Joint Committee has been established to deal with the standardisation of electric generating sets for marine purposes.

Ammeters and Voltmeters, being a revision of E.S.C. Report 49, which is now well in progress (the recommendations from this Association receiving full consideration) in the revised draft of which the proposed specification for transformers for use with these instruments is being embodied.

Electricity Meters (E.S.C. 37), under which recommendations have been made to the E.S.C. covering a proposed revision of this specification.

Accessories, under which recommendations are being prepared for the assistance of the E.S.C. in the standardisation of lamp-sockets and other details.

I.E.E. Wiring Rules, under which recommendations have been transmitted to the Institution regarding desirable amendments in the present (7th) edition of the Wiring Rules.

The Council adopted Engineering Standards' Committee's Specification No. 74, being a specification of a standard electric vehicle charging plug, prepared by the Electric Vehicle Committee.

On February 1st, 1916, the Council issued "Instructions to Members for the use of Conditions of Sale and Contract," amending and consolidating all previous instructions on this subject. Little opposition to the Association's conditions has been encountered during the year, thus bearing added testimony to their reasonableness. Fifty-six different purchasers raised questions which were amicably settled with the assistance of the industrial solicitor. Of these, 46 came from municipal and 10 from industrial purchasers. Many were merely repetitions of a question previously settled with the same purchaser. The work involved included 150 personal interviews with, and about 400 written communications by, the industrial solicitor.

The Council successfully protested against circular instructions issued by the Mines Department to their Inspectors, stating that where British firms had difficulty (owing to "control") in supplying machinery, such machinery could be obtained from America.

The Council appointed witnesses to prepare a case for submission to the Commissioners of Inland Revenue in favour of increasing the standard percentage of profits allowed under the Finance Act (No. 2), 1915. The case prepared was referred to the Board of Referees, before whom the witnesses made several appearances. It was proved to the satisfaction of the Referees that the electrical industry had become a national "key" industry, and that it was essential that it should receive adequate consideration at the hands of the Government. As a result of the Council's efforts, the standard percentage was raised by 1 per cent., as already announced in the Electrical Review.

During the year the Council, at the request of the Accumulator Section, was successful in obtaining from the Local Government Board extensions of the loan periods for storage batteries from seven to ten years, and five to seven years in certain cases respectively. The same Section was similarly successful in obtaining a desired revision of the battery specification issued by the War Office.

The Supply of Electricity Bill promoted by the I.M.E.A. was scarcely expected to make progress in present circumstances, but it is understood that a further effort will be made to advance it this year.

The Incorporated Association of Electric Power Companies has invited the co-operation of the Association in drafting a new Electric Lighting Bill.

The Council invited members to make towards the equipment of the Peking University's laboratories gifts of machinery similar to those presented to the University of Hong-Kong. A report on the subject will be issued to members.

The growth and progress during the year of various bodies formed to foster British and Empire industry had been noted with much interest and sympathy. One such body, the British Empire Producers' Organisation, whose efforts extend into many oversea dominions, had already received the Council's support. Another, the Federation of British Industries, formed primarily to watch over the industrial interests of this country, has the Council's cordial sympathy. The chairman of the B.E.A.M.A. has been on its executive council since its formation, and several members of the Association have joined it.

The growth of the B.E.A.M.A. has rendered advisable the creation of some co-ordinating body composed of members closely connected with the work of the Sections, and the Council welcomes the proposed establishment of a Sectional Committee or Board composed of such members and reporting to the Council. It is hoped by this means to concentrate effort in matters common to all Sections.

The system of tendering embodied in the agreements known as cross-tendering agreements continues to find favour among members, but has not been extended during the year. The Association has in operation the following such agreements: (1) Steam-engine builders and dynamo makers, (2) Diesel-engine builders and dynamo makers, (3) steam-engine builders, (4) turbine makers, (5) condenser makers.

Several arbitrations were submitted and settled during the year. The steady growth of the Association obliged the Council early in the year 1916 to take into question the advisability of moving into larger premises. They finally decided that during the period of the war they should manage with the present holding by carrying out some alterations. These were completed in June. The work of the Association's status inquiry agents, the British Traders' Association, has proved useful and satisfactory to members.

The number of members on the register at the end of the year (December 31st) was 144. Thirty firms were admitted to membership during the year, and one resigned.

CO-OPERATIVE EXPORT TRADE.

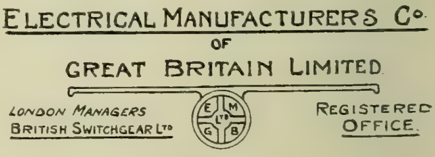
In our last issue we announced the registration of a new company with the title "British Switchgear, Ltd.," and as it represents an enterprise of exceptional interest, we are glad to be in a position to give further particulars as to its constitution and purposes.

In the Electrical Review for December 31st, 1915, we welcomed the registration of the Electrical Manufacturers' Co. of Great Britain, Ltd., which was formed by seven well-known electrical manufacturing concerns to act co-operatively in the Russian market. An eighth has since been added, making three dynamo and motor, and five switchgear companies, as follows:—

Bruce Peebles & Co., Ltd.
Crompton & Co., Ltd.
Lancashire Dynamo & Motor Co., Ltd.
Allen, West & Co., Ltd.
Brook, Hirst & Co., Ltd.
Erskine, Heap & Co., Ltd.
Whipp & Bourne, Ltd.
Electric Control, Ltd. (since added).

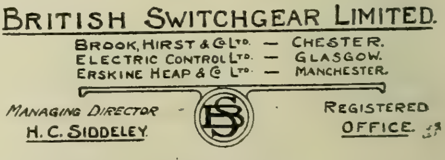
The nominal capital of the Manufacturers' Association was £12,000 in £1 shares, and we are pleased to learn that very satisfactory progress has been made with the business considering, of course, the shipping and other difficulties of the times.

British Switchgear, Ltd., which has now been formed with a capital of £48,000, is closely related to the Manufacturers' Co., indeed, their offices are together in that magnificent building, Australia House, Strand, W.C., which, when it is finished, will be one of the most palatial piles in London. What offices could have been taken more appropriately for the housing of so promising and important an electrical enterprise? Mr. H. C. Siddeley, in whose mind the germ of the co-operative organisation first had birth several years ago when touring Colonial and foreign markets, was chairman of the Manufacturers' Co.—known in brief as "The Russian Syndicate," but he has now been followed by Mr. E. H. F. Reeves in that capacity, and Mr. Siddeley will be its manager and secretary, while, at the same time, he will hold office as


ELECTRICAL MANUFACTURERS Co
OF
GREAT BRITAIN LIMITED

LONDON MANAGERS
BRITISH SWITCHGEAR LTD

REGISTERED
OFFICE.


BRITISH SWITCHGEAR LIMITED.
BROOK, HIRST & Co LTD. — CHESTER.
ELECTRIC CONTROL LTD. — GLASGOW.
ERSKINE HEAP & Co LTD. — MANCHESTER.

MANAGING DIRECTOR
H. C. SIDDELEY.

REGISTERED
OFFICE.

managing director of British Switchgear, Ltd., who are the managers for the Electrical Manufacturers' Co. of Great Britain, Ltd. Mr. A. P. Wood, the well-known and far-seeing manager of the Lancashire Dynamo & Motor Co., Ltd., has been elected a new director of the Russian Syndicate now that Mr. Siddeley has resigned that particular office. In the reproductions of nameplates on the previous page we show at a glance the relation of the two concerns and their respective monograms:—

The Manufacturers' Co. has offices at 13, Myasnitskaya, Moscow, in charge of a well-known Russian electrical engineer, Mr. S. I. Landau, who, for the best of reasons, has had a very wide experience in Russia, and has the right knowledge to enable him to deal satisfactorily with the Government and with other authorities. In London, too, the personnel is strengthened by the presence of a Russian engineer, who received his training in Belgium. We have been privileged to see documents showing that The Manufacturers' Association is acknowledged by the authorities in Russia as working for the Russian national defence.

British Switchgear, Ltd., operating at Australia House will in the first instance deal with the Russian switchgear contracts of the "Syndicate," but it will also represent three members in London and trade in their manufactures in other parts of the world, opening foreign branches and establishing foreign agencies for British switchgear on behalf of the three firms whose names appear on the nameplate above.

The advantages of co-operative action among different firms, whether makers of like or unlike manufactures, are too well known to readers of the Electrical Review to need detailed re-statement here. In this particular case, however, the arrangement of the two organisations along the above lines will not only make for economy, efficiency, and strength, as the result of concentrated effort in an expert selling company employing a better-paid staff than individual firms are generally able to engage, and having one strong series of operations instead of separate and rival action by an agent appointed by each firm, but the three firms interested in British Switchgear, Ltd., will be able to offer a complete line of switchgear, and the prejudice against the splitting up of orders need not exist in the mind of the purchaser. The combined output of the three firms is very large, and they will thus be in an excellent position to put up a strong competition against the efforts of very large German and American concerns. A point claimed in favour of the grouping of similar firms, and one which should not be lost sight of, is the personal factor. Each of the firms has a live, enterprising specialist in its own particular department of manufacturing, and when a number of such specialists meet round a board table, armed with authority to take action according to the requirements of the moment, prompt measures and the best results may be expected to follow.

Co-operation between groups is a policy pursued entirely on their own initiative by firms in the ranks of the B.E.A.M.A.—indeed, all of the eight firms in the Siddeley Russian groups are active members of that Association.

The new organisations have our best wishes for their success in trying to win for British electrical industry a large share of the coming trade with the vast Russian market. The foundations of the business are being well laid by men of wide experience and sound judgment, and their far-seeing plans have been prepared at the right moment to enable them to take full advantage of the situation. We have no doubt that their doings will be watched with great interest by the industry as a whole, and that their example will, in course of time, be followed by manufacturers of other electrical lines.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

[*Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest to our readers.*—Eds. Elec. Rev.]

B.T.H. Crane Motors.

A recently-issued List, No. 2,269, describes the crane and hoist motors manufactured by the British Thomson-Houston Co., Ltd., of Rugby. These motors are standardised for various ratings up to 50 H.P. for 115-230-550-volt circuits.

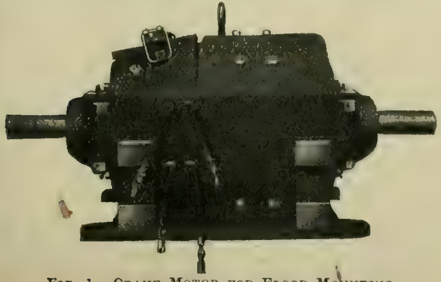


Fig. 1.—Crane Motor for Floor Mounting.

The machines are totally enclosed, reversible, four-pole series wound, and fitted with commutating poles.

The magnet frames are of cast steel, divided horizontally, and octagonal in shape; the top half carries the brush-holder studs. The end shields carrying the bearings have oil reservoirs, and can be swung 90° or 180° to keep the oil supply below the bearings when the motor is mounted on wall or ceiling.

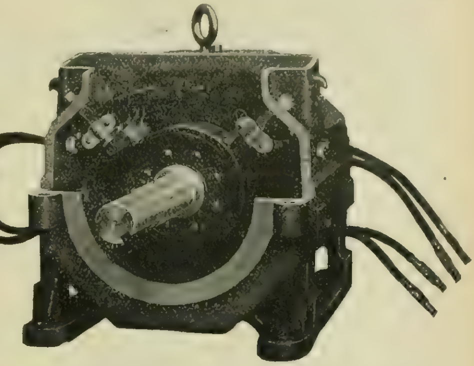


Fig. 2.—Motor with Frame cut away to show Brush Gear, &c.

The field and armature coils are former wound. The armature core and commutator are assembled on a sleeve, which construction permits the removal and insertion of a shaft without the necessity of disturbing the armature windings or the commutator. Similar extensions are provided at each end of the shaft, so that the spur gear or the brake can be mounted at either end.

The machines can be fitted with back gears on either side of the frame; series-wound magnetic brakes can be mounted; disk brakes to hold half the full-load torque of the motors; or shoe brakes to hold the full-load torque, the braking power being adjustable.

B.T.H. Pressure Governors.

The British Thomson-Houston Co., Ltd., of Rugby, in a recent list (No. 5,521), described its type CR 2,920 pressure governor panels for A.C. or D.C. circuits. These are designed for use with automatic starters controlling motor-driven pumps or air compressors for maintaining a constant pressure of air or water. A panel of this type is illustrated in fig. 3, and consists of a Bourdon tube gauge operating a pointer fitted with silver contacts, which serve to make a small-current circuit for operating the relay mounted on the right of the panel; this relay will operate on either A.C. or D.C. circuits, and, when energised, closes or opens the operating circuit of the automatic starter. No circuit is actually broken on the gauge contacts, and as the relay coils are only energised momentarily, no series resistance is necessary for them.

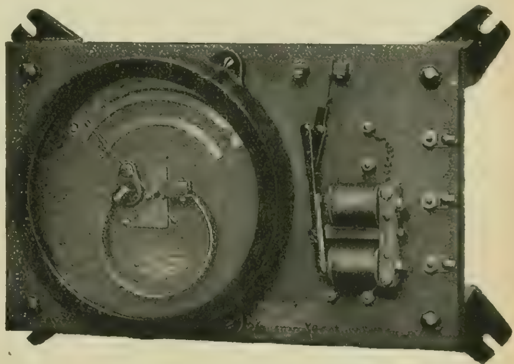


Fig. 3.—Pressure Governor Panel.

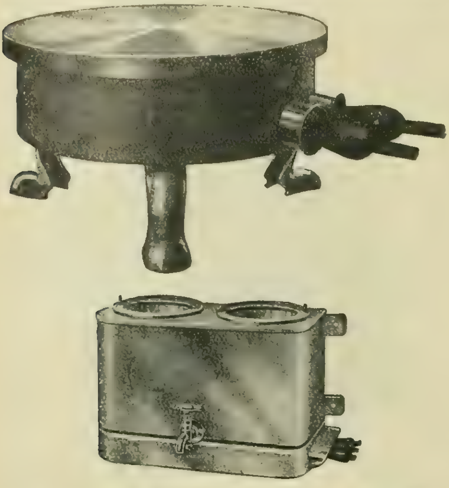
The panels are made for pressures up to 1,500 lb. per sq. in.

Simplex Heating Apparatus.

Messrs. Simplex Conduits, Ltd., of Garrison Lane, Birmingham, have just issued a new catalogue (No. 647) of electric heating and cooking apparatus, which shows a good range of their "Plexsim" goods.

Many of the articles illustrated are specially designed for industrial use, and we understand there has been a particularly brisk demand from many of the national and other factories recently built, which tends to show that electric heating is taking its share in the "factory efficiency" campaign now in progress.

Among the articles illustrated are large electric kettles and urns for mess rooms, staff tea rooms, &c., also industrial hot plates, glue, wax, and solder pots, and stills for distilled water in various sizes.'



Figs. 4 and 5. Plexsim Hot-plate and Glue-pot.

Fig. 4 shows a hot plate, made in 7-in. and 8-in. diameter sizes, with loadings of 750 and 1,000 watts respectively, while fig. 5 is a copper glue pot, each pot holding 2½ pints, fitted with an 850-watt heater.

The Plexsim electric still, made in two sizes, for 4 pints and 4 gallons, is designed for workshop use and built in sections, all parts being accessible.

Wattmeter Correcting for Transformation Losses.

A singular type of wattmeter, that enables one to measure the high-tension input from the low-tension output side, is the work of an Austro-Hungarian inventor, Gino Campos, of Milan, Italy. Ordinarily wattmeters are designed to indicate the input or output *in situ* by connecting the voltage and current coils to determine the watt factors at the point of measurement. However, by the disclosure made in Patent No. 1,201,996, it becomes possible to measure the total input on the high-tension side of a transformer by merely connecting the wattmeter to the low-tension side of a transformer. In other words, the wattmeter automatically corrects for the transformer losses. This ingenious result is accomplished by simply compensating the voltage and current coils of the dynamometer by means of additional turns, whose fields are proportional to the current and voltage respectively of the low-tension side. Because the copper losses of transformation, are proportional to the square of the current, and the iron losses are substantially proportional to the square of the voltage, it is seen that such compensated winding can suitably add to the deflection reading of the wattmeter, to make it measure both the low-tension output and the watts lost in the transformation of power. —*Electrical World.*

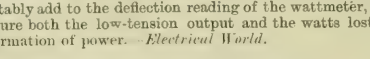


Fig. 6. -Diagram of Circuit Connections.

The Heat Treatment of Steel.

In the heat treatment of steel it is all-important to know exactly when the critical temperature is reached. In the "Crit-point," a new instrument of the Gibb Instrument Co., of Pittsburg, Pa., use is made of the well-known fact that steel in the process of heating loses its magnetic properties when it is brought to its critical point. Through the medium of electromagnetic coils the magnetic condition of the steel in the furnace is determined. A magnetic indicator is placed in the circuit, so that this meter immediately indicates whether the steel has reached its critical point. When the temperature of the surface comes to the critical point, the meter needle approaches a red line indicative of the critical point, and gradually comes closer to it as the heat penetrates the steel and the interior is brought to the critical point.

It will be seen that the "Crit-point" does not measure temperature. But the exact knowledge of the temperature is irrelevant, so long as the heat-treating man has a simple and exact means for ascertaining when the critical temperature is reached.—*Met. and Chem. Engineering.*

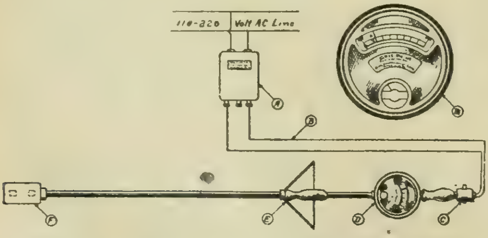


Fig. 7.—The Crit-point Detector.—a, Small Transformer, 110 or 220 v.; b, Flexible Lampcord.; c, Switch; d, Indicator; D_1, Indicator Enlarged; e, Asbestos-protected Shield; f, Search Coil.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Published expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

1,046. "Accumulators for miners' electric safety lamps." J. Taylor. January 22nd.

1,050. "Receivers for telegraphy, telephones, &c." T. Harvey January 22nd.

1,060. "Multiple crystal detector for wireless telegraph instruments" J. Hetherington. January 22nd.

1,062. "Electric switching apparatus." W. J. Howard & A. Reyrolle and Co. January 22nd.

1,071. "Antennæ for wireless signalling." British General Electric Co. and General Electric Co. January 22nd.

1,080 "Electric terminals or connections." H. C. Bell. January 22nd.

1,095. "Automatic electric control of petrol, electric, &c., vehicles." V. S. Robinson & P. F. Smith. January 22nd.

1,101. "Automatic stopping device for steam or electric locomotives and railway rolling stock." J. B. S. Poyser. January 23rd.

1,110. "Electrical apparatus." N. Stell. January 23rd.

1,113. "Method for guiding electric wire into groove of trolley wheels of tramcars, &c." T. Main. January 23rd.

1,114. "Electric switches." A. Crawford, W. Preston, & W. Sanders and Co. January 23rd.

1,122. "Means for travelling electric contacts." R. Donald January 23rd.

1,146. "Electric furnaces." G. B. Filmer & J. J. Denton. January 23rd.

1,155. "Motor vehicle lighting dynamos." C. L. Breeden & H. Lucas. January 23rd.

1,177. "Electrical fire alarms, &c." R. Cawthorne. January 24th.

1,184. "Apparatus for operating feed devices of reciprocating tools, &c." Lancashire Dynamo & Motor Co. January 24th.

1,223. "Process for electrolytic treatment of metals, ores, their residues, &c." F. Bourgeot. January 24th.

1,233. "Electric signalling system." R. Lambourne. January 24th.

1,256. "Sparking plugs." V. Perrett. January 25th.

1,277. "Process for manufacture of thermo elements having copper sulphide as the positive constituent." J. Marschall. January 25th (Germany, December 9th, 1915.)

1,278. "Dynamo-electric machines." British Thomson-Houston Co. and J. Martin. January 25th.

1,279. "Automatic switching devices for thermic telephones." B. E. D. Kilburn (Naamlooze Vennootschap de Nederlandsche Thermo Telephoon Maatschappij). January 25th.

1,282. "Winding for electric coils." M. Martinez. January 25th.

1,303. "Ignition devices for internal-combustion engines." P. T. Woodland. January 25th.

1,307. "Apparatus for producing perforated strip by electrical current impulses." Creed & Co. and H. H. Harrison. January 25th.

1,310. "Manufacture of tungsten oxides, salts, and/or metal from tungsten ores, minerals, intermediate products, residues, and/or wastes." E. A. Ashcroft. January 26th

1,315. "Electric ovens, &c." F. P. Fletcher. January 26th

1,343. "Self-generating electric pocket lamp." F. D. M. Gordon January 26th.

1,346. "Small electric motors." E. Volkers. January 26th. (Germany, February 17th, 1916.)

1,347. "Automatic telephone systems." Automatic Telephone Manufacturing Co. January 26th. (U.S.A., February 14th, 1916.)

1,355. "Electrical batteries." W. A. Saxby. January 26th.

1,390. "Terminal connections for accumulators or secondary batteries." W. O. Kennington. January 27th.

PUBLISHED SPECIFICATIONS.

1915.

17,319. Electric Heaters. C. R. Belling. December 9th.

18,103. Filament Winding Machines. Westinghouse Metal Filament Lamp Co. December 28th (U.S.A., December 29th, 1914.)

1916.

The numbers in brackets are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

70. Electric Controller, particularly for use in connection with Electrically-propelled Vehicles. J. E. Hamilton. January 3rd, 1916. [102,981.]

135. Driving Clutches for the Magnetos of Motor Cars. A. Saurer (firm of). January 5th, 1915. [100,005.]

241. Power Transmission on Rail and Road Trains and the like. J. G P. Thomas & Thomas Transmission, Ltd. January 6th, 1916. [102,987.] (Cognate application, 1,229/16.)

334. Order Telegraph and Light Instruments. L. Schor. January 7th, 1916. [102,993.]

455. Apparatus for the External Shaping of Clay in the manufacture of Telegraph Insulators and the like. H. L. Doulton & W. Podmore January 11th, 1916. [102,994.] (Addition to 22,757/14.)

THE
ELECTRICAL REVIEW.

VOL. LXXX. FEBRUARY 16, 1917. No. 2,047.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: February 16, 1917. [No. 2,047.

Page
Co-operation in Export Trade 169
National Service and War Loan 170
The Inspection of Munitions, by "Commercial" 171
Steam Turbines for Land Purposes, by H. L. Guy (*illus.*) (*concluded*) 171
New Electrical Devices, Fittings and Plant (*illus.*) 174
Legal 175
Correspondence—
  British *v.* German Manufactures 177
  City and Guilds Examinations 178
  Fuse Failures 178
  The Kilowatt Pubiishing Co., Ltd. 179
War Items 179
Business Notes 180
Electrical Developments at Perth, W.A. 183
Notes 184
City Notes 188
Stocks and Shares 189
Market Quotations 190
Electric Tramway and Railway Traffic Returns 190
Improved Methods of Power Measurement (*illus.*) 191
Boiler-House Operation and Maintenance (*illus.*) (*continued*) 192
Principles Involved in Computing the Depreciation of Plant 194
The Röntgen Society 195
Foreign and Colonial Tariffs on Electrical Goods 196
New Patents Applied for, 1917 196
Abstracts of Published Specifications 196
Contractors' Column ... ... Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE 1–4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.
Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 6d.; Canada, £1 8s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.
AUCKLAND N.Z: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.
BRISBANE: Gordon & Gotch, Queen St.
CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.
DUNEDIN, N Z.: Gordon & Gotch, Princes Street.
JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c.: Central News Agency, Ltd.
LAUNCESTON: Gordon & Gotch, Cimitiere Street.
MELBOURNE: The Mining & Engineering Review, 90, William Street; Gordon & Gotch, Queen Street.
MILAN: Fratelli Treves.
NEW YORK: D. Van Nostrand, 25, Park Place.
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto 1° 307.
SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.
WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE "ELECTRICAL REVIEW'S"
ELECTRICAL & ALLIED TRADES DIRECTORY
(THE RED BOOK),
1917 EDITION,
IN PREPARATION.
H. ALABASTER, GATEHOUSE & KEMPE,
4, Ludgate Hill, London, E.C.

CO-OPERATION IN EXPORT TRADE.

IN view of all that has appeared in our pages during the past few years regarding the need for co-operative action on the part of British electrical and engineering firms desiring to secure export trade after the war, peculiar interest attaches to what is known as the Webb Bill that is shortly to come before the U.S. Senate. The purpose for which the Bill is designed is to authorise American exporters to co-operate in order to place themselves on an equality with foreign rivals. According to the American electrical Press, the Webb Bill has received the approval of organisations and individuals representing all elements of manufacturing, merchandising, national production, transportation, and finance in foreign trade. The National Foreign Trade Council, in placing its views before a Senate Committee, has stated that even before the war doubt as to the application of the anti-trust laws compelled American exporters individually to cope with Government-encouraged combinations of foreign rivals united to resist American competition, and often to sell to combinations of foreign buyers equipped to depress the prices of American goods. The revelations and almost certain consequences of the war, however, have left no room for doubt in the mind of the National Council that co-operation in export selling, with every safeguard against illegal restraint of domestic trade, is imperative to meet proposed *post bellum* co-operative buying, not only by groups of European industries, but even by Governments, with the object of controlling prices. It is considered that unless the Webb Bill is passed, and the legality of export co-operation established, many industries of moderate size will be unable to enter foreign trade because of prohibitive expense which co-operative effort would reduce; also that "greater stability of export business could be obtained through co-operation and a wider distribution obtained in the benefits of oversea sales as a balance wheel against recurring periods of domestic depression and unemployment."

Whatever doubt there may be in the minds of American traders concerning their right to co-operate, there need be none in the minds of British traders. These know only too well under what a serious handicap they have been placed in many British Colonial and foreign markets when their divided forces have had to meet the consolidated Trust forces of Teutonic manufacturing and finance. They know what they ought to do, and they have the power to do it. American doubts in regard to the legal rights of co-operation are stated to have amounted to prohibition, and the consequent individualistic weakness of small concerns is described as enabling foreign buyers to play off American producers one against another, and to buy American raw materials cheaper than American consumers can, and in the long run confer upon the foreigner "a practical subsidy against ourselves."

The *Electrical World*, in a recent article, states that the American General Electric and Westinghouse Companies would experience little, if any, inferiority, as compared with their foreign competitors, so far as industrial combinations affect their efficiency, but, the writer adds, apparently in reference to the smaller manufacturer: "Co-operation of American electrical manufacturers would permit the joint financing of many foreign enterprises in which such financing must be done to secure business. Moreover, it would permit the extension of credits, where necessary, to compete with the credits offered by foreign manufacturers." Further: "In seeking the removal of restrictions or obstacles to freer trade in American goods, in propaganda favouring the adoption of American standards and designs by Governments and others, and in education abroad touching the merits of American electrical products, united action would be invaluable."

Whether the Webb Bill will pass at the present stage or not may be uncertain in view of the other more immediately important matters which, due to the enemy's ruthlessness in submarine warfare, are now engrossing the attention of the whole American people. And whether it passes now, or later, or not at all, really is a matter of domestic concern for the States alone, the present movement being intended to secure a revision of American anti-trust laws. But the moral of it all is unaffected by the issue. Our trans-Atlantic cousins have not had the same reasons as ourselves in the past for feeling the handicaps imposed in the world markets by the methods, measures, and strength of Teutonic organisation. We were awake to the circumstances of the situation, but did not in peace time see the necessity, or possess the right spirit, for adopting suitable counter-measures. War-time, which has altered the whole outlook in regard to world trade. should engender strong co-operative action on the part of British traders.

The mere recital above of the appreciation that America is now expressing of the principle of co-operation should strengthen the hands of those who have already adopted that principle as a theory for future application, as well as of those who have definitely launched their schemes.

National Service and War Loan.

As we write, the whole of the nation is passing through another of those periods of heart-searching and self-examination of which there have been many during the past two or three years. Men, munitions, and money have all been called for again and again, and the demands of the Allied cause have been successively met. To-day, the speeding-up policy is making its new demands, and these, likewise, will be met, we trust, in time to make Victory certain before the "falling of the leaves." The call for fighting men does not need to be expressed in the same way as formerly, as the Military Service Acts embrace the required numbers of men of the right age and physical strength and endurance that the conditions of modern warfare demand. But those Acts can only produce them as they are drawn from the making of munitions and from establishments engaged in industry. Therefore, the National Service scheme of Mr. Neville Chamberlain is getting to work to find substitutes for the fighting men who are still busy at the bench. At present, the call is for volunteers—every man between the years of 18 and 61 is appealed to—who are prepared to place themselves at the disposal of the State in her time of need.

Everybody who has the interests of the Allied cause at heart will wish complete success to this immense test of the voluntary industrial principle. Mr. Chamberlain is a business man who, while knowing from the inner counsels of the Government what the exact needs of the situation are, also fully appreciates how sweeping are the demands that he has been called upon to make. Apparently it will be necessary for some industries to be pooled, and for others to remain in a state of suspense, but Mr. Chamberlain has shown quite plainly that he recognises how delicate an operation these measures entail, and he is fully alive to the danger and difficulty of saying what are and what are not essential war-time industries. Economic interests and the need for exercising care so that industries shall not be disorganised more than is imperatively necessary, as they must be ready for full-speed activity immediately after the war, are present to his mind as he issues his appeal for men for the war factories. But while due weight will be given to all such considerations, the situation demands Labour of many kinds, and that immediately. Here is one of the outstanding reasons for self-examination and heart-searching, and every reader must in justice to the Cause consider his ways.

Another call for introspection is made in connection with the great War Loan, for which the lists close to-day. As Mr. Bonar Law has stated, "It is vital that the War Loan should be a success; it will be taken as the standard of the staying power of our people." It is also most attractive as an investment, to every class of the community, and there still remain a few hours. In this matter we can only secure the full measure of success if every man and woman recognises individual responsibility. Though the lists of what, it is hoped, will be the last War Loan, are closing, there will still remain ways in which industry can help. We would repeat our own appeal of several months ago to heads of industries represented by this journal to continue to push war-savings schemes among their employés as energetically and generously as they possibly can. Representing as they do what are, perhaps, more than all others, essential war industries, they are giving profitable employment to greatly increased numbers of workpeople, and from the earnings of these many more millions sterling should be forthcoming for War Loan purposes. Many electrical and engineering works are doing admirably with such schemes. It is not too late for others to follow suit.

THE INSPECTION OF MUNITIONS.

"Some New Methods, and Some Old Ones."

By "COMMERCIAL."

During the past two years the long-suffering British public has been subject, among other necessary evils, to a flood of advice, reproach, and argument, poured forth from the presses of every sort of paper in the country. So diffuse and all-embracing has this flood been, so diverse the topics, even when, as in some cases, coming from one pen, that the ordinary citizen may be pardoned for presuming that the flood had done its work. England is undoubtedly awake, and things are moving! Granted that we have gone far to abolish the old order of muddle and unpreparedness, we have good reason to believe that there still exist several hindrances to the business-like conduct of our present task. Just as the country has been plagued by the presence of the amateur lawyer touch in its great Departments of State, so it is to-day by the business amateurs in the new War Departments. Of which more anon. The hide-bound, short-sighted policy of past years of which we have in the Review complained again and again, still thrives in business, in spite of all advice, reproach, or argument.

The new war organisation has brought into being a number of new departments. There is a Director of this, that, and the other—Aircraft, Waterways, Ordnance, Navy Contracts, and so on, *ad libitum*. Each one is in the market for necessary materials, and each one has its own inspectors. The writer happens to deal with electric wires and cables, and hopes to be believed when stating that most of the said inspectors did not, prior to the war, know a cable from a cow. Some are men enough to admit it; the others show it unconsciously. Travelling expenses in the shape of train fares or motor-car expense are incurred to bring such inspectors to contractors' works, when often the job is so small as to be hardly worth while, and, in any case, the old Army or Navy inspectors could deal with the whole of such orders. One day recently two army officers came by car a 30-mile each way journey to inspect three coils of 7/22 ordinary wire. Another gentleman made the same trip by train to see 200 ft. of motor-car ignition wire. Fancy ordering such material for the British War Department in 200-ft. lots!

Numerous well-appointed London hotels are now in the hands of the Ministry of Munitions, and this is the sort of thing for which they are used. After the three coils of 7/22 before mentioned had been inspected, we received 24 foolscap size printed sheets from the Statistical Department of the Ministry, and a request that we should make a weekly return, in triplicate, of the progress of this order. The only conclusion possible is that the particular star of the Statistical Department had no idea of the nature or quantity of the material with which he was dealing, and what use he could make of a weekly return can only be conjectured.

Certain other orders necessitated the use of large quantities of raw material. This was obtained from three firms in weekly deliveries. The Ministry took this supply under their wing, and, week after week, a return was made of the quantities received. No interruption in the supply occurred, and no such weekly return was necessary. An ordinary business man would have asked us to report only when the supply failed, but they are not of this class at the London headquarters of the Ministry of Munitions. The whole thing is a waste of paper, stamps, and busy men's time.

In the average factory in peace times the question of delivery is one which looms large in the troubles of the manufacturer. To-day the same problem is a hundred-fold more difficult, and quite as much so is it in a cable factory as in any other controlled works. Materials like copper and steel (wire or tape) cannot be used for any save Class A or B, and most others are not easy to obtain. Pressure of work compels the maker to quote long deliveries, and the quoted time is even then often insufficiently long. A motor-car firm is quoted five to six weeks for a quantity of ignition wire. The order comes along, and a request for part delivery at once follows in a few days. Again and again they ask for delivery, only to be refused. A new powder factory is in building, and the engines, pumps, and fittings are ready. The necessary cable is ordered, and four days later they require it, as the engines are ready, &c. A shipbuilder orders cables, and in the same way asks for immediate delivery, as the ship is urgently required and the job will be stopped.

All these are actual cases of fact. The writer is not discussing the nature of the ground in the Balkans, or the next move of the Huns. These cases are British procedure in business to-day. The Germans will never be gentlemen, and the British will always be fools. It may be pointed out that, apart from all question of the negligence and incapacity of people who habitually muddle along in this manner, it is unfair to attempt to accede to their requests for quick delivery, because it necessitates delay with the orders of others, who have been good and reasonable enough to anticipate their requirements in a proper manner. A breakdown job is in quite another category, and will always command assistance; but cases of the sort quoted are unreasonable and foolish, and the only cure lies in the hands of the people concerned. They may learn sense some day, but apparently the present upheaval has not taught them a great deal. A motor-car, an aeroplane, or a ship cannot be built in a day, even though we may be persuaded that they can. The exercise of a little intelligent foresight would obviate all such trouble, besides saving time and money spent on useless appeals for special treatment. Business people who lack that requisite are a nuisance in ordinary times. In the present instance all the goods concerned are, it should be remembered, for war purposes, and so the more need for everything to be done to avoid delay. Happily, the number of firms who are open to the charge thus made, is not apparently a large one, though they are not on that account any less conspicuous. As an alternative to the perusal by the Statistical Department of so many hundred silly forms per week, the writer suggests that they invite controlled firms to communicate when they are troubled by impossible demands from people who have not yet lost the habit of being "too late." A little attention from headquarters would possibly affect the culprits more than mere paper entreaty, and would certainly help us on with the war better than a whole car-load of triplicate advices.

STEAM TURBINES FOR LAND PURPOSES.

By H. L. GUY, A.M.I.Mech.E., Assoc.M.I.C.E.

(*Abstract of paper read before the* Manchester Association of Engineers.)

(*Concluded from page* 147.)

A 6,000-kw., 1,500-r.p.m. set, installed at the Port Dundas station of the Glasgow Corporation, illustrates the reliability of a modern steam turbine unit, and of the importance of coal consumption. The turbine is of the Rateau impulse type, designed for 190 lb./sq. in. g., and 166 deg. F. supht., containing a velocity wheel, followed by 10 Rateau impulse stages, the maximum tip speed being 553 ft. per second.

Between July 24th, 1914, and October 31st, 1915, this set generated 52,852,500 units, or 78.93 per cent. of the maximum possible full-load output. The set was started up in February, 1914, and had generated 100,000,000 units by August, 1916, so that with a coal consumption of, say, 1.75 lb. per kw.-hour, the coal used by the set would equal 78,250 tons in two and a half years, or at the rate of 31,300 tons per annum, which represents a coal bill of £23,500 per annum, with coal at 15s. per ton, so that each 1 lb. improvement in steam consumption saves about £1,710 per annum in cost of fuel alone.

In the example stated, if the saving in coal consumption alone is considered, and capitalised at the rate of 10 per cent., an increase in purchase price of £2,350 would be justified for each 1 per cent. improvement in steam consumption.

A set supplied to the London County Council, rotating at 1,500 r.p.m., and rated at a normal load of 8,000 kw., and a maximum capacity of 10,000 kw., of the British Westinghouse Rateau impulse type, was designed for a pressure of 180 lb./sq. in. g., with steam at a total temperature of 550 deg. F.; it contained a two-row velocity wheel, followed by 12 Rateau stages, the first Rateau blade height being 1 7/16 in., and the last 14 in., so that the ratio of the last blade height to the mean diameter is just over 1 to 5, and the maximum tip speed 565 ft. per second. The overall length of the set is 37 ft. 2 in., and the maximum width 12 ft. 7 in., so that

21.4 KW. capacity is provided per sq. ft. of floor space at the maximum rating.

A condenser, having 20,000 sq. ft. surface, maintains a vacuum of 28¼ in. (30 in. bar.) at maximum load.

The following official test consumptions were obtained, the figures being corrected to 180 lb./sq. in. g., 550 deg. F.

Load.	125 %	100 %	75 %	50 %
Vac. inches (30-in. bar.) ...	28½	28½	28·82	28·95
Adia. heat drop, B.TH.U./lb. ...	385	385	396	402·2
Steam consump., lb./KW.-hr.	12·208	12·453	12·598	12·809
Generator efficiency ...... %	96	95·5	94·5	92·5
Adia. turbine efficiency %	75·4	74·4	72·2	71·4

One of the first sets of 15,000-KW. capacity, built by Messrs. J. Howden & Co., was installed in the Stuart Street power station of the Manchester Corporation. The turbine is of the Zoelly impulse type, containing 14 stages.

The condensing plant was supplied by Messrs. Richardsons, Westgarth. The surface condenser has a surface of 24,000 sq. ft. The following are the guaranteed steam consumptions:—Steam conditions: 190 lb./sq. in. g., 530 deg. F. total temp., 27.5 in. vac., adiabatic heat drop 357.4 B.TH.U./lb.

Load.	125 %	4/4	3/4	1/2	1/4
Steam consumption, lb./KW.-hr.	14·25	13·65	14·12	14·92	16·95
Combined genr. and turbine efficiency	66·7	69.5	67·2	63·6	56·0
Assumed generator efficiency...	96·0	95·0	94·5	93·0	87·5
Corresponding turbine efficiency	69·5	72·9	71·1	68·5	64·0

For examples of high-pressure turbines of the largest size, we have to turn to the United States of America. The British market in the past has not demanded units of similar capacity, but when such sets are required British makers will be found able to cope with the demand in the fullest measure.

One of the most notable American large sets is that shipped in 1913, by Messrs. C. A. Parsons, for the Fisk Street station of the Commonwealth Edison Co. The plant is rated at 25,000 KW. at .95 P.F., and runs at 750 R.P.M., the generator being 25 cycles, 3-phase. The following consumptions were guaranteed:—Steam conditions: 200 lb./sq. in. g., 200 deg. F. superheat, 29 in. vac., adiabatic heat drop 418.5 B.TH.U./lb.

Load.	25,000 KW.	20,000 KW.	10,000 KW.
Steam consumption, lb./KW.-hr. ...	11·65	11·25	12·5
Combined turbine and genr. efficiency	69·8	72·3	65·0
Assumed generator efficiency	96·0	95·0	92·0
Corresponding turbine efficiency ...	72·7	76·1	70·7

The high-pressure blading consists of 64 rows, arranged in six expansions. The first blade is 2¾ in., and the last 6¼ in. long.

The low-pressure cylinder is built on the double-flow principle, each flow containing 24 rows of blades, arranged in six expansions, the first blade height being 2¾ in., and the last 19 in., the ratio of the blade length to mean diameter is approximately 1 to 5.6, while the tip speed of the last row is 410 ft. per second. The exhaust is 252 sq. ft. in area, which at 25,000 KW., corresponds to an exhaust velocity of 190 ft. per second.

The condenser has a surface of 39,300 sq. ft. The set is 76 ft. 2 in. long, and 18 ft. at the widest point; the capacity per sq. ft. of floor space is therefore 18¼ KW. at maximum.

The General Electric Co. of America supplied for the Northwest station of the Commonwealth Edison Co., of Chicago, a set rated at 30,000 KW. at 1,500 R.P.M., the alternator being of the 3-phase, 25-cycle type, generating at 2,000 volts. The turbine is designed for 230 lb./sq. in., 600 deg. F. total temperature, and 29 in. vacuum.

The turbine consists of a high-pressure and low-pressure cylinder placed in tandem, the high-pressure cylinder containing a two-row velocity wheel with an approximate mean diameter of 7 ft. 6 in., followed by nine single-row impulse wheels, which expand the steam down to 7 lb./sq. in. absolute, at which pressure it enters a two-stage double-flow low-pressure turbine, having wheels of an approximate mean diameter of 9 ft. 9 in. A rectangular exhaust area of 168 sq. ft. connects the turbine to the condenser. The ratio of the length of the last blade to the mean diameter is approximately 1 to 7.8, and the tip speed 860 ft. per second. The surface condenser has 50,000 sq. ft. of cooling surface.

This turbo-generator is 59 ft. 6 in. long by 18 ft. 4 in. wide, so that a capacity of 27.5 KW. is provided per sq. ft. of floor space.

A set of the same rating and speed by the same maker weighs 435 tons, or 32.5 lb. per KW. The consumption guarantees of this set are as follows:—Steam conditions: 215 lb./sq. in. g., 200 deg. F. superheat, 28¼ in. vac., adiabatic heat drop 403 B.TH.U./lb.

Load.	30,000 KW.	22,500 KW.	15,000 KW.
Consumption, lb./KW.-hour	12·45	11·9	12·75
Combined turbine and genr. efficiency	67·8	71·0	66·2
Assumed generator efficiency ...	96·0	95·0	93·0
Corresponding turbine efficiency ...	70·6	74·8	71·4

The American Westinghouse Co. supplied a 30,000-KW. set to the Interborough Rapid Transit Co., which was started up in December, 1914. In 1901 four 7,000-KW. Allis Chalmers reciprocating sets were installed, having a steam consumption of 17.3 lb./KW.-hour. These engines have now been replaced by three turbines with a total capacity of 90,000 KW., occupying the same floor space as the original engines. The purchase price of the turbine sets per kilowatt was only 22.5 per cent. of that of the engine set, while the saving in coal cost alone on one set is estimated as being over £40,000 per annum. Since the installation of the first set the average monthly coal consumption has been reduced from 2.5 to 1.5 lb. per KW.-hour.

The steam end of the plant consists of a high-pressure and separate low-pressure turbine, each coupled to its own alternator, but permanently connected on the electrical side, the high-pressure turbine running at 1,500 R.P.M., and the low-pressure at 750 R.P.M.

Steam entering the high-pressure turbine at a pressure of 200 lb./sq. in., with 120 deg. F. superheat, is expanded in six expansions to a pressure of 14 lb./sq. in. absolute, when the most economical load of 25,000 KW. is carried. The height of the first blade is 4 in., the last being 9 in. Cast steel is used for the high-pressure cylinder.

Each side of the double-flow low-pressure cylinder contains 20 rows of blades, arranged in six expansions, the first being 6 in. and the last 18 in. high, rotating with a mean peripheral speed of 400 ft. per second, so that the ratio of the length of the last blade to its mean diameter is 1 to 6.75. This low-pressure cylinder weighs 147 tons, while the weight of the low-pressure rotor is 57 tons. The area of the exhaust is 190 sq. ft. In the rotors the stress in the drums and disks at full speed is less than 4.3 tons per sq. in., so that ordinary materials can be used in their construction.

After passing through the low-pressure cylinder the steam passes into two surface condensers, each having 25,000 sq. ft. of surface, which maintain a vacuum of 29 in. when supplied with 37,500 gallons cooling water per minute.

Test results are shown below. Steam consumptions are corrected to 215 lb./sq. in. absolute, 120 deg. F., 29 in vacuum (30 in. bar.), corresponding to an adiabatic heat drop of 399.9 B.TH.U./lb.

Load in KW.	32,348.	26,740.	26,505.	21,925.	16,342.
Corrected consumption, lb./KW.-hour	11·332	11·258	11·274	11·421	11·770
Assumed genr. efficiency	96·0	95·0	95·0	94·3	94·0
Turbine efficiency relative to adiabatic expansion	78·25	79·6	79·5	79·0	77·0

Geared Turbines.

The geared turbine has now established a place for itself as an important prime mover for various land purposes, in all those cases where the most suitable speed of the driven machine is less than half the best speed of the turbine. One application is the use of gears for driving a direct-current generator. In such a case there are three alternatives deserving consideration:—

(*a*) The turbine may be direct coupled to a high-speed D.C. generator, running at a speed of 2,500 to 3,000 R.P.M. The difficulty with such a machine lies in the construction of a satisfactory commutator, and in spite of the fact that some ingenious devices have been developed to overcome these difficulties, such as the radial commutator, a 500-KW. set in a single machine appears to be the limit for safe operation. For outputs below that stated, when the voltage is suitable, this type of plant is cheaper, as efficient, and occupies less space than either of the alternatives.

(*b*) A turbo-alternator, running at 3,000 or 3,600 R.P.M., can be used in conjunction with a rotary converter, forming a combination which, in certain cases, has distinct advantages. This combination is particularly suitable when D.C. power must be supplied to several points some distance apart, when the transmission losses and cost of mains can be kept to a minimum by generating at a moderate or high voltage, and transforming down at the sub-station where the rotaries are installed. In many instances direct current is essential for a part of the system only, while the remainder can be served more efficiently by an alternating supply, a case for which the rotary plant is peculiarly suitable. With such a mixed system of distribution the rotary has the further advantage that it can be run inverted, taking direct current from sets with which it works in parallel, or from a battery, and supplying alternating current into the mains, thus helping out the A.C. sets in case of a breakdown.

A further advantage will arise if the linking-up schemes now under consideration mature, because small D.C. stations will receive alternating current from the trunk mains and convert it into D.C. by means of an existing rotary, thus having their main turbo-alternator sets as a stand-by, whereas in the case of the direct-connected or of the geared D.C. generator, it will be necessary to install rotaries. The turbo-alternator rotary plant does not suffer from the limitation in desirable size, which applies to the other two alternatives.

(*c*) Double-helical turbine gearing can be employed to reduce the speed of the turbine to that most suitable for an engine-type D.C. generator; the speed of the former is usually between 3,000 and 4,000 R.P.M. for units of moderate size.

The relative merits of the two latter alternatives are shown in figs. 4 and 5. The costs of the two types of plant are plotted in fig. 4, as ordinates, the output being abscissæ.

At 1,500 KW. the purchase price of the two types is the same; for larger outputs, the rotary scheme is the cheaper.

The steam consumptions for the two types have been plotted in fig. 5, showing that the rotary plant has a consumption at full load from 3.8 per cent. to 1.8 per cent.

higher than the geared combination, a saving in favour of the geared scheme which, for sizes above 1,500 kw., is more than balanced by the lower purchase price of the rotary set.

One of the largest geared d.c. sets was supplied to the Cleveland Electric Illuminating Co., Ohio, in 1912. The turbine, which is of the back-pressure type, exhausting at atmospheric pressure, running at 1,800 r.p.m., is coupled to a 3,750-kw. generator through a double-helical gear of the Melville-Macalpine type. The following particulars of these gears may be of interest:—

Maximum b.h.p.	5,500
Speed pinion, r.p.m.	1,800
Speed wheel, r.p.m.	180
Pinion pitch diameter	10·392 in.
Wheel pitch diameter	103·43 in.
Number of teeth on pinion	26
Circ. pitch teeth	1,255
Length tooth face	40 in.
Vel. at pitch circle, ft.-sec.	81·61
Lb. pressure per in., face width ...	92·68
Number of pinion bearings	3
Angle of helix	30 deg.

When alternators are required of moderate or small output for 25 cycles, the alternator can, with advantage, be driven by a geared turbine, because, with 1,500 r.p.m., the turbine speed which is the highest possible for direct-coupled sets, the plant becomes both expensive and inefficient, as is clearly shown in fig. 1. The possibilities of this solution can be illustrated by the following example:—

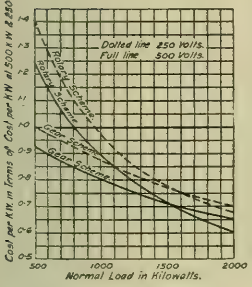


Fig. 4.—Relative Costs of Geared and Rotary Direct-current Sets.

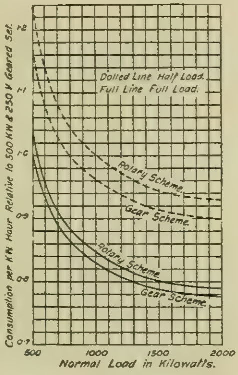


Fig. 5.—Relative Steam Consumptions of Geared and Rotary Direct-current Sets.

A Manchester firm was faced with this difficulty in a recent extension to its power house. A set normally rated at 1,500 kw. was required to supply a three-phase, 440-volt, 25-cycle system. These requirements could be met by either of the following alternatives:—

Scheme A.—A 1,500-r.p.m. turbine, directly coupled to an alternator.

Scheme B.—A 3,750-r.p.m. turbine geared to an alternator running at 750 r.p.m.

Scheme C.—A 3,600-r.p.m. turbine geared to an alternator running at 500 r.p.m.

Scheme D.—A 3,000-r.p.m. turbine directly coupled to a 50-period alternator, and electrically coupled to a 50-period motor, driving a 25-period alternator.

The relative steam consumptions and costs of these schemes are shown in the following table:—

Scheme	A	B	C	D
Steam consumption :				
Full load ...	1·0	0·927	0·935	1·0
Half load ...	1·0	0·922	0·93	1·05
Cost	1·0	1·005	1·11	1·38

Scheme B was adopted, a turbine having one velocity stage and seven Rateau stages being coupled to a Melville-Macalpine floating frame gear, driving a three-phase, 25-period alternator.

Many engineers insist on having condenser pumps steam driven, and as all the pumps are usually designed on the rotary principle, a steam turbine is very suitable for this purpose. Unfortunately, a high-speed low-lift centrifugal pump, running at 2,500 r.p.m., is usually 30 to 40 per cent. less efficient than one built for 500 r.p.m. To overcome this difficulty a reduction gear can be introduced between the turbine and the centrifugal pump, the air and extraction pumps being directly coupled to the turbine. Such a set, supplied to the Birmingham Corporation, and working in conjunction with a 5,000-kw. set, is shown in fig. 6. The air and extraction pumps take 57 b.h.p., while the circulating pump requires 133 b.h.p. to drive it. In this particular case the geared scheme requires 39 per cent. less steam than one originally proposed, in which the circulating pump was directly coupled to the turbine and run at 2,500 r.p.m.

Reducing Turbines.

In a large number of industrial concerns, such as textile and dyeing works, chemical works, sugar factories, paper mills, breweries, &c., a supply of heating-steam is necessary for sundry heating, boiling, and drying processes, and at the same time the plant requires a considerable amount of power. By generating the heating-steam at 150 to 250 lb. per sq. in., and passing it through a back-pressure or reducing turbine before it is exhausted to the heating main, a considerable amount of electrical power can be generated for a small additional expenditure of coal, usually less than half a pound per kilowatt-hour.

The steam required for heating large buildings may be utilised to generate electrical power, and if central heating stations are ever introduced into this country on a large scale, the electrical energy which can be generated will represent a valuable by-product.

With the back-pressure turbine the amount of steam required for heating purposes, and the work which can be done by the turbine, are directly connected. In many installations the amount of electrical power required and the demand for heating-steam bear no direct relation to one another, so that a machine is desirable which will give either heating steam or electrical power independently, as the demand for either varies. To meet these requirements the reducing turbine was introduced, consisting of a back-pressure turbine, followed by a low-pressure turbine on the same shaft, and in the same casing. Steam from the high-pressure main, at some pressure usually between 150 and 220 lb. per sq. in. g., with a superheat from zero to 300 deg. F., passes through the stop valve and high-pressure governor valve into a steam belt, feeding the nozzles of the first stage. It then passes through a velocity wheel and a Rateau stage before being exhausted at some pressure between 60 lb. per sq. in. g. and atmospheric, into the heating main *viâ* a non-return valve and a stop valve.

If the work done in the high-pressure stages is less than the load on the generator, a certain amount of steam is by-passed by an automatic valve through the Rateau stages in the low-pressure end, and expanded down to the vacuum in the condenser. A variation of 5 per cent. in steam pressure up or down is a reasonable range within which the automatic by-pass valve should maintain the heating-steam pressure.

If at any time the amount of heating-steam required exceeds that corresponding to the load on the generator, the deficit is supplied by a reducing valve. The non-return valve is provided to prevent steam from the reducing valve, or from another set, passing through the heating main into the low-pressure end of the turbine, when it would not be under the control of the governor, and might cause the machine to run away. An atmospheric relief valve is inserted between the non-return valve and the heater connection on the turbine to prevent an unduly high pressure being produced in the high-pressure end of the turbine casing in the event of the by-pass valve sticking when the stop valve is closed. When no heating-steam is required the whole of the steam entering the machine passes through all the stages into the exhaust, and under these conditions the turbine operates as a straight high-pressure set.

The economies which can be realised by the use of a reducing turbine depend in a large measure on the steam conditions with which it is to operate. In general it is safe to say that the initial pressure should be as high as commercial considerations will allow, and that 150 deg. to 200 deg. F. of superheat is desirable. Every endeavour should be made to keep the pressure at the heating-steam outlet on the turbine as little as possible above that required at the heating plant, for which reason all the valves in the heating system—of which there are usually a large number—should be of high-class design, suitable for high temperatures and able to pass the full steam quantity with as small a drop in pressure as is practicable. This drop in pressure should be guaranteed by the valve maker—a practice which, if followed in ordering valves for all purposes, would have considerable effect in improving their design. In many cases manufacturers are asked to supply sets designed for heating-steam pressures of from 40 to 60 lb. per sq. in. in cases where 10 lb. per sq. in., or even lower pressures, would be quite suitable. The higher pressure is often given because steam has always been supplied at that pressure, and any change is opposed from a fear that heating will not be so efficient, and may even be impossible if the pressure is lowered.

In the vast majority of cases the heating-steam can be supplied at, or a little over, atmospheric pressure, and under this head fall nearly all those cases in which steam is required to heat or boil liquids in open vats or maintain temperatures below 220 deg. F.

The enormous increase in the work capacity of heating-steam which accompanies a decrease in back pressure is shown graphically in fig. 7.

It will be seen that with steam at an initial pressure of 180 lb. per sq. in. and a superheat of 150 deg. F., the work which can be obtained is doubled by reducing the heating-steam pressure from 60 lb./sq. in. g. to 10 lb./sq. in. g., so that if 20,000 lb. of heating-steam is required for 3,000 hours per annum, an additional 654,000 kw.-hours can be obtained with the reduction in heating steam pressure stated, representing an annual saving of over £1,350 if electricity is valued at ½d. per unit.

One of the great advantages of a reducing turbine, as compared with a reducing engine, arises from the fact that the mechanical losses are only from 1 to 2 per cent. of the output, and that the radiation losses are usually only about 0.5 per cent. of the heat supplied to it, so that all the losses except 1.5 to 2.5 per cent. appear as useful heat in the heater mains. The mechanical losses of back-pressure engines can be anything greater than 6 per cent., particularly if the back-pressure is substantially greater than atmospheric, when the dimensions become very large relatively to the capacity of the set. The increased heat radiated from the engine cylinders can be appreciated from the fact that, while in a reducing turbine the heating-steam performs the whole of its work in less than 1/600 of a second, it would remain in an engine cylinder for about three-quarters of a second.

There are many processes requiring heating-steam, in which the steam is passed directly into the liquid to be heated; in such cases it is imperative that the steam shall contain no trace of oil. As the steam from the reducing turbine is entirely free from oil, it is in many cases the only type of prime mover which can be employed.

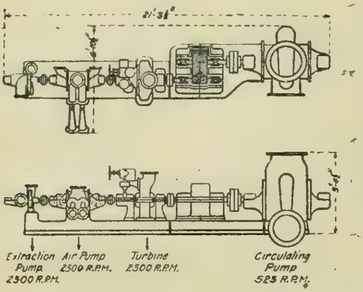


FIG. 6.—DIMENSIONS OF PUMPING SET.

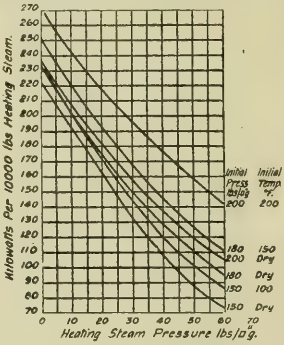


FIG. 7.—POWER OBTAINED FROM HEATING-STEAM.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

[*Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest to our readers.*—EDS. ELEC. REV.]

Cantie Patent Fuse Gear.

WE have received from the CANTIE SWITCH CO., LTD., of 67, Mount Street, Nottingham, a specimen of their new patent fuses, the constructional features of which are shown in fig. 1, while a complete fuse board with the cover removed is shown in fig. 2.

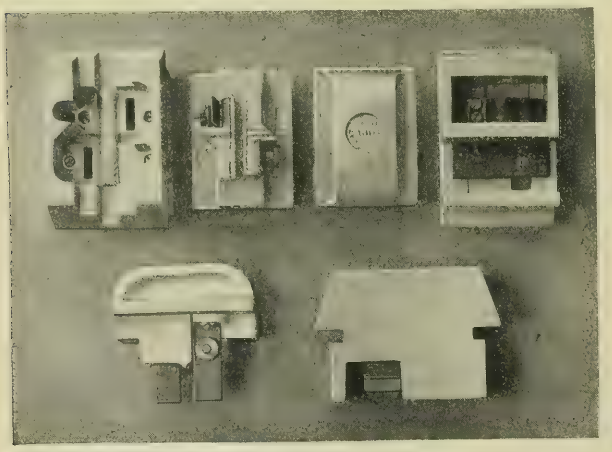


FIG. 1.—CANTIE PATENT FUSE: VIEWS SHOWING TOP OF BASE, UNDERSIDE AND TOP OF BRIDGE, UNDERSIDE OF BASE, AND ELEVATIONS OF BRIDGE AND BASE.

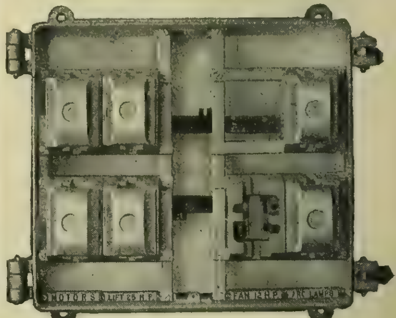


FIG. 2.—CANTIE DISTRIBUTION BOX.

Both the fuse base and holder are substantial pieces of china; the contacts, sockets, &c., are of heavy copper and brass; the live base terminals are sunk, and safe from accidental contact, while the bridge has a wide flange which effectually shields the fuse terminals.

Both base and bridge are designed so that there is no direct line metal to metal, thus making it difficult for an arc to form. The makers advocate copper fuse wire, and this is attached to the bridge terminals by milled clamping nuts, and bent so as to lie in a central asbestos-lined channel; a special feature is the short fuse length—only 2 in. in the 50-ampere size—which leads to a marked reduction in energy loss on full load and substantial monetary savings. The bridge handle is well ventilated and cool in use. The fuse bases are carried on bars in a substantial iron distribution box, and any base can be removed singly in two minutes, or all the bases with the bus-bars behind can be taken out together.

No fillets are required in the box, owing to the substantial china walls of the bases. The cable sockets fit in split holes tightened by a screw from the front.

The boards are supplied in 1 to 12 ways, for double and triple-pole circuits of 10 to 50 amps. per way; the design is a pleasing one, and, we should judge, is sound both mechanically and electrically.

We understand that very satisfactory tests in practical use have been carried out with considerable currents, the fuse clearing itself without damage to contacts or china.

New Electric Steel Furnace.

A NEW type of electric steel furnace, known as the Greaves-Etchells furnace, is being built by Messrs. T. H. WATSON AND CO., of Sheffield. It is suitable for making all grades of alloy steels and high-speed tool steels in small ingots. The furnace is a three-phase furnace in which two of the carbons are introduced at the top, and the whole of the hearth is connected to the third phase, acting as the third electrode. With a small furnace designed to melt 6 cwt. in three hours, it has been found possible to obtain five heats of 18 per cent. high-speed steel in 10 hours. The longest time occupied from charging to finished ingots was 1 hr. 40 min., and the shortest time 1 hr. 15 min. This small furnace has already made over 560 consecutive heats of high-speed steel, and the lining has once been renewed. The standard size in which this type of furnace is being built is for a capacity of 10 to 12½ cwt., but some furnaces are also being built for larger sizes, up to six tons.—*Metallurgical and Chemical Engineering.*

Chemically Pure Battery Plates.

A TYPE of plate known as the "chemically pure" which has recently been placed on the market by the Gould Storage Battery Co., New York City, has been designed with a view to greatly increasing the life of the positive plate and making it more nearly approximate that of the negative plate. The process of formation of the plate is entirely different from the electrochemical processes hitherto employed in the manufacture of Gould Planté plates The chemically pure active material of the new plate, with a higher capacity per sq. in. surface than the old plate, now makes it possible to obtain normal battery capacity with a smaller plate surface than formerly. This permits the use of heavier ribs and wider acid space between the ribs. There is a somewhat heavier section of reserve lead in the ribs of the plate for future conversion into peroxide, and the active material being formed in a thin but very dense skin over the surface of the ribs, the grooves between the ribs are left open clear to the bottom, permitting free circulation of electrolyte. The battery gives a somewhat higher voltage on discharge, and reaches a full state of charge at a slightly lower voltage than is experienced with the older type of plate.—*Electrical World.*

LEGAL.

Meirowsky Insulating Tubes.

A problem of the English manufacture of insulating tubes occupied the Patents Court on Wednesday, when Mr. H. Clarke, of Messrs. H. Clarke & Co., the Atlas Works, Hullard Street, Old Trafford, Manchester, applied for a licence to use Patent No. 26,941, of 1906, covering an improved method and apparatus for forming insulating tubes. The Controller, Mr. Temple Franks, and Sir Cornelius Dalton heard the application.

The patent is in the name of Max Meirowsky, and claims a method of forming insulating tubes by means of a mandrel, around which the material to be wound is passed perpendicularly to the axis of the mandrel, as distinguished from spirally. The fibrous material, which may be wound together with insulating material, and is of breadth equal to the length of the tube to be formed, is powerfully stretched before being wound on the mandrel, so that the fibrous material, during the winding operation itself, forms the outer pressure mould, or former, and the materials are wound with perfectly uniform tightness, while dispensing with a stationary pressure support or roller.

In another claim the stretched fibrous material, before being wound, is led between two heated rollers, and the freely movable independent mandrel is, during the winding operation, pressed uniformly against the surface of the hot rollers, so that the layers of material to be wound are, before being joined to those already wound, and the latter are, before receiving new layers of material, strongly heated from the exterior.

Mr. Worsnup, Manchester, appeared for the applicant, and Mr. Rudolf Moritz was counsel on behalf of respondents.

Mr. Worsnup stated that the applicant was originally in the employ of Meirowsky & Co., the patentees, who had branch works in Manchester. At the outbreak of the war they were represented here by a Mr. Schultz. Mr. Clarke, in October, 1915, commenced business on his own account, and, later, Mr. Schultz visited him, at his invitation, to look at a machine which he had built, and threatened proceedings for infringement. When asked what was their authority, Mr. Schultz's firm replied that they had control of the patent by permission of the Public Trustee. The applicant inquired whether this was so, and was told by the Public Trustee that he had given no authority whatever. Mr. Clarke was advised by his patent agent that he was not infringing. He, however, thought it was the proper course to come to the Court and ask for a licence.

Mr. H. Clarke, answering the Controller, said it was possible to make tubes of this character without using any specific machine. They were being made on several machines at the present moment.

Mr. Moritz, intervening, observed that the patent now being applied for was both a process and an apparatus patent. There was a particular method of winding in relation to the mandrel—perpendicularly to the axis, as distinguished from spirally.

Mr. Clarke added that he had been deterred from developing his connection to some exent by this threat of infringement.

Mr. Moritz explained that Mr. Geo. Schultz had changed his name to Scott, and was now Captain Scott, of His Majesty's Forces. Captain Scott had conducted the English business of Meirowsky, and with the outbreak of the war the English liability of carrying on fell on Captain Scott. It was a partnership between Captain Scott and Meirowsky. When Captain Scott joined the Forces, he invited Messrs. Schultz & Co., the well-known electrical engineers, whose managing director was his father, to go to Manchester, take up the English business of Meirowsky & Co., and manufacture. Captain Scott was an English-born son of Mr. Schultz, who himself was born in the free city of Hamburg as it then was, and naturalised in this country in the early sixties.

Cross-examined by Mr. Moritz, Mr. Clarke said the experience he gained in his employment guided him in building a machine, and it wound perpendicularly upon the mandrel, and employed heavy pressure and hot rollers. He should say that in broad principles the machines were not the same. He did not wind the tubes under heat and "great pressure": there was a certain amount of pressure but not pressure caused by stretching the fibrous material. His machine had not a brake, like the patented machine, and it contained a roller for winding crafts paper. In all the time that he was with Meirowsky & Co. he did not know that theirs was a patented machine. There was no mark upon it. It was by pure inadvertence that when he began he placed on his note heading "late G. Schultz & Co., Ltd." It should have been "late of," and when his attention was called to the mistake (which, he admitted, was careless) he at once remedied it. He recalled no statement by young Mr. Scott, when that firm was building a larger machine, to the effect that the machine was patented. Meirowsky & Co.'s works were now closed.

Mr. Moritz contended that Messrs. Schultz & Co. under the new arrangement could supply all public requirements, and having regard to all the circumstances, this was not a case where the Court should interfere, and so encourage an English employé of a German firm to start independently and build a plant, and then come to the Court for a licence.

The Controller: Supposing the German business had been closed at the outbreak of war. We have had many cases in which a manager has come at once for a licence to manufacture. Mr. Clarke may be in a not entirely dissimilar position.

Mr. Moritz: At the time of the war Capt. Scott was an English subject, and has always been one. He called on his father, managing director of Schultz & Co., to go to Manchester and seize the business and carry on. There was a power of attorney. Messrs. Schultz proposed to shift the necessary plant to their London works, where they would carry on, and then, he supposed, the Board of Trade would wind up the business of Meirowsky & Co. If they did, Messrs. Schultz & Co. would apply for the patent, and acquire it. They had done trade with the Admiralty of £3,000 or £4,000 a year in these tubes. Capt. Scott was the person entitled to manufacture in this country under his agreement, and the arrangement could be called either an exclusive licence or a partnership. It dated from September, 1912, and was to terminate in December, 1917. (Mr. Moritz then produced the agreement, in German.). The patentees, he said, gave the agency for carrying on the manufacture in England. There was a clause to the effect that if Capt. Scott's father died, or left his business, the son was to be relieved of his partnership, in order to go and take up Schultz & Co. The business transactions were to be carried out in the name of Meirowsky & Co., and Capt. Scott was to have the full use of the English patents—an exclusive licence. Of course, as to whether Capt. Scott's power of authority to his father to take the business at once was a strictly legal transaction, counsel did not know.

The Controller: It is quite conceivable that that agreement was suspended by the war. The Courts have held that an agreement of that kind was put an end to. Captain Scott's agreement was with a purely German firm. People left in that position with an agreement have come here to ask for a licence, and have produced their agreement, and said, "We want to carry on;" and we have given them a licence in dozens of cases. We have said, "We cannot give you an exclusive licence, but if you are fulfilling the needs of the country, you have a right to come here and say so." It would have been very much better if Captain Scott had come here for a licence in the first instance, because the whole affair, as it seems to me, is a hopeless one at the present time.

Mr. Moritz: They have laid it before the Board of Trade, and the Board of Trade have said, "Go on."

The Controller: The Board of Trade should not have done so. We shall have to consider this case.

Mr. Moritz: In the meantime, the Board of Trade intend to wind up Meirowsky & Co. Messrs. Schultz, intending to manufacture in London, have sold some of the machines.

The Controller observed that he would look into the terms of the agreement. The Court would no doubt have given Captain Scott a licence if he had applied, though an exclusive licence was a different question. The applicant's method might be called sharp practice, but it was constantly done; he might have felt that the company which had employed him was destined to be wound up.

Mr. Geo. Schultz said he was managing director of Schultz and Co., whose subscribed capital was all English. Both his sons had assumed the name of Scott. When he himself went to Manchester and took charge of this business, he informed the Board of Trade, and they approved. He had that day received a notice that the Board of Trade were going to look into the affairs of Meirowsky & Co. It was in the autumn of last year that he found the Manchester works very inconvenient. They then had ample stocks in hand for meeting all demands, and were bringing a machine to London for the purpose of carrying out Government work. They had calls from the Admiralty, and had recently brought to the notice of the Admiralty a speciality in connection with mica tubes, which overcame one of the difficulties in connection with micanite tubes. It had been arranged that the one firm should manufacture for the other, and they were in a position to meet all possible demands. Meirowsky & Co. at one time ran five machines.

Mr. Arthur Wm. Scott, son of the last witness and brother of Captain Scott, said the firm of Meirowsky & Co. had a contract with the Admiralty to supply them with so many tubes for three years. When the Admiralty wanted tubes of 18 in. diameter inside and 20 in. outside he proceeded to devise a special machine, for which Geo. Schultz & Co. now held the patent. Arrangements had been made for meeting all the orders entrusted to them upon the patented machine.

The Controller: It seems to me that if you have been carrying on the business of Meirowsky & Co. you ought to have been paying over your profits to the Public Trustee as custodian.

Mr. Moritz: The business has been carried on at a loss since the outbreak of the war.

Sir Cornelius Dalton: How would you be injured if a licence were granted to Mr. Clarke?

Mr. Scott: He is our competitor in the Manchester district, where we are established. We are also expecting an infringement in another quarter.

Replying to the Controller, Mr. Moritz said these tubes were largely used for wireless apparatus. He suggested that if the Board granted a licence to the applicant in the present case, they would have gone further than they had ever gone before. Having built a machine, he came and asked the Court to protect him against the consequences.

The Controller: You may call it sharp practice, but you have to remember what the company was. Meirowsky & Co. was an alien enemy business, and the question is whether we should over look such sharp practice for the purpose of facilitating the trade of the country.

Mr. Moritz: When Capt. Scott comes back he will legitimately expect to have anything that is going in the way of Meirowsky's business.

The Controller: It may appear that Capt. Scott is the agent of Meirowsky.

Mr. Clarke offered 5 per cent. royalty on the selling price, and Mr. Moritz announced that the opponents would apply for a licence and offer the same percentage.

The Controller: We shall have to consider the case of Meirowsky, and look into the details. The licence of Meirowsky does not convey an interest in the patent. I will report to the Board of Trade, in due course, on the evidence presented at the hearing of this application.

Vaughan & Co. v. Golder's Green Amusement and Development Co.

After a long interval of adjournment, occasioned partly by the illness of a witness and partly by the necessity to make way for other cases, the action being heard by Mr. Pollock, one of the High Court Official Referees, again stood adjourned indefinitely on February 8th, owing to other actions being interposed.

W. Vaughan & Co., Ltd., electrical engineers, of Cross Street, Islington, sought to recover from the Golder's Green Amusement and Development Co., Ltd., of Duke Street, St. James', the balance of charges for fitting up electrical installations at the defendants' new theatre of varieties at Golder's Green. Damages were also claimed for breach of contract both by plaintiffs and defendants. The case involved two novel questions of law, one being as to whether, notice of the assignment of the debt not having been served upon the defendants, the plaintiffs were entitled to sue, and the other whether damages could be claimed against the plaintiffs, they not being the contractors who had carried out the work, but a company to whom the business of the contracting firm had passed.

Mr. Copping, holding a brief for Mr. C. A. Bennett, appeared for the plaintiff, and Mr. Ernest Pollock, K.C., for the defendants.

According to Mr. Copping's opening for the plaintiffs, the contract was to put in the electric installation for £1,700, the work to be completed to the satisfaction of the consulting engineer, Mr. A. E. Mitchell, and payments were to be made upon the certificate of the architect, Mr. B. Crewe, at the rate of 75 per cent. of the value of the work executed; half the balance was to be paid on completion, and the remainder in six months after the date of the consulting engineer's certificate of completion. The plaintiffs duly erected and equipped the installation in accordance with the contract, in addition to which they executed certain extra work, for which they claimed £500 odd. The whole of the work was completed in March, 1914. Since completion of the work, the company which carried it out had been reconstructed, and the present plaintiffs were the assignees of its assets and its debts. A great deal of difficulty had arisen from the supply pressure provided by the Hendon Electric Supply Co. being 3,000 instead of 200 volts, which necessitated a large portion of the plant being scrapped. According to the contract the work was to be completed by March, 1914, but it was, in fact, sufficiently completed to allow the theatre to be opened on Boxing Day, 1913. The defendants admitted the contract, but did not admit that T. W. Vaughan and Co., Ltd., did the work, and they said that the work was incomplete and defective and not in accordance with the contract, and they denied liability to pay for any extra work beyond that provided for by the contract. It was provided in the specification that all main and sub-circuit cables, leads, &c., should be designed to have a current density not exceeding 750 amperes per sq. in., for which purpose the incandescent lamps were to be taken at certain amperages mentioned. This provision, they said, had been disregarded throughout, and cables and leads of smaller sizes than those provided for had been substituted. Moreover, the conduits throughout were too small, and could not carry cables and leads of the size specified. By reason of this, it was alleged, it would be necessary to re-wire throughout. The specification provided that the bases of all boards should be of polished slate or marble of, in the large sizes, at least 1¾ in. in thickness, but the large boards or bases were not of that thickness. There were a number of other details which were said not to be in accordance with the contract. The defendants did not admit that the payments they had made had been on account of the claim of £1,700, the contract price, and the clause of £559 for extras, but said that they had been made on the architect's certificates for work done, and they counterclaimed £1,000 for breach of contract. The plaintiffs denied the defendants' allegations.

Mr. Ernest Pollock, K.C., said it would have to be proved that there was an assignment of the debts from the one company to the other. No notice of the assignment had been served upon the defendants, and the plaintiffs had no right to sue.

Mr. Copping said that the correspondence would afford ample evidence that the defendants had notice.

The Official Referee thought that the point as to whether the plaintiffs were entitled to sue should be dealt with first. Unless that point were established, the plaintiffs would have no case, and it would be waste of time to go into the other matters until plaintiffs' position had been established.

Mr. Copping argued that it would be convenient to have the amounts settled before the point of law was decided, as, in the event of a decision being given in his favour by another Court, the whole thing would have to be gone over *de novo*.

Counsel for the defendants raised the point that the plaintiffs, not being the parties with whom the contract was made, were not in a position to claim against them for breach of contract.

Mr. Copping said that in that case the plaintiffs would put themselves in exactly the same position as if they were the contracting company, taking all the liabilities as well as the assets. He offered to put them in the same position as that in which they would have stood had they been actually parties to the contract.

Mr. Ernest Pollock, K.C., said that he must decline to accept the offer.

The case was adjourned, and, upon the hearing being resumed after an interval of three weeks, Mr. Copping said that before proceeding with the evidence he desired to apply to join the old company as plaintiffs, as he had got from Mr. Justice Astbury, who was the Companies Judge for the current term, an extending order for the winding-up of the old company until August next.

Mr. Pollock, on behalf of the defendants, resisted the application, pointing out that after correspondence between the parties on the subject, the writ was issued by J. W. Vaughan & Co. (1914), Ltd. He cited authorities, upon which he contended that the notice of assignment was bad as not being in accordance with the Judicature Act. He said that in the middle of the case, after the adjournment and after they had all come to fight on the basis of the point raised in the pleadings, and after the delivery of the defence, it was now concluded that the old company could be joined. That, he said, was not right.

The Referee: Supposing they paid the whole of the costs up to the present time?

Mr. Pollock: Yes; if we are put in a position to enforce our full counterclaim. If they paid the whole of the costs up to date, the whole company might be joined. In any case, it would be a misfortune if they were not to go through with the case on the question of figures.

Mr. Copping said that he had already offered to place the new company upon the same footing as the old, and accept all liabilities as well as assets.

The Referee said that there had been no equitable assignment because no notice had been given of those to whom the debt had been assigned, and the plaintiffs had all along assumed that they were entitled to sue in their own right as if they were the contractors.

Mr. Copping said that it was only a question of notice, and they had a perfectly good assignment both in law and in equity.

The Referee said that the amendment could be made at any time, and the only question was upon what terms.

Mr. Pollock said it appeared there was a confession on the part of the plaintiffs that if the case went on as at present stated they would fail, and therefore they were desirous of fighting the claim on some other ground.

The Referee said it was a singular position of things. There was a company which had entered into a contract to do certain work, which, the defendants said, had not been done properly. The company which did the work went into liquidation, and started again as J. W. Vaughan & Co., Ltd. (1914), and they dealt with the matter throughout as if they were in precisely the same position after the assignment as the original company. They never gave any notice or intimation before the action that they were the persons who were entitled to recover in respect of the debts of Vaughan & Co., and they showed distinctly that they were claiming as if they were the original contractors. Having brought their action, a defence was set up, and they were asked to state when the assignment took place. That was the position of things when the case came to trial. There had been no equitable assignment, because it was never intimated to the defendants that the debt had been assigned. On the contrary, the plaintiffs had allowed the defendants to believe that they were suing as the original contractors. It was quite clear also that there was no legal assignment. If an amendment of the pleadings was now to be made, it resolved itself into a question of terms. It seemed to him that the order for amendment ought to be made on the terms that the plaintiffs paid the costs up to the present time.

Mr. Copping asked that the order should be made in a form which would enable him to appeal.

The Referee: I decline to allow the amendment unless the plaintiffs pay the costs up to the present time.

After some discussion, it was decided to go on with the hearing, and witnesses were called in support of the plaintiffs' case,

Mr. Edward Mitchell, consulting engineer, of 110, Cannon Street, E.C., giving evidence upon the details of the specifications under which the work was carried out.

The hearing was adjourned.

Telephones and War Surcharges.

The Postmaster-General sued Messrs. Harry South & Lambe, trading as the Stanneries Metal Works, 48-50, Waterloo Street, for £3, in the City of London Court, on February 8th, before Sir John Paget, Bart., K.C., Deputy Judge, for the balance of telephone charges.

Mr. Ward, defendants' solicitor, said he had raised a counterclaim for loss suffered by the defendants through having the telephone cut off, but objection had been raised by the Postmaster-General, who said no one had any right to claim damages against the Crown, except through the old form of a petition of right. Seeing that the telephone service was a commercial business, the British public ought to be able to deal with it as if it were an ordinary trading community. It was very unfair that a claim for damages could not be raised against the Postmaster-General.

Mr. Alsop, solicitor for the Postmaster-General, said, as regarded the telephone service being a commercial undertaking, it was an undertaking for the benefit of the State and all the inhabitants, The Deputy Judge said he could not entertain the counter-claim.

Mr. Alsop explained that the defendants entered into an agreement for a year with the usual annual subscription of £5 and £1 10s. for minimum message fees. The £3 10s. had been paid, and £3 was now due. At the top of the contract it said "War Surcharge, £4." Defendants paid the £4 when they sent the application form. The extra £4 had to be charged by the Postmaster-General because he was unable to get any money from the Treasury with which to construct new telephone lines.

Mr. Hall, in the contract office of the telephone service, proved making the agreement with the defendants, and said he explained the war surcharge at the time. The £4 was added in September, 1915.

One of the defendants, **Mr. South**, declared that he was not told anything about having to pay an additional £4 when he entered into the contract. He was quite sure nothing was said about it, and if he had known that the Postmaster-General wanted £11 10s. for a year's telephone service, he would have done without it. The Postmaster had cut off the telephone after a very short time, and what it amounted to was that the Postmaster-General had got the money and the goods.

Mr. Alsop added that the £4 was only charged when the subscriber needed the telephone put on in a hurry.

Mr. Ward, defendants' solicitor, suggested that his clients had been hardly treated by the Post Office.

The **Deputy Judge** said that was so, unless they had been pretty obstinate. He could not ;hold that the Postmaster-General's staff had said nothing to the defendants about the £4 surcharge. A Government department did not do that sort of thing. Judgment for the plaintiffs, with costs.

Electrically-Welded Flexible Tubing.

Mr. Temple Franks and Sir Cornelius Dalton, in the Patents Court, heard an application by the United Flexible Metallic Tubing Co., Ltd., of 112, Queen Victoria Street, E.C., for a licence to use the German patent No. 3,822, of 1909, for a form of metal tubing which can be used for covering electric cables, the characteristic of which is that a metal band is wound in the form of a screw-thread, and has its edges welded, the joints being welded together by autogenous or electric welding. For the production of tubes of this kind, the specification states, electric resistance welding, as well as autogenous welding (acetylene welding), may be employed. In that case, the welding of the joints of the tube could be done through the winding of the tube on the ordinary tube-winding machine, in which case the winding spindle would form one electrode and one of the winding rollers of the winding head the other electrode. The longitudinal section of the wall of the tube, when constructed, has the configuration of a waved line, and the tube readily bends by reason of the corrugation.

Mr. Wm. Berryman, applicants' works manager, said the applicant firm already made a flexible tube which was used for cables, of an entirely different construction. That was in the form of rings or, in section, interlocking strips, each coiled upon itself, and so permitting play backwards and forwards. Where there was much vibration, there was a disadvantage in continuous sliding of these parts and the wear and tear involved. This was avoided in the patent tube, which, however, was less flexible than their own. For particular uses, the corrugation took different designs in section. The system of jointing was peculiar. The form of tubing covered by the German patent was not being manufactured in this country at the present moment. The applicant firm was entirely British, with no alien enemy shareholders, and employed about 300 hands. They made four million feet of tubing last year, or 760 miles, in sizes ranging from ¼ in. diameter to 15 in. The patented tubing was suitable for heating and cooling, and avoided the disadvantage more of the applicants' asbestos packing, where there was wet steam or vibration. The flexibility of the tube was obtained from the spring of the metal. The applicants offered a royalty of 5 per cent. on the selling price of the tubing, and the Controller announced that he would advise the Board of Trade to issue the licence.

Actions against Carlisle Electric Tramways Co.

At Carlisle County Court, on 6th inst., before Judge Taylor, J. Cassidy, cattle dealer, sued the above company for damages for injuries caused to a number of cattle.

For the plaintiff, it was explained that on September 22nd, when it was very dark, a number of cattle belonging to the plaintiff were being driven along Port Road, when a tramcar approached, and, despite the shouting of the drover, ran into the cattle, damaging several. It was contended that the car was driven at an unreasonable speed by a boy, and was inadequately lighted.

Damage was admitted, but on behalf of the defendants, it was submitted there was no proof of negligence, and it was contended that to drive cattle through dark streets under present conditions amounted to contributory negligence. It was stated that the car driver was 17 years of age, and it was admitted that he had had a week's training.

His Honour, in giving judgment for the plaintiff for £23, the sum claimed, said it seemed remarkable to him that in a city the size of Carlisle it should be possible to run tramcars up to a speed of 12 miles an hour, in charge of young men of 16 or 17 years of age, with the streets in their present condition. The authorities should see that this condition of things did not exist any longer

A second case was down for hearing, in which T. Clarke, farmer, sought to recover £95 for damage to cattle, but, in view of the previous decision, judgment was entered for the plaintiff by consent for £70, and costs.

Alperton Rubber Co. *v.* Manning and Others.

In this action, which was brought to restrain a disclosure and use of the plaintiff company's secret formulæ for the manufacture of hard rubber for insulating processes and the like, Mr. Justice Peterson, in the Chancery Division, delivered his reserved judgment on Tuesday, February 13th.

The plaintiffs alleged that Manning, on leaving their employ, took with him a book containing certain formulæ. He had since entered the employ of the second defendants, the Belgium Tire Co., Ltd., and disclosed the formulæ to them, and the company had used such formulæ in executing orders for their customers. Manning claimed the right to use the formulæ as part of his business experience and equipment, and the defendant company denied that any orders executed by them were executed in accordance with any formulæ obtained from the plaintiffs.

His Lordship held that for Manning to disclose secret formulæ obtained by him while in the plaintiffs' employ was a breach of contract either express or implied. He found as a fact, that certain formulæ had been disclosed and used by the Belgian company, but others had not. He accordingly directed that the book which was in Court should be delivered up to the plaintiffs, and granted an injunction, with costs, except so far as they had been increased by the issues on which the plaintiffs had failed.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

British v. German Manufactures.

I esteem it a compliment that you should have found the time and inclination to comment upon my letter of the 22nd ultimo.

It is a little unfortunate that you should have been somewhat vague in the application of the motto which you so kindly present to me, for the subsequent context leaves one a little in doubt whether it is the gentle Hun or myself that you are pleased to designate as the "Devil" when you construe it by such a "homely expression," but which I shou'd prefer to call a loose expression, for I am sure that if in our college days either of us had so construed it we should have incurred the righteous indignation of our respective tutors.

I have to compliment you on the manner in which you have skated over what one may call your *faux pas* in not having taken the precaution to be sure of your facts before giving publicity to an alleged breakdown to the Newport plant. In fact, a perusal of your reply leaves the impression that you dealt with my letter somewhat hurriedly. Anyone reading my communication with ordinary intelligent carefulness could be under no misapprehension as to my view of what should be the future policy of this country towards German manufactures after the war. There are numerous occasions in the course of my communication where this is made quite evident, but to none of which you refèr. Incidentally, there is a printer's error which, unfortunately, rather destroys the sense of the tenth paragraph in my letter. The sentence, "Certainly, I could not imagine any giving the Germany market an opportunity to tender," should obviously have read, "Certainly, I could not imagine any *municipal authority*, &c." The omitted words appeared in my original.

As a matter of fact, I was almost afraid that my views on this point would be regarded as rather Utopian, and therefore when, in my concluding paragraph, I referred to the necessity for a "broad-minded industrial international policy," I hoped that the preceding substance of my communication would have left no possibility of a misunderstanding in regard to the use of that expression, since the total exclusion of the Austro-German market was evidently regarded by me as an essential basis upon which to build such policy, and that obviously by their total exclusion in such matters they would *ipso jure* be placed outside the scope of any such arrangement. Therefore, it could not have been in my mind to have included them in any such foreshadowed policy. It is some little satisfaction to me to have read during the weekend the views of others all tending in the same direction, perhaps most forcibly expressed in the *Observer*.

I must further congratulate you on so carefully omitting all reference to what I take the liberty to consider the most important paragraph in my communication, if any part whatever could be so dignified, namely, my reference to your own admission as to what was the one great danger to be guarded against. It is only natural, I suppose, that you should have omitted it, as no keen debater or critic will go out of his way to draw attention to an evident weakness in his own case. Generally speaking, I submit it was perfectly clear that I was not attacking your leader from any desire to defend, even in what you do me the honour to admit was a judicial and impartial manner, the position of German manufactures, but solely because I considered it was your evident intention to make the whole question a "stalking horse" for the furtherance of a certain political propaganda.

Regarding my alleged detachment from mundane affairs, what precise connection there is between detachment from mundane affairs and the holding of a judicial and impartial opinion on the relative merits of British and German manufactures I am at a little loss to understand. Here, again, I am afraid your phraseology is a little unhappy. Anyone who knows me, or has had the opportunity of personal contact with me during the past two years, will know how utterly unjustified such an allegation is, and I am afraid that in attempting in a veiled manner to cast some suspicion upon my patriotism by an *argumentum ad populum* you have not done yourself justice. It has been my good fortune to have had considerable opportunities of assisting in the great cause quite outside the heavy work of my department.

In conclusion, my sole object in writing, and I think I have made it abundantly clear, was to controvert what I considered to be arguments extremely illogical, and without due regard to the *status quo ante bellum.* I am afraid there is a great deal yet to be done in the way of removing some of our unfortunate insular prejudices, and, perhaps, too exalted opinion of our national superiority. It is, I submit, an undeniable fact that many of the disappointments and disillusions of the past two years have found their genesis in these characteristics, and since you appear to have an inclination for presenting mottoes to the undeserving, I suggest there is one which we all might with advantage adopt, namely, "*Fas est et ab hoste doceri.*"

Whilst I am aware that I have perhaps occupied already too much of your valuable space, I will thank you to do me the favour of publishing this reply.

A. Nichols Moore, *Borough Electrical Engineer.*

Newport, Mon., *February 5th*, 1917.

[We regret the unfortunate printer's error, due to a line of type being misplaced.—Eds. Elec. Rev.]

It is indeed refreshing in these momentous times to read such a letter as has emanated from Mr. A. Nichols Moore, borough electrical engineer of Newport, and which appeared in your issue of February 2nd. Here is no weak-kneed free trader renouncing his principles because of the war, no politician trimming his sails to catch the popular breeze. No, we have here a gentleman in an important and responsible position, a borough electrical engineer, monarch of all he surveys (except his committee, perhaps), before whom the unfortunate British manufacturer cringes and trembles, who, when he has not been busy buying German machinery, has evidently been pondering on the incapacity of the home manufacturers.

With his remarks on the actual virtues of the British and German machinery we are not concerned; in fact we are willing to assume that the latter is the better, but let us go deeper than Mr. Nichols Moore has groped. How did the Germans get their experience? Did the German municipalities or supply companies put up their own manufacturers (favoured as they were by a considerable tariff) against foreign makers? We trow not. No, the German manufacturer obtained his experience because he was given his opportunity, and was helped by his Government to make a profit to pay for his experience. This borough electrical engineer (we must be thankful that there are many exceptions) grudges the British manufacturer any profit, makes him pay higher wages, and, would you believe it, actually takes his money (i.e., his contributions for electrical energy, rates, etc.) to pay his German competitor.

This is an example of the beautiful principles of Free Trade; are we to return to that glorious state after the war, and are our men fighting and dying in thousands for this? Well, it is better to realise what we have in our midst than to imagine we have learned anything since August 4th, 1914. And the same authority cries, "Who in the early summer of 1914 would have questioned the propriety of giving the German market an opportunity to tender?" Aye, who indeed? We are now told to manufacture all we can, to grow all we can, and because, forsooth, this authority foresaw nothing he thinks no one else did. For sheer self-delusion and conceit the Free Trader is only excelled by the Hun. He advocates higher technical education, but no amount of education can overcome unfair competition, and it is evidently our lack of real education that permits us, alone of all the world, to tolerate the promulgation of such fallacies. That education is not the true cause is proved by the progress of the chemical industry alone during the present period of protection.

We are astonished, Mr. Editor, that Mr. Nichols Moore should attack your political tendencies, and lest he should think that we are disappointed tenderers, we may say that although we have had many years' experience of unscrupulous German competition, aided by similar buyers, we are not makers of heavy electrical machinery.

Electrical Manufacturer.

City and Guilds Examinations.

In the fourth paragraph of his letter in your issue of 2nd instant, "No Energy" suggests that the average teacher of electrical-installation work would be unable to express an opinion as to whether the subject was grossly neglected or not. We must decline to believe this, and prefer to give the average teacher credit for understanding the scope of his subject and the way it should be treated.

The average teacher presumably consults the official syllabus, and various requirements in the way of apparatus and material for dealing with the subject both in the workshop and at his lectures, must automatically suggest themselves to him.

What we should like to hear about are:—(*a*) cases where the teacher's efforts are utterly cramped for workshop facilities, and (or) for supplies of apparatus, &c.; and (*b*) cases where the story is quite the reverse.

We think we know enough about the general situation to foretell that the (*a*) cases would form an overwhelming majority.

The pen name adopted by your correspondent seems to indicate that he is not a progressive. As there is nothing in his letter that would offend the most backward head or principal who made a practice of ignoring the subject, he might have revealed his identity. Failing that, his remarks lack weight, and we think we may ignore his numbered items, most of which are more or less beside our point.

The trend of "No Energy's" letter is to the effect that the classes are O.K. but lack support. Our argument is that the poor support is due to gross neglect of the class equipment and facilities; and we think no broad-minded, independent, and progressive person could fail to arrive at the same conclusion.

Though we are not teachers of electrical-installation work, we are in touch with many who are.

A. P. Lundberg & Sons.

London, N., *February 12th*, 1917.

Fuse Failures.

The electrical trade, who have not previously seen the interesting series of photographs exhibited in your last issue, will certainly feel indebted to Mr. S. W. Baynes for allowing them to be published. The design of fuses, their possibilities, their limitations, under ever varying experimental test, and in practice upon a thousand different circuits, is itself the study of a lifetime, and in fact has been the daily work of comparatively few. I am sure Mr. Baynes will accept from one part of them a few remarks in support of a desire for caution, and at the same time a few friendly criticisms.

Mr. Baynes suggests "that cartridge fuses should be so designed that it is impossible to short-circuit them with ordinary fuse wire." This suggestion, offered obviously in all sincerity, is the one proposition that has ever been in the forefront with every "cartridge-fuse designer" upon both continents. If Mr. Baynes then proceeded to offer to the industry a foolproof "cartridge fuse," which he had designed, which would answer to his own description, then it would indeed be a welcome invention, and add additional lustre to his reputation. Unfortunately, however, neither Mr. Baynes nor anybody else has yet done so, so it next remains to deal with the facts as they arise. Mr. Baynes then proceeds to describe a cartridge fuse which he uses in his "sealed" fuse boxes of the "Zed" type, and which, unless the impression were corrected, might lead the uninitiated to infer are not open to the same objection. This class of fuse, however, is unfortunately very easily tampered with, and owing to the short length of "air break" under such conditions, is probably the most dangerous of its class in this respect. Upon one occasion, and not many miles from the St. Pancras electric works, a serious fire occurred in consequence, and I still possess a part of what was left of the fuse box, and a cork surrounded with twisted fuse wire used as a temporary substitute for the "Zed" type fuse, and the unwitting cause of the disaster. In Northern America, where similar style porcelain fuses are sometimes used, I have seen hundreds of specimens that have been tampered with. They figure on the walls of the fire offices, and of nearly every central-station mains department, and are held up to the public as a warning. I am, of course, not directing this criticism at the "Zed" fuse itself, as a fuse cartridge. For the comparatively small currents for which it has so far been designed, it is excellent, and so long as Mr. Baynes has a reliable staff, and keeps the unbroken seals upon his fuse boxes, it will behave as well as any other good design of cartridge fuse, but directly it is beyond his limited control, it must continue to fail under "abuse." Obviously, occasions will arise when, for some reason or another, the "spare cartridge" is not available, and a temporary expedient is necessary; the "best" cartridge fuse under such circumstances is one designed so that there are "ample clearances," and fixing connections sufficient reasonably to ensure continuity of supply until the temporary expedient has been replaced.

It was perhaps about 14 or 15 years ago that I brought back from Berlin the "Zed" fuse, which I first introduced to Mr. Baynes at St. Pancras for his patent "emergency" fuse box, and my company have been interested in the supply of the cartridges ever since that date. I am naturally gratified, and perhaps a little flattered, in spite of its unwelcome German origin, that the "Zed" cartridge fuse has fulfilled its allotted task so well. At the same time, and for the same reason, I shall be admitted free from personal bias, when I desire to pay tribute to a British inventor, Mr. W. M. Mordey, the originator of the sand-packed cartridge fuse in universal use throughout Great Britain, standardised by the British Admiralty, and standardised throughout the great North American continent.

Cartridge fuses embodying the original characteristics of this invention, and carrying various improvements, will not only perform all the functions of the German invention, but can be guaranteed to deal, in silence and safety, with capacities and voltages double and treble, and double again, the size of the maximum Teutonic design yet made. Moreover, they always possess the insuperable advantage that in case of dire emergency (e g., the absence or breakdown of the spare), that they offer a better temporary expedient. Several years ago I was invited by the Newcastle Electric Supply Co. to make up some heavy fuses, larger than any previously contemplated. These were designed upon the lines of Mr. Mordey's original invention, and with certain improvements, the results were truly extraordinary, and the results "beautiful to witness." Many circuit breakers were subjected to the same tests, but all failed but one, and in the case of "the one," the results were somewhat disastrous. I cannot do better, perhaps, than submit herewith a copy of an unsolicited letter, hitherto unpublished in the Press, which was sent to me, giving the result of these trials.

(*Copy.*)

Messrs. Berry,. Skinner & Co.,
78, Upper Thames Street, E.C.

Dear Sirs,—I have pleasure in giving you the following account of the test of the large cartridge fuses you supplied to the Newcastle Electricity Supply Co The test was carried out at our Pandon Dene sub-station, the 600-volt traction battery being used for the purpose.

The fuses were placed straight across the battery without line resistance, other, than the connecting leads, which were of 0.5 sq. in. section approx.; and about 6 ft. of bare copper conductor of smaller section as a safety device. When the circuit was closed, the testing engineer and all present were greatly surprised at the action of the fuse, which blew without any external sign, except a slight hiss.

I witnessed two tests on your fuses with the same result, and a third test on a well-known make of circuit breaker, with magnetic blow-out. The latter had a far more disturbing effect on the battery connections, and did not break the circuits as rapidly as your fuses.

When it was observed that your fuse was designed to carry 2,000 amps. continuously the result was quite wonderful It was, in fact, the only device tested which could have been satisfactorily erected on a switchboard All the other apparatus tested arced, and unless specially placed would have been dangerous.

The battery used for the purpose of the test was the largest in the country, and in consequence the test was very much more severe than if the fuses had been shorted across the terminals of a traction generator I have only once previously seen a similar test, on a smaller battery, and in that case the ordinary forms of circuit-breaker failed conspicuously, due to the contacts welding together.

In my experience, it is much more difficult to break an arc with a 600-volt continuous current than with the same power at a higher voltage.

You are at liberty to make use of this letter should you wish it.—Yours faithfully, C. CAREW GIBSON.

The vast possibilities of the powder-filled cartridge fuse will be interesting reading for many of your readers. It is gratifying to know that we need not go to Germany to find the inventor of the best type of cartridge fuse, and still more reassuring to realise that the National Board of Underwriters of the United States of America have standardised on the invention of a British-born subject.

In conclusion, I desire gratefully to acknowledge the privilege Mr. Baynes gave me several years ago, actually to witness a series of tests upon "rewireable" fuses, and in particular for testing one of my company's standard "Masta" fuse-switch boxes, under identical conditions. The size selected by me for the purpose exceeded by 50 per cent. the largest "Zed" type fuse made. The results, needless to say, were that the circuit was interrupted practically noiselessly, and without arcing, and the cartridge when sawn in half afterwards by Mr. Baynes's assistant, Mr. Walters, was, with the exception of the melted fuse wire, quite intact. Needless to say, Mr. Baynes, with characteristic promptitude, at once gave permission for such apparatus to be used upon the St. Pancras supply, a graceful concession, having regard to the fact that the requisite provision for such apparatus had been overlooked, when the local rules and regulations were re-printed.

Herbert H. Berry.

London, E.C., *February 12th*, 1917.

The Kilowatt Publishing Co., Ltd.

In amplification of the note published in your issue of January 12th, announcing the voluntary liquidation of the Kilowatt Publishing Co., Ltd., I shall be glad if you will allow me to add that the decision of the directors to cease publishing "Electrical Engineering" at the end of last year was arrived at in consequence of the depletion of the staff, and that all creditors of the company have been paid in full.

Although other duties have prevented my taking any active part in the publication of "Electrical Engineering" or the affairs of the Kilowatt Publishing Co. for some considerable time, my name has been so intimately connected with "Electrical Engineering" during the ten years of its publication that I should like the above facts to be made known to your readers, to avoid any wrong interpretation being placed upon the note which you published.

F. Charles Raphael, Lt. R.E. (T.).

London, S.W., *February 9th*, 1917.

WAR ITEMS.

The Siemens Shares.—The Public Trustee is inviting tenders, which have to be delivered by April 2nd, for the whole or part of 119,660 shares of £5 each, fully paid, in Siemens Bros. & Co., Ltd. The issued capital is 120,000 shares of £5 each, fully paid. Particulars appear in our advertisement pages to-day.

Report on Trade After the War.—Lord Balfour of Burleigh's Committee, set up by the late Government to advise as to the best method of carrying out the resolutions of the Economic Conference of the Allies at Paris and of promoting British and Imperial trade after the war, has completed its report, which has been sent to the Prime Minister. The report is unanimous, and the recommendations are said to be very wide-reaching.—*Morning Post*.

The *Times* on Wednesday also stated that the report was unanimous, and that it would be found to "recommend the adoption of Imperial preference as the foundation on which should be reared our world economic policy of the future." The Committee includes men of every school of political and economic thought.

Leaving Certificate.—An electrical switchgear fitter, employed by a Rochdale controlled firm, applied to the Rochdale Munitions Tribunal for a leaving certificate, on health grounds. He produced two doctors' certificates, and his Trade Union secretary said the man's breakdown was due to the "unhealthy state of the works." The firm wrote that their works were as healthy as any in the district. The certificate was granted.

To be Wound Up.—The Board of Trade has ordered the following companies to be wound up under the Trading with the Enemy Amendment Act:—

Brimsdown Lamp Works, Ltd., Kingsway House, Kingsway, W.C., manufacturers and dealers in electric lamps and fixtures. Controller: H. J. Morland, 3, Frederick's Place, Old Jewry, London, E.C.

Coal Distillation Co., Middlesbrough, manufacturers of coke ovens and by-product plant. Controller: G. B. Nancarrow, Royal Exchange, Middlesbrough.

Exemption Applications.—When an appeal was made to the Middlesbrough Tribunal for the exemption of the electrician at the Opera House, the Military Representative remarked that the difficulty of finding a substitute was that the business was not regarded as of national importance. He was given until May 1st.

At Southport, Mr. A. S. Black, the borough electrical engineer, applied for the exemption of four men, who had been debadged. He said the Minister of Munitions said they could not be called up until substitutes had been found, and he had written for the latter. The Tribunal refused the appeal, but the men are not to be called up before substitutes are found.

Mr. Barr, the Swansea borough electrical engineer, has been requested to apply for the exemption of the switchboard attendant. The engineer stated that he had lost two of his men, one of whom had joined the Army, and the other, refusing to do so, left and got a similar appointment in an electrical works on the East Coast, where he obtained exemption from military service. What he (Mr. Barr) complained of was that his men were refused exemption at Swansea, but went elsewhere and got it. The works could only be carried on with great difficulty if the present attendant was called up.

At Northampton Tribunal, Dr. Rambaut, the medical superintendent of St Andrew's Hospital for Mental Diseases, Northampton, appealed for the exemption of H. Heritage, aged 24, electrician at the branch hospital at Llanfairfechan. Dr. Rambaut said Heritage was quite a genius. He was responsible for the whole of the electric installation and machinery at Llanfairfechan. His duties included the working of the turbines when the water coming down from the hills was used. He was a Class A man, but the difficulty of obtaining labour was so great that it was practically impossible to find a substitute. The Tribunal gave exemption to March 31st, with leave to appeal again, but urged Dr. Rambaut to make endeavours in the meantime to obtain a substitute.

At the West Riding Appeals Tribunal, at Dewsbury, last week, the case of an electrical engineer and draughtsman, aged 24, who was given conditional exemption some little time ago, was heard. On that occasion it transpired that he had come from a good position in Spain to do national work in England, but considered he could be vastly more useful in such work than in the Army. The Military Representative now wanted the case to be reviewed. The young man, it was stated, had said on the first hearing that he had a fixed engagement with the Yorkshire Electric Power Co., and he (the Military Representative) challenged that statement at the time, and he now had a letter from the manager of the company stating that the position was only a temporary one. The appellant, in answer to a question, said he adhered to his statement that he had a fixed position. He denied that he had been offered a fixed position with another firm and had refused it, but said he had been offered a better paid job, but his employers refused a leaving certificate, saying he was in a certified occupation. In answer to the Chairman, the appellant said that when he went to the Yorkshire

Electric Power Co., he was told he would be on trial for a month, and was then to sign an agreement, and he would be subject to an advance in six months. He held that that was as fixed as any position could be. The Chairman said the view of the Tribunal was that if a man was employed in a certified occupation with a firm which was not Government controlled, he could leave at any time. The appellant: Do I understand that if the Yorkshire Electric Power Co. is not a controlled firm I can leave and take up this other job? The Chairman: Of course, we cannot advise you. The appellant said he had sacrificed a lot of money to come to England, and if he got the new job at better pay than he was now earning he would still be £3 a week worse off than he was in Spain. In answer to the suggestion of the Military Representative that the appellant had refused an offer by the Yorkshire Electric Power Co. of a fixed job, the latter said the offer was for him to sign a three years' agreement at his present salary, and he refused. The Chairman said that was quite another story, and he was entitled to refuse, and if the firm were not controlled the appellant could go to another engaged in work of national importance. The Tribunal decided to confirm its previous decision, and the conditional exemption was granted.

Before the Chertsey Rural Tribunal, the Military Representative asked for the withdrawal of a certificate of exemption held by Mr. G. W. R. Howard (37), of Pyrford, inspecting engineer to the Tudor Accumulator Co. Mr. Howard, it was stated, was responsible for the proper maintenance, under contract, of the company's storage batteries at military camps, forts, and hospitals, and in railway and munition works throughout the South of England. The Tribunal respited the appeal for inquiries.

An East Grinstead (Sussex) firm, appealing for their electrician, aged 38, stated that the man visited a large number of houses to keep the engines going for electric light, pumping, &c. He went round to run the engines, and had relieved about 20 men. Three months were allowed, with no new appeal without leave.

An appeal was made at Hereford by Mr. W. H. Preece (35), an electrician at the municipal electric light works. Exemption was refused, but appellant is not to be called up until an efficient substitute has been found.

At Clacton-on-Sea, Mr. H. W. Everitt, electrical engineer, appealed for further exemption for R. Cook (28), for whom he could not find a substitute. The man had the care and lubrication of two gas engines and a Diesel engine, and assisted with the electricity plant. The Tribunal granted six weeks' temporary exemption to find a substitute.

Before the Redruth Tribunal, Mr. L. A. Hards, manager for the Cornwall Electric Power Co., appealed for exemption for eight men, and stated that their pre-war staff of 220 was reduced to 160. Three of the men were refused exemption, two were conditionally exempted, two were given six months each, and the other until August 1st.

At the Sunderland Military Tribunal, the Military Representative applied for the review of conditional exemption certificates granted to two electricians in the employ of the Corporation. Mr. Blackman, borough electrical engineer, said that if the staff of the generating department was further weakened there might be the possibility that, through the temporary failure of the supply of current, thousands of men engaged on work of supreme national importance might be unable to continue their tasks. The Tribunal withdrew the certificate of the younger man, who had been passed for general service, and confirmed the exemption in the other case.

Grays Tribunal has granted temporary exemption until April 30th to Mr. C. Gooden, engineer at the U.D.C. electricity works.

At Winchester, before the Hants Appeal Court, the Military Representative appealed against conditional exemption allowed locally to an assistant meter tester, aged 25, and passed for general service, engaged at the Winchester Corporation electricity works. The Military Representative argued that the man was not necessary for the generation of electricity, and that meter testing did not come within the category of a certified occupation. As Chairman of the Electricity Committee, the Mayor said the question was not whether the undertaking would suffer, but whether the public would suffer. The service was a public one, and since the war the Committee had induced 13 of the men to join up. Two men now did the work of four, and two girls had been instructed in the technical work for 12 months, but without success. The conditional exemption was withdrawn, and a final two months substituted.

At Watford, on January 31st, Mr. A. W. Barham, electrical engineer to the U.D.C., appealed for two employés who had been debadged, L. Cook (26), coal trimmer, passed for active service, and H. Tomkins (30), engaged in the same work, and who is now in hospital. Mr. Barham said that he could not get other men. The Tribunal decided that Cook should join up on March 1st, and the other case was respited for a month. Mr. Barham remarked that it was possible that the munition authorities would say that Cook was not to go on the date fixed.

At Weston-super-Mare, the Electric Supply Co., Ltd., applied for conditional exemption for S. F. Saunders (37), fitter-driver at the generating station. Mr. G. Charlton, managing engineer, stated that the man was indispensable, and although he was a munitions volunteer, a Board of Trade inspector had declined to remove him from the works as they were already understaffed. Conditional exemption was allowed.

At Swindon, an appeal was made by the Swindon Engineering Co. for Mr. G. A. Smith, electrical engineer, managing director of the company. Counsel said that Mr. Smith had invested the whole of his life's savings in the concern, and upon him very largely depended the well being and continuance of the business. They had carried out sub-contracts for munitions, mostly of an experimental character, and had been promised numerous contracts. The amount of capital involved was £10,000, and Mr. Smith was a specialist in electrical and hydraulic work. Two months were granted. Counsel gave notice of appeal.

Bath Tribunal, with the assent of the Military, granted three months' exemption each to W. Hayward (41), body builder; T. T. Tregaskis (37), driver; and E. W. Perry (37), painter, appealed for by the Bath Electric Tramways, Ltd.

BUSINESS NOTES.

Anglo-American Trade.—Arrangements have been made for establishing an American Chamber of Commerce in London. Particulars of membership may be obtained from Mr. J. Tuck Sherman, the secretary, at the temporary offices, 3, Lombard Street, E.C.

Sales of Shares.—The Public Trustee is inviting tenders for 82,406 £1 shares (10s. paid) and 81 £1 paid, in the British Railway Traffic and Electric Co., Ltd., also 2,250 £1 pref. and 2,500 £1 ordinary shares in the Yorkshire Copper Works, Ltd.

Patent Restoration.—An order has been made restoring Patent No. 23,979, of 1911, granted to Christopher Harvey for "Improved incandescent electric lamp and holder therefor."

Patents and Alien Enemies.—Application has been made to the Board of Trade by Messrs. Fredk. R. Butt & Co., Ltd., for the avoidance or suspension of Patent No. 25,101/12, granted to Bauer, for high-tension electrometers.

Bankruptcy Proceedings.—John Taylor Peddie, mechanical engineer, Exhibition Buildings, Aldwych Site, Strand, London.—The following amended notice is substituted in the *London Gazette* of February 9th for one that appeared there in February, 1916:—

To pay in full forthwith any preferential claims in priority to other debts, also all proper costs, charges, and expenses, together with the fees and percentages of and incident to the bankruptcy petition and this proposal. Also a composition of 5s. in the £ to all unsecured creditors in respect of debts provable under the receiving order herein payable, as provided by the scheme, such payment to be guaranteed to the Court's satisfaction. (The whole composition was paid down in cash to the trustee.) Four creditors have released their claims herein. Mr. Frederick Seymour Salaman, chartered accountant, 1-2, Bucklersbury, E.C., to be trustee hereunder at a remuneration of 2½ per cent. on the amount receivable by him under this scheme. Receiving order discharged. Adjudication annulled.

C. B. O'Gilvie, electrical engineer, 43, Dudley Road, Whalley Range.—The public examination of this debtor was fixed for February 6th, at Salford. The debtor's name was duly called, and when he did not put in an appearance at the end of 15 minutes, the Official Receiver suggested that as the non-appearance might be due to the inclement weather, the examination should be adjourned. The Registrar assented.

Catalogues and Lists.—"Cantie" Switch Co., Ltd., 67, Mount Street, Nottingham.—Illustrated descriptive list of "Cantie" patent fuse gear, with prices and code-words of boards for double and triple-pole circuits, 10 to 15 amperes per way.

Electrical Supplies Co., 233, Tottenham Court Road, London, W.C.—Priced leaflet of Hotpoint El Radio heaters.

Swedish General Electric Co., Ltd., 5, Chancery Lane, London, W.C.—January list of D.C.-type "K" motors and Century single-phase motors.

Enterprise Manufacturing Co. (Ashdown and Roberts), Gun Street Electrical Works, Bishopsgate Street, London, E.C.—Illustrated price circular of Beam convertible electric fires, electric irons, &c.

The Keighley Gas and Oil Engine Co., Ltd., of Imperial Works, Keighley, have sent us a block of date and engagement slips for 1917. The block is mounted on a stout base in the shape of one of their "Imperial" engines; it is made to stand on the desk or to hang.

Dissolutions and Liquidations.—Maschinenfabrik Augsburg-Nurnberg A.G.—The Controller, Mr. B. E. Mayhew, Alderman's House, Bishopsgate Street, E.C., has applied for his release.

Fazackerley & Co., plumbers, electricians, &c., Market Street, Droylsden.—Messrs. R. Fazackerley and J. E. Capper have dissolved partnership. Mr. Capper attends to debts, &c., and continues the business under the same name.

For Sale.—The Borough of Salford Electricity Department has for disposal a quantity of old-pattern electricity meters. The Walthamstow U.D.C. has for disposal four Dowson gas generators and auxiliaries, and one gas-holder. Full particulars are given in our advertisement pages to-day.

Spain.—A Barcelona firm, according to the British Consul there, states that it is almost impossible to obtain switches and other small electrical goods.

LIGHTING AND POWER NOTES.

Accrington.—Alderman Higham recently stated to the T.C. that now they had some spare plant at the electricity works the engineer was taking every opportunity of getting the plant into as good condition as possible, and steps were being taken with regard to the boring and lining of three cylinders, at a cost of £100 each, and the supply of one new spare top cylinder at £240. The new plant, he proceeded, was working most satisfactorily.

Ashtead.—Street Lighting.—The Leatherhead Electricity Co., in asking the Parish Council to pay the charges due in respect of public lighting, said it was prepared, when the lighting restrictions were removed, to enter into a contract for the lighting of the parish for one year at the same charge as previously, despite the advanced prices of labour and materials. It was decided to ask the company to make a reduction on the present account, as the Council had not the power to enter into a contract such as suggested.

Birmingham.—The report of Councillors Beale and Appleby on the recent failures of the electricity supply, has been submitted to the Lord Mayor; it is now being considered by the Electric Supply Committee, and, together with comments, will come before the City Council at its next meeting.—*Birmingham Daily Post.*

Bradford.—The Corporation is lodging formal objections to the Clayton and Queensbury Electric Lighting Order Bill and the Rawdon and Yeadon Electric Lighting Order Bill. In the former case, the town clerk reports that the Order will affect Bradford as regards tramways, gas, and water, as well as possible extension of boundaries, and in the latter case the Order affects the city only in regard to possible boundary extension. The objections are lodged to give the Corporation an opportunity to take future action as thought desirable, and the matter is left in the hands of the chairmen and deputy-chairmen of the Finance, Electric, Gas, and Water Committees.

Bradford-on-Avon.—The B. of T. has extended the electric lighting Order for one year.

Bristol.—Street Lighting.—As a result of certain experiments, it has been arranged to considerably increase the street lighting in certain throughfares where the lighting is under the control of the electrical department.

Burton-on-Trent.—Proposed Plant Extension.—The Electricity Committee has decided to approve a scheme of extensions at the electricity works. Application is to be made to the L.G.B. and the Treasury for sanction to borrow £25,000 for the plant, &c., required. During January, 427,803 units were sold for lighting, power, heating, &c., and 50,977 for traction, showing an increase of 93,651 units under the former head, and a decrease of 1,096 units for traction as compared with the corresponding period of last year. Two motors for driving in connection with the supply of power to the English Grains Co., Ltd., are to be purchased.

Derby.—Proposed Loan.—The T.C. has applied for sanction to a loan of £29,500 for the extension of the electric power station.

Gravesend.—The T.C. has decided to seal a petition against the West Kent Electric Power Bill, it being considered that the district between Gravesend and Dartford, covered by the Bill, should be reserved for Gravesend, and principally for the purpose of linking up with Dartford, if the scheme for doing so is ever carried out.

Liverpool.—Year's Accounts.—The electric supply accounts for the year ended December 31st last show a total income of £405,650, and a balance (gross profit) of £229,788). Of this amount interest absorbed £68,631, and sinking fund contributions £57,146, while £39,168 was transferred to renewals, and £65,000 contributed to rate relief. The renewals fund now amounts to £102,778, some £36,000 having been deducted during the year. The reserve fund stands at practically £180,000 while a fuel guarantee fund also figures at £5,388. No operating data is published with the accounts.

At the City Council meeting, last week, Mr. E. Russell-Taylor, the chairman of the Electricity Committee, said that the Corporation sold, last year, over 60,000,000 units. In 1912 it made a profit of £51,000; last year it almost doubled the amount, and gave £65,000 towards the relief of the rates.

London.—Battersea.—The Finance Committee reports, with reference to the extensions of mains, &c., in the Nine Elms district, that it has only been found necessary to apply, at present, for sanction to a loan of £1,000 (instead of £4,300) towards the cost of the work in question.

Morley.—Year's Working.—The accounts of the electricity department to March last, just issued, show an income of £3,901, and an expenditure of £4,514, the deficit on the year being £612, as compared with a deficit in 1915 of £301. The capital expenditure was £28,446, and the loans outstanding are £20,800.

Preston.—Mr. J. F. Simpson, the borough electrical engineer and tramways manager, has submitted to the Corporation Tramways Committee a report upon the supply of electricity for power purposes. At present the provision of electricity in the town and district, for both lighting and power, is controlled by the National Electric Supply Co., Ltd. It is pointed out in the report that the existing company produce a comparatively small amount of energy for power purposes, and that as a scheme to deal with the question on a sufficiently broad basis would involve the erection of a new power station, it is hardly to be expected that the company would sink the necessary capital, in view of the fact that its powers lapse in 17 years. A case is made out for the equipment of Preston with a plant in readiness to meet the growing industrial demand and the expected expansion of trade on the conclusion of the war, and it is suggested that the Corporation possesses an ideal site for a new generating station.

Queenstown.—It is understood that there will be a considerable extension of electric lighting in connection with the new shipbuilding yard which is to be established; it is said that the scheme will also include the Rushbrooke Docks.

Sheffield.—An application from the Electrical Trades Union for increased pay up to 49s. per week for wiremen, cable jointers, and skilled electrical workmen has been acceded to. The preparation of plans and specifications for the buildings and equipment of the new power house at Blackburn Meadows is to be proceeded with; one 10½-in. lathe and one screwing machine for the fitters' shop at the Neepsend power station are to be purchased at a price not to exceed £237.

Southwick.—The U.D.C. has decided to raise no objection to electricity for power being supplied by Brighton T.C. to a local firm, provided the Council's rights are properly safeguarded.

St. Helens.—The Electricity Committee has been considering the question of supplying electricity to the proposed electrolytic works which the United Alkali Co. contemplates erecting; provisional terms have been arranged, and it is hoped the new works will be secured for the borough.

Stockport.—Year's Working.—The accounts of the Corporation electricity undertaking for the year ending March 31st last show that over 15 million units were sold, and some 17½ million generated, the total plant capacity being 11,000 KW. The total revenue for the year was £50,010, of which £30,000 was derived from power supply; the gross profit was £18,576, and, after meeting interest and loan charges, an expenditure of £3,400 on works of a capital nature, and transferring £1,028 to reserve, a balance of £3,000 remained (which is scheduled as available for rate relief). The electricity reserve fund only amounts to £1,859, but some £6,977 has been spent out of revenue on capital account.

Extensions Held up.—At the last meeting of the Council attention was directed to a decision of the Government not to grant any facilities for the manufacture and installation of additional plant required by the electricity department. It was asserted that the plant was at present working at the top of its capacity, and it would be a serious matter for factories, the tramways, and the town generally if there was a breakdown. The chairman of the Electricity Committee said they intended to press for facilities for providing the plant.

Stretford.—Application for badges has been made for four employés at the electricity works, but the Ministry of Munitions informed the U.D.C. that it was unable to issue the necessary badges.

Swindon.—Plant Extensions.—The T.C. has decided to lay down additional plant to enable current to be supplied to a new factory in the town. The estimated cost is £6,000.

Torquay.—The T.C. has decided to accept the offer of the Tramway Co. to pay £250 towards the extra cost of coal for the period from August 1st, 1915, to July 31st, 1916, and 10 per cent. per unit additional on the rates for current set forth in the agreement from July 31st next. The company had declined to pay an extra ¼d. per unit as from August 1st, 1915.

United States.—Returns published in the *Electrical World* show that the central station output in 1916 amounted to 23,300 million KW.-hours, an increase of 23 per cent. over 1915, and the revenue from this source was 417 million dollars, an increase of 15 per cent. The total income of "service companies" was not less than 1,750 million dollars, and, with the revenue of manufacturing and other electrical companies together, made a total estimated at 2,500 millions. Income for electric traction service is estimated at 750 millions.

The Central Stations placed orders for 2,000,000 KW. of steam turbines and 400,000 KW. of water turbine plant.

In connection with the agitation for an increased diversion of water from Niagara, it is stated that plans and specifications have been prepared by the Niagara Falls Power Co. for modernising its plant, at a cost of $11,000,000, which will enable the company to develop 180,000 H.P., instead of 90,000 H.P. as at present. Additional transmissions will be constructed to Buffalo and into Central New York and Pennsylvania.

Warminster.—The B. of T. has extended the electric lighting Order for one year.

Worcester Park.—Proposed E.L.—From correspondence read at the last meeting of the Parish Council, it appeared that both the South Metropolitan Electric Tramways and Lighting Co. and the Wimbledon T.C. are anxious to supply electricity to the district. Wimbledon Corporation, however, only proposed to supply a part of the parish, whereas the South Metropolitan Co. would supply the whole of the parish. It was resolved by the Council to agree with the decision of the R.D.C., which was to support the application of the South Metropolitan Co., provided that satisfactory guarantees were given in the Act that the price to consumers should not exceed 6d. per unit.

TRAMWAY and RAILWAY NOTES.

Bacup.—The Mayor reported to the Town Council on the recent arbitration proceedings with Rawtenstall *re* fares, and Councillor Lord said that although Bacup had proved its case, it had to pay half the costs of the award. The only satisfaction it had was that a lot of money had been thrown away, and no one was any better for it, except the arbitrator.

Brighton.—Electric Vehicle.—The Corporation, on the recommendation of the Works Committee, has decided to purchase a 3½-ton electric battery vehicle and a 5-ton steam vehicle, each to have interchangeable bodies, to be used for watering and general haulage. The Committee estimates that these two vehicles will do the work of six horsed vehicles. The present cost for horse and driver is 11s. 4½d. per day. The estimated cost, including interest, depreciation, maintenance and wages, &c., is, for the steam vehicle, 23s. 8d. per day; for the electric vehicle, 27s. 7d. per day.

Bradford.—Mr. Greenside, of the Labour Regulation Department, has made his award in the dispute between the tramway department and its engineering employés. In sending a copy of the award to the Amalgamated Society of Engineers, Mr. Greenside stated that the action of the engineers in refusing to work overtime pending a settlement was not only illegal but unjustifiable in the national interests, and if the offer of arbitration had been accepted by them when made, the dispute could have been settled long ago.

Burnley.—Strong criticism was made at a meeting of the Council on the suspension of the late cars, but an amendment in favour of reconsideration was defeated.

A Sub-Committee of the Tramways Committee has been asked to report on the heavy increase in working expenses and the decrease in traffic receipts since the suspension of the late cars.

Continental.—Russia.—On December 17th (O.S.) a meeting of the Committee on New Railways was held to consider the question of constructing the Neva suburban tramways for Petrograd from the town boundaries to Voznesensk, a length of about 20 versts. Besides groups of contractors, the Petrograd district and Government zemstvos asked for the concession with a limitation of the tramways to the village of Ust-Izhor. The new Railways Committee, recognising the preferential claims generally of local public bodies, decided in favour of granting the right to construct the suburban tramways to the District Councils, giving preference again to the Council of the district most closely interested. For the purpose of the construction of the tramways as soon as possible, the Committee fixed the time to start work not later than May 1st (O.S.), 1917, and the date of completion to be not later than January 1st (O.S.), 1919.

Darwen.—Fare Increase.—The T.C. has decided upon an increase in the fares on the Corporation tramways: otherwise the tramways would have to make a further call upon the rates.

Doncaster.—The T.C. has referred back to the Tramways Committee for reconsideration a proposal to construct a double tramway line from St. Sepulchre Gate to Baxter Gate.

Dudley.—Tramway Accidents.—On Wednesday, last week, an adjourned inquest was held into the circumstances respecting the overturning of a car in Tipton Road on January 4th, by which the conductress, Annie Payne, was killed, and 26 persons were injured. The jury found that the accident was caused by the carelessness of the conductress in releasing the brake without convincing herself that she had received the proper signal to do so. They also expressed the opinion that the Tramway Co. was to blame for not having made some arrangement that would have prevented the accident.

On the same day two cars came into collision in a fog on the single line on the Dudley and Stourbridge route at Scotts Green, and a motorman, John Mogan, was killed. At the inquest it was stated that Morgan was responsible for the accident in leaving the loop, contrary to the regulations, which were to wait in the loop until the Stourbridge car had passed; also, that the conductresses should have acted as pilots. A verdict of "Accidental death" was returned.

Glasgow.—Finance.—It is recommended that the whole tramway debt be wiped off, and that no further sinking fund be provided except for further borrowings, and that there shall be a cancellation of all borrowing powers except for future extensions and additions to plant. In the course of a report by Mr. James Dalrymple, the general manager, it was stated that as the total amount of the accumulations of revenue invested with the Common Good now exceeded the amount of capital indebtedness, it was proposed to transfer from the depreciation and permanent way renewals fund to the sinking fund such a sum as would make the sinking fund equal to the capital expenditure. The total amount of capital expenditure was £3,835,156. The net amount owing to the Common Good was £2,328,889. The proposal was that this sum should be taken out of the depreciation and permanent way renewals investment account. The total sinking fund already applied in reduction of debt was £1,506,267, which, added to the £2,328,889, would make the total sinking fund £3,835,156, being the exact amount of the capital expenditure. The effect of this arrangement would be that the sinking fund would equal the capital expenditure, or, in other words, the whole of the debt would be wiped out, and there would remain a balance of £119,055 at the credit of depreciation and permanent way renewals fund.

Mr. Dalrymple pointed out that he thought it wise to add to this sum annually out of revenue. He suggested that the following sums might be set aside out of revenue to meet expenditure in renewals:—Permanent way, £39,600 (£200 per mile of single track); power station and sub-station plant, £13,827 (3 per cent.); cars and electrical equipment of cars, £16,755 (3 per cent.); other rolling stock, £2,790 (15 per cent.); and Clydebank bridges, £550 (5 per cent.)—a total of £73,522.

Halifax.—Proposed Fare Increase.—At the last meeting of the Council, the proposal of the Tramway Committee to increase the tramway fares by 50 per cent. was defeated by a large majority. Many meetings of protest had been held by business men as well as the workers' organisation. No arrangement has been come to with adjacent towns whose systems join up, and until such arrangement is made, nothing further can be done.

L. & Y. Railway Electric Services.—In the annual report of the directors of the Lancashire and Yorkshire Railway, it was stated that the electric train service on the Manchester and Bury line, which commenced running on April 17th last, had given every satisfaction, and that the change from steam to electric traction had been greatly appreciated by the public.

Liverpool.—Year's Working.—At the meeting of the City Council, last week, Mr. E. Russell-Taylor said that last year they made a greater profit on the tramways than prior to the war, notwithstanding that their expenditure had increased by £147,000, of which £50,000 represented increased wages and bonuses to the employés. They carried 157,636,595 passengers, 13,500 more than in the record year of 1913, including 4¾ million soldiers and sailors carried free of charge. Of their 2,700 employés, 1,900 had joined the Forces, and 100 had been killed.

London.—It is stated that every endeavour is being made to commence the through "Bakerloo" tube service between the Elephant and Castle and Watford on March 1st, and to this end the Central London and Piccadilly Companies are lending cars owing to the present shortage. The Ealing extension of the Central London line has been completed for steam trains, but shortage of equipment prevents its electrification.

Manchester.—Traffic Congestion Report.—The report of the Select Committee of the Corporation appointed to deal with the problem of traffic congestion in the city deals exclusively with the problems of tramway transportation, and a sweeping scheme of reform is suggested. The report suggests the use of a portion of the old infirmary site, in Piccadilly, as a tram terminus, the erection of general tramway offices on another portion, and the acquisition of the whole of the open spaces and squares in the city for tramway terminals. The construction of six great arteries and the cutting of new streets is also recommended, as well as that there should be a limitation of tramway traffic within a certain prescribed area in the centre of the city.

Preston.—Year's Working.—The annual report of the Corporation tramways department shows that the total revenue amounted to £51,332, or an increase over the previous 12 months of £3,557, the passengers having increased from 10,761,381 to 11,631,232. The working expenses and war service allowance amounted to £31,201. The gross profit was £20,130, and after deducting financial charges there was a balance to be carried forward of £3,697. The reserve fund had been increased to £47,309.

Rotherham.—Purchase of Cars.—The Tramways Committee proposes to purchase 10 second-hand cars to relieve the present pressure on all routes.

Salford.—Fare Increase.—The T.C. has decided to increase the fares on the Corporation tramways, which are now paying £32,032 per year in increased wages, war bonuses, and allowances to dependents of employés on active service, and, in addition, meeting many other higher charges.

Sheffield.—Purchase of Cars, &c.—Owing to the curtailment of the railway services, there is need for additional cars on the Sheffield and Rotherham through service at certain periods of the day; a meeting is to be arranged with the Rotherham Tramways Committee on the question of a more frequent service. In view of the fact that the Ministry of Munitions has not granted a permit for the purchase of 25 new tramcars, the offer of the L.C.C. to sell 10 four-wheel double-deck cars is to be accepted. The Tramways Committee has confirmed the action of the city surveyor in purchasing 75 tons of rails from the Brighton Corporation. The cost of constructing car top covers required for the converted single-decked cars, the construction of which is being continued in the department workshops, is to be met out of revenue.

Stockton-on-Tees.—Proposed Tramway Purchase.—The T.C. has decided to discuss at a special meeting the question for purchasing the tramway undertaking in conjunction with the Thornaby and Middlesbrough Corporations.

Stretford.—The B. of T. has extended for a further year the time in respect of the tramways and works referred to in Sec. 31 of the Manchester Corporation Act, 1911 excepting a portion of tramway in the U.D.C. of Cheadle and Gatley authorised by the Manchester Southern Tramways Act, 1903. The U.D.C. has decided to oppose the renewed application to the Light Railway Commissioners by the promoters of the Lostock Light Railways Order.

U.S.A.—The Illinois Central Railway has submitted to the Chicago Railway Terminal Commission a comprehensive plan for reconstructing the lake front passenger terminal, and including the electrification of its suburban passenger service within five years.

The Traction and Subway Commission has made public a portion of its report on the improvement of transportation in the city, which will involve an estimated cost of $260,000,000, for which 58 miles of subway and 525 miles of surface lines can be built (single-track mileage being reckoned).

Walsall.—With a view to urgent repairs being carried out at the generating station, the tramway service was shut down on three days between 9 a.m. and 8 p.m. The increased price to be paid for energy will involve an additional expenditure by the tramway department of about £1,000 per annum.

Wolverhampton.—In order to resume the 'bus service to Penn, it is proposed to purchase two Tilling-Stevens petrol-electric chassis and suitable bodies, at an estimated cost of £1,016 each, also a second-hand Albion 'bus.

TELEGRAPH and TELEPHONE NOTES.

Brazil.—A wireless station has been discovered five miles from Rio de Janeiro, at Nictheroy. It is stated that it was established to communicate with the German ships detained in the harbour.

Spain.—A decree has been issued placing all wireless telegraph stations in Spain under official supervision, and henceforth they will be worked under State control.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—March 7th. Powell-Duffryn Steam Coal Co. Electrical goods for 12 months. Stores Manager, Aberaman Offices, Aberdare.

Australia.—SYDNEY.—March 5th. Council. One 7,500-K.V.A. turbo-alternator. See "Official Notices" January 5th.

ADELAIDE.—March 28th. P.M.G.'s Department. Telephones, telephone parts, line and battery material, &c. Schedules 444 to 453. See "Official Notices" February 2nd.

MELBOURNE.—March 21st. Victorian Railways. 200 half-watt lamps and 100 lanterns; also 100 contact couplings.* April 4th. Terminal blocks (complete) for electrical connections.—*Australian Mining Standard.*

March 7th. Council. 1,048 electricity recording meters. See "Official Notices" February 9th.

BRISBANE.—March 28th. P.M.G.'s Department. Cable (switchboard), Schedule 394.

Argentina.—BUENOS AIRES.—March 30th. *Electric carbons during 1917, for the municipality. Local representation. Conditions from Oficina de Licitaciones, Intendencia Municipal de la Capital, Avenida de Mayo 525, Buenos Aires.—*B. of T. Journal.*

Barrow.—March 5th. Corporation. Electrical stores for 12 months. Borough Electrical Engineer.

Bolton.—March 7th. Electricity Committee. Materials and stores. See "Official Notices" to-day.

Canada.—March 28th. Toronto Electric Commissioners. Synchronous condensers, 5,000, 7,500 or 10,000 K.V.A. capacity. See "Official Notices" February 9th.

Grenada.—March 31st. The time for tendering for the Government electric light and power concession, already announced, has been extended to March 31st.

Harrogate.—March 5th. Corporation. By-product steam boiler plant. See "Official Notices" February 2nd.

Kilmallock.—March 5th. Kilmallock (Co. Limerick) E.L. & P. Co., Ltd. Hydraulic turbine, dynamo and motor booster, battery, switchboard. See "Official Notices" to-day.

London.—BERMONDSEY.—February 22nd. B. of G. Electric lamps. Mr. E. Pitts Fenton, Clerk, 283, Tooley Street, S.E.

HAMMERSMITH.—February 28th. B.C. Electricity stores for 12 months. See "Official Notices" to-day.

METROPOLITAN WATER BOARD.—March 8th. Twelve months' supply of electric lamps. Chief Engineer, Savoy Court, Strand, W.C.

Londonderry.—March 17th. Corporation. Engine-room stores, carbons, electricity meters, cables, &c., for the Electricity Department. Town Clerk.

Macclesfield.—March 14th. Cheshire County Asylum. Electrical goods for one year. Mr. W. G. F. Tingay, Clerk to the Asylum, Parkside.

Manchester.—March 7th. Electricity Committee. Coal-conveying plant and suction ash plant. See "Official Notices" February 9th.

Spain.—Tenders have lately been invited by the municipal authorities of Finisterre (Province of Coruna) for the concession for the electric lighting of the town during a period of six years.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Basingstoke.—In consequence of the enormous increase in the cost of crude oil for the Diesel engines at the electric generating station, the Council has accepted the tender of Messrs. Cole, Marchent & Morley, at £450, for converting the three engines so that tar-oil may be used. The difference in the present prices of the two oils is about £4 per ton, which on a year's consumption is estimated to effect a saving of from £400 to £460, after paying the cost of converting the engines. A tender for 200 tons of tar-oil, at not exceeding 90s. per ton, has been accepted.

Bridlington.—T.C. 200 tons of Pope & Pearson's washed small coal from the Normanton Pit, for the electricity works: Provincial Coal Supply Co., Ltd., £1 1s. per ton.

Glasgow.—T.C. Electric lighting of two shops in Gallowgate: Messrs. Smith & Stevenson, £41. Cable for the Tramways Committee: Liverpool Electric Cable Co.

Sheffield.—Corporation. Accepted tenders:—

Electric Construction Co., Ltd.—Direct-current traction switchboard, converter, and feeder panels, for Newhall Road sub-station.
A. Reyrolle & Co., Ltd. H.T., 3,000-volt loose sub-station switchgear.
H. C. Hornbuckle. Erection of sub station, Newhall Road.
Mortimore, Lyon & Co. Generating set and condenser for charging electric vehicles, £810.

Sunderland.—T.C. Tenders accepted:—

Babcock & Wilcox, Ltd.—Boiler stanchion.
British Mannesmann Tube Co., Ltd.—Boiler tubes.
Ferranti, Ltd.—E.H.T. switchgear.
Thos. Ness, Ltd.—Pitch and creosote oil.

Wolverhampton.—Corporation Electricity Committee:—

Reyrolle & Co.—Two switch panels, with instruments, transformers, &c., £670.
Staveley Iron Co.—Large c.i. pipes, £750.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, February 16th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Annual general meeting. Paper on "Alternating Stress Experiments," by Mr. W. Mason.

Greenock Electrical Society.—Saturday, February 17th. Visit to Dellingburn power station. (Members to meet at 2.30 p.m.)

Thursday, February 22nd. At 7.45 p.m. At 22 West Stewart Street. Paper on "Electricity Supply Costs," by Mr. F. H. Whysall.

Association of Mining Electrical Engineers.—Saturday, February 17th. At 4.30 p.m. At the Royal Technical College, Glasgow. Paper on "Electrical Converters," by Mr. C. S. Buyers.

Saturday, February 17th. At 3.30 p.m. At the Midland Hotel, Mansfield. Paper on "The Steam Turbine and its Industrial Application," by Mr. P. J. Plevin.

Illuminating Engineering Society.—Tuesday, February 20th. At 5 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Paper on "The Effect on the Eye of Varying Degrees of Brightness and Contrast," by Dr. James Kerr.

Institution of Civil Engineers.—Tuesday, February 20th. At 5.30 p.m. At Great George Street, S.W. Paper on "The Commercial Metering of Air, Gas and Steam," by Mr. J. L. Hodgson.

Institution of Electrical Engineers.—Wednesday, February 21st. At 7 p.m. At the University, Edmund Street. Discussion on "Fuel Economy."

(**Scottish Local Section**).—Friday, February 16th. At 7.30 p.m. At 207, Bath Street, Glasgow. Eighth Kelvin Lecture, "Some Aspects of Lord Kelvin's Life and Work," by Dr. A. Russell.

(**Yorkshire Local Section**).—Wednesday, February 21st. At 7 p.m. At the Philosophical Hall, Leeds. Paper on "Some Points in connection with Engineering Specifications," by Mr. J. Shepherd.

Liverpool Engineering Society.—Wednesday, February 21st. At the Royal Institution, Colquitt Street. Discussion on "The Gladstone Dock."

ELECTRICAL DEVELOPMENTS AT PERTH, W.A.

RECENT issues of the *West Australian* contained a lengthy description of the new East Perth power station and E.H.T. electrical distribution system, which, as mentioned in our issue of Jan. 26th, has been partly brought into use. As our readers are aware, the scheme has been carried out by the W.A. Government, which has entered into various agreements, and notably with the Perth and Fremantle authorities for the supply of energy at cheap rates.

The power station, which is situated on the banks of the Swan River, was commenced in June, 1914, and placed in partial operation on December 3rd last, the constructional work having been seriously delayed owing to shipping difficulties. When completed the plant will have a capacity of 12,000 KW., but space will be available for another 4,000-KW. unit, which it is expected will meet all requirements for some years, including suburban railway electrification.

The buildings are of steel and concrete, standing on a concrete raft foundation supported by piles. The coal is brought in by railway, automatically weighed and elevated, and conveyed to 300-ton bunkers over the boilers; the ashes are discharged by a suction-ash plant. Six marine-type Babcock boilers, with economisers, superheaters, and chain-grate stokers, are installed; the boilers supply steam at 210 lb. per sq.-in. pressure, superheated to 600° F., and each has a normal rating of 20,000 lb. steam an hour.

Each turbine is supplied with steam from a plant unit consisting of two boilers, two economisers, with an induced draught plant, chimney, and feed pump. Each turbine unit consists of a 4,000-KW. set, supplying 40-cycle, three-phase energy at 6,000 volts pressure and running at a speed of 2,400 R.P.M.: all the turbine auxiliaries are operated from a transformer, supplied direct from the alternator, thus ensuring their operation should the machine oil switch trip. An alternative interlocked supply is also provided from the main bus-bars.

Two motor-generators and two batteries supply energy for the electrical control of the switchgear and for lighting. The surface condensers are supplied with river water by vertical-type circulating pumps; the air pumps are of the three-throw type driven by geared induction motors.

The generators are equipped with forced ventilation, through cloth filters, the air being discharged outside the building. The oil switchgear is installed in a special switch-room, and is of cubicle construction: Merz-Price balanced protective gear is fitted to the generators, and the Merz-Hunter split conductor system has been adopted for trunk feeder work.

The local tramways are supplied through self-synchronising rotary converters giving 600 volts direct-current; two 1,200-KW. machines are installed at the tramway sub-station, and two similar sized machines at the power station.

It is stated that the expenditure on the power house to date has been £274,000, which will rise to £320,000 on completion; the expenditure on the ring main which supplies the sub-stations erected by the Perth City Council is stated to be £23,000; the total approximate cost of the scheme to the City Council is £162,878; the estimated total Government expenditure upon the whole scheme from Fremantle to Midland Junction, including power house, sub-stations and transmission, is £375,000.

A sub-station is provided adjacent to the power station, in which energy from the latter is stepped up from 6,000 to 20,000 volts pressure for transmission to Midland Junction and Fremantle.

The transmission line was erected by the tramway department, and is in duplicate throughout: it supplies step-down sub-stations at Midland Junction workshops, Ways and Works Department, Midland Junction Council's station, Guildford Council's station, West Guildford Roads Board's station, and Messrs. Cumming, Smith & Co.'s works at West Guildford. The transmission consists of copper wires carried on Jarrah A type poles; each line is rated at 2,500 KW. A similar line is being constructed to Fremantle by way of Victoria Park and South Perth to the port; it will also supply the Naval Base at Cockburn Sound.

The Perth Council's four sub-stations and the tramway sub-station are supplied through a three-core paper-insulated and armoured ring main; the Murray Street sub-station serving the city proper, is the largest, and contains four 500-K.V.A. transformers giving a supply at 440 volts for power and 250 volts for lighting. The area covered by the City Council's supply is divided into 26 sections for distribution purposes. The Wellington Street sub-station has a capacity of 1,000 K.V.A., Colin Street and Palmerston Street, each 400 K.V.A., and a fifth sub-station of 200 K.V.A. has just been erected at Maylands. The total cost of the five sub-stations has been £17,230.

The Council's agreement with the Government provides for supply within a 5-mile radius of the G.P.O., the Government reserving to itself the right to supply tramways and railways. The Government is to supply energy to the Council at the cost of production, but not exceeding ·75d. per unit, and the Council will add the necessary capital charges, &c. Most of the consumers in the radius have undertaken to take energy, but several of the municipalities, including Subiaco and South Perth, are standing out. The consulting engineers to the scheme are Messrs. Merz and McLellan, who have been represented by Mr. C. T. Briggs, while Mr. W. T. Taylor is acting as Superintendent for the Government.

It is believed by those in charge that under the arrangements entered into an output of 16 million units will be sold in the first year of complete operation, and that the undertaking will prove more than self-supporting.

The contractors for the buildings and boilers were Messrs. Babcock & Wilcox; for the turbine plant and condensers, Messrs. Willans and Robinson; for the switchgear, transformers, and rotaries, the British Westinghouse Co.; and for cable and line material, Messrs Callenders.

NOTES.

Compound for Use in Building Dry Batteries.—The war in Europe has caused a scarcity of various articles once available in large quantities, and much effort and ingenuity has been exerted by all the warring nations toward finding substitutes for one thing and another. It had been the custom abroad until almost a year ago to use wheat or rye flour for thickening the electrolyte of dry batteries, but since there is now rather a scarcity of these cereals attention has been turned to other substances. Of these, kieselguhr, water-glass, gelatine, starch, sawdust, and glass-wool seem to have proved satisfactory. One of these products, or an admixture of several of them, is used as the base or binder. For the electrolyte proper is used well-powdered salammoniac, calcium acetate, zinc chloride, and thin refined glycerine in the proportion of about equal parts of salammoniac and calcium acetate, 80 grammes of each, 40 grammes of zinc chloride, and 10 grammes of glycerine. The mixture is stirred energetically after being covered with distilled water at a temperature of 40° C., and until all solid matter is dissolved and thoroughly mixed in one concentrated solution, which is then allowed to be taken up by the binder, forming a paste which is then applied between the plates of the cell or battery to form the electrolyte. The whole is enclosed in a casing of paraffin fitted with vents for the escape of gas. The addition of equal parts of calcium acetate and salammoniac is said to make a very satisfactory mixture, one which has high conductivity and does not crystallise, nor is it hygroscopic.—*Electrical World.*

Employers and the Future of Industry.—In the report of their proceedings during the past year, the Employers' Parliamentary Council express the opinion that when the time comes for taking stock of the nation's industrial resources, in view of the universal competition which will rule the markets of the world, it will be found that any return, even on a small scale, to the conditions which governed national production in the period before the war would be disastrous, and possibly fatal, to British interests both at home and abroad. It may, say the Council, be assumed as extremely unlikely that the systematic restriction of output which prevailed before the war, and is, unhappily, still existent, will ever again find favour in this country outside the ranks of the Labour Unions.

The Council note evidence on every hand of the growing feeling of distrust in the old methods of Labour Unionism. The fact of those methods having to be abandoned to meet national necessities has impressed itself strongly even on the minds of those who formerly excused them as promoting the interests of Labour. While it is only natural that such a body as the Trade Union Congress should formally reiterate its demand that pre-war conditions should be resumed, in accordance with the guarantees given by the Government, when it was found essential that those conditions should be set aside for war purposes, it may be noted that, so far, no reasons have been advanced for reverting to the evil practices which the pressure of direful circumstances caused to be discontinued, but a multitude of reasons—most of them obvious and incontrovertible—have been put forward in favour of saner regulations with respect to labour and industry, which it will soon become of vital importance that all classes concerned should strictly observe. The demand that after the war labour shall take a larger share of the profits of industry, a demand that has been endorsed by several members of the Government, and with which sympathy has been expressed in many influential quarters, is, in the opinion of the Council, one to which no reasonable exception can be taken, provided that Labour, earnestly and wholeheartedly, performs its part in the general scheme of production, and thus establishes a good title to the claim for greater remuneration. A high standard of production can be maintained only if the energies of Capital and Labour alike are exerted to their utmost capacity. Whatever the conditions under which various industries are conducted in the future, whether systems of co-partnership, or profit-sharing, or wages, the effort everywhere will have to be of a generally sympathetic and high-spirited character if all concerned are to benefit in the shape of increased gains.

Explosion Due to Static Electricity.—A *Daily Express* dispatch from Annapolis states that electricity generated by the friction of a fur coat worn by Surgeon Raymond Spear, of the United States Navy, "grounded" through a motor-car standing on wet ground, and caused a spark which exploded the petrol. Surgeon Spear was severely burned, and the vehicle was destroyed. It is explained that the surgeon had walked to his garage while wearing his fur coat and rubber boots. The flapping of the coat against his legs furnished sufficient friction to generate the electricity, while his boots insulated him from the ground and allowed his body to store it. When he approached the motor-car a spark was made which brought about the explosion.

Vienna Tramways.—Owing to lack of coal the tramway service in Vienna has been stopped for the present between 9 a.m. and 5 p.m.—*Times.*

Volunteer Notes.—First London Engineer Volunteers.—Headquarters, Balderton Street, Oxford Street, W.—Orders for the week, by Lieut.-Col. C. B. Clay, V.D., Commanding :—

Monday, February 19th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30—8.

Wednesday, February 21st.—Instructional Class, 6.15. Platoon Drill, Platoon No. 1.

Thursday, February 22nd.—Platoon Drill, Platoon No. 7. Ambulance Class by M.O., 6.30.

Friday, February 23rd.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.25—8.25.

Saturday, February 24th.—N.C.O.'s Class, 2.30, under Company-Commander Fleming.

Entrenching.—Suspended until further orders.

Telephone Number.—The Telephone at Headquarters is now *Mayfair 1969.*

(By order), Macleod Yearsley, *Adjutant.*

Tramway Rails.—The following statement appears in the February issue of the *Journal* of the Tramways and Light Railways Association :—

"A small Sub-Committee was formed in 1915 with the object of providing tramway rails to those members who were in urgent need of same. Negotiations took place with a Committee of Manufacturers, and members were circularised in order to ascertain the quantities required.

"Applications for nearly 13,000 tons were received, but subsequently, owing to the prices quoted, several of these decided to withdraw. It was then found that the net amount remaining was not sufficient to induce the Committee to approach the Ministry. The manufacturers of special work, Messrs. Edgar Allen & Co., Ltd., and Messrs. Hadfield's, Ltd., were applied to, and with their help they were able to assist members to the extent of 580 tons—211 tons BS No. 1, 1c, 2, 2c ; 135 tons No. 4, 4c ; 234 tons No. 5, 5c. Stocks are now exhausted, but if any of our members should have a surplus of rails and will let the secretary know it would materially help other members with their shortage."

The Brittleness Produced in Steel Springs by Electroplating.—Messrs. M. DeKay Thompson and C. N. Richardson have investigated the fact that small steel springs become brittle when plated in copper cyanide baths. Plating in a nickel bath containing no cyanide had no such effect.

Though the explanation of the brittleness produced in a spring wire when used as a cathode in a hot cyanide solution could not be found, the following results were obtained :—

Spring steel becomes brittle when used as cathode in a hot cyanide solution, either sodium cuprocyanide or simply sodium cyanide. The effect is more pronounced with the simple salt. Brass and phosphor-bronze are not affected. Brittleness is not produced by the liberation of hydrogen on the steel. The carbon content is not changed by the electrolysis. The crystalline structure is not changed by electrolysis. The brittleness is not produced in annealed wire ; the brittleness is produced by use as cathode whether the wire is coiled, or not bent in any way. The brittleness is not produced when the wire is used as anode, or when it is suspended in the solution without the passage of electricity. *Met. and Chem. Engineering.*

Electrometallurgy in the U.S.A. in 1916.—The installations of electric steel furnaces in the United States approximately doubled in 1915 and continued at an almost undiminished rate in 1916. The chief trouble met with is a lack of experienced operating men. High-speed tool steel is now being manufactured in 6-ton heats as a regular procedure, in contrast with the 100-lb. pour of the crucible. The heavy demand for high-speed tool steel and the difficulty of securing crucibles at any price have made the electric steel furnace an economic necessity.

A considerable number of electric furnaces have been installed in foundries for the manufacture of steel castings. More installations are contemplated involving the use of the electric furnace in a duplex process with the open-hearth furnace or the converter. Several electric furnaces are melting ferro-manganese before additionto steel.

In Germany—formerly the largest producer of electric-furnace steel—the heavy demand for tool steel has also resulted in an increased use of the electric furnace for steel making. In August the production reached 17,000 tons per month, or six times teh monthly production at the outbreak of the war. On the other hand, the production of crucible steel has remained stationary. The monthly production of electric-furnace steel in Germany is now double the crucible output.

On a smaller scale there has been a heavy increase of ferro-alloy manufacture in the United States. Three new manufacturers of ferro-silicon started production during the year. At the outbreak of the war about half of the domestic ferro-silicon consumption was imported, but now practically all ferro-silicon needed for consumption is manufactured there, and a small amount is being exported. To provide part of the needed furnace capacity a calcium carbide plant in Niagara was switched over to ferro-silicon manufacture. During the period in question the domestic consumption of ferro-silicon doubled, and is estimated at 45,000 tons annually.

The largest domestic producer of ferro-chrome was able to supply the increased needs of the steel industry. With other alloys, such as ferro-tungsten, ferro-vanadium, ferro-titanium, and ferro-molybdenum there has been an increase of production, and several plants have been established. There is now sufficient plant capacity in the country for filling all domestic requirements of ferro-tungsten, and for the first time considerable quantities of ferro-tungsten are being exported. Exports of ferro-vanadium have doubled since 1915. Most of the new producers are using the electric furnace. Ferro-titanium is produced at Niagara to the limits of plant capacity, and the demand is greater than the power supply. A fair quantity of ferro-molybdenum is being manufactured in the United States, and towards the end of the year there was a marked increase in demand for foreign shipment, believed to have to do with the lining of big guns. Ferro-uranium was produced commercially for the first time in the U.S.A., and may be added to the new products of the electric furnace.

Aluminium manufacture in the United States enjoyed in the past year undoubtedly the maximum production and maximum prosperity in its history.

As a result of operations started in 1915 several plants are producing on a small but commercial scale by electrolysis very pure metallic magnesium.

Among new electrometallurgical enterprises electrolytic zinc looms large. There is the electrolytic zinc plant of the Anaconda Copper Co. at Great Falls, Montana, with a production of 100 tons of electrolytic zinc per day, while as a result of the Bully Hill experiments of the General Electric Co. a $350,000 electrolytic zinc plant is being erected at the Mammoth smelter in California.

The electrolytic copper refineries that were hit so hard at the start of the war have all been working to the limit of their capacity. Electrolytic refining has also made a success with tin.—*Met. and Chem. Engineering.*

The 1886 Company: a Long Arm.—A note from Moscow says that the Governor (N. V. Chelnokoff) of Moscow has returned from Petrograd, where he attended a sitting of the Committee for Combating German Predominance, at which a project for the liquidation of the 1886 Company was submitted, according to which it was proposed to form a new company to take the place of the Electric Lighting 1886 Company. Forty per cent. of the shares would be transferred to the Treasury ; 30 per cent. to the Moscow and Petrograd Town Councils ; the balance to be left with the present shareholders, subjects of Neutral Powers. The whole concern, Moscow and Petrograd, is valued at 55,000,000 roubles. A subsequent advice is as follows :—

At a recent sitting of the Moscow Town Council, a member (M. Mazing) explained how the Ministry of Trade and Industry granted a 4,000,000 R. subsidy to the 1886 Company. The *Ruzkiya Viedomosti* recounts his statement as follows :—Recently it has been shown that the company required 6,000,000 roubles to carry on its business. The company explained that failing such a grant, Moscow would be left without current for both lighting and industrial purposes. Previous to the beginning of the war, all the money at the disposal of the company was sent to Berlin. There remained only a few hundred thousand roubles, which were distributed for various purposes by the manager. It appears that the banks will not give the company money. The position of the company is such that it is impossible to say to whom the money may be given on credit, and from whom one may expect to receive it, for a continuous change in the position of the company is taking place. When it was shown that the banks would not advance money, the president of the board of the company, General Tzventorzhitsky, proposed to ask for it from the Ministry of Trade and Industry. The representative of the Ministry of Finance, Kukelbeker, supported the proposition. This support was sufficient for the presentation of the request. The representative of the Moscow Town Government desired to take part in the preparation of the memorandum, but he was informed that the board had sufficient grounds for the success of the application, and did not require any co-operation by a representative of Moscow. The grounds appeared to be quite sufficient, and the request was acceded to, though for a lesser sum. The Minister of Trade decided to grant the company a 4,000,000 roubles subsidy. This sum will, of course, be of great assistance to the company.

Information on the allocation by the Council of Ministers to the 1886 Company of a 4,000,000 roubles loan has produced a great impression in the Town Council, says the *Novoie Vremya.* It was hoped in the Council that the financial difficulties experienced by the company would hasten the decision on the point of liquidation. The President of the town made a detailed report to the Town Governor on the discussion that took place on the subject at the last meeting of the Special Executive Council, when N. I. Sushkin said that the former Minister of Trade and Industry, V. I. Timiryazeff, having strong relations with the banks, had decisively stated that the company would not obtain credit before the decision of the question of liquidation : and, on the contrary, a large credit would be opened on the transfer of the concern into the hands of the town. After this report was read, the Town Governor immediately sent detailed reports to the Minister of Trade and Industry, Prince Shachovsky, and to the President of the Committee for Coping with the German Predominance, Stishinsky. In these reports Mr. N. V. Chelnokoff recalls the opinion of V. I. Timiryazeff, and asks for the speeding-up of the decision to liquidate. But apparently the Special Council of the 1886 Company has a long arm in the Petrograd administration since the question of a loan was decided in a couple of days. At a later sitting of the Town Council on this question, a protest will probably be registered against such Government support of a German concern.

Appointments Vacant.—Several station engineers for 40-80-kw. oil-driven electric power stations in Lincolnshire for the War Department—Northern Command (50s. to 60s.) ; cost clerk (male or female) and shift engineer (50s.) for the Walsall Borough Electricity Department. See our advertisement pages to-day.

Late Legal. Blundell *v.* Comins.—In the Court of Appeal, Lords Justices Swinfen Eady and Bankes, and Mr. Justice Lush heard an appeal by Mr. C. J. Weld Blundell from the verdict and judgment given against him in a libel action brought by Mr. Comins, of Chas. Comins & Co., chartered accountants, of London.

Mr. Parfitt, K.C., for the appealing defendant, said that Comins had been for about four years auditor of the Float Electric Co., and as such he made a monthly statement for the information of Mr. Weld Blundell, who really was the company, and had put large sums of money into it. £500 damages had been awarded to Mr. Comins in respect of a letter which had also formed the subject of an action by Mr. Lowe, a former manager of the company. In reply to a question by Lord Justice Swinfen Eady, Counsel said that the grounds of the appeal were that the damages were excessive, and that there was misdirection on the part of the Judge in omitting to direct the jury that the defendant ought not to be responsible for any injury to the plaintiff's reputation by the dropping of the letter and its consequent publication.

Without calling on the respondent, the Court dismissed the appeal.

Lord Justice Swinfen Eady said the letter complained of was a serious libel. It imputed misconduct to a professional man in his profession. True, the defendant's communication was to his own professional adviser, and it might be that the plaintiff never even heard of it. Certainly, it was not a communication made and intended to be communicated to the plaintiff. But, on the other hand, the damages could not be restricted to such pecuniary loss as the plaintiff could establish that he suffered. The damages were at large. That being so, could it be said that £500 was so excessive in amount that the jury must have been under some wrong impression, or acted on some wrong principle? He thought not. It was not for the Court to say whether the amount was such as they would have awarded.

Lord Justice Bankes agreed with regret. (1) Because the language used by the defendant was so absurd that very little importance would be attached to it, especially by those who knew the defendant; (2) because the tendency of juries at present was to award extravagant damages in libel actions.

Mr. Justice Bray concurred.

The appeal was therefore dismissed.

Institution and Lecture Notes.—Royal Society of Arts. In the programme of forthcoming arrangements, is a fixture for March 7th, at 4.30 p.m., when Mr. J. H. Vickery, LL.B., will lecture on "German Business Methods."

Institution of Electrical Engineers.—The Council of the Institution has contributed £500 towards the cost of translation of the specifications of the Engineering Standards Committee into foreign languages.

The Council is also purchasing £5.250 new War Loan and the Benevolent Fund £700, these amounts being in addition to any amounts that may be transferred.

An alteration in the programme of the Scottish Local Section for the session provides for an Edinburgh meeting of the Section on March 20th, to hear a paper by Mr. G. A. Juhlin on "Voltage Regulation of Rotary Converters."

Association of Municipal Electrical Engineers.—The list of members of this Association now includes nearly every municipal electrical engineer in the country. No congress was held last year, owing to the president and other members being away on active service. It is hoped, however, to hold a congress this year, either at Cape Town or Durban, for which the following papers have been provisionally accepted:

1. "Tariffs," by Mr. John Roberts, Durban. (Further discussion and consideration of paper printed in *Proceedings*.)
2. "Standardisation," joint paper by Mr. John Roberts, Durban, and Mr. B. Sankey, Port Elizabeth.
3. "Gas Plant," by Mr. F. Castle, Oudtshoorn.
4. "Design and Management of Small Power Installations," by Mr. E. J. Hamlin, Stellenbosch.

The Association has had under consideration for some time past the subject of standardisation in relation to sizes of plant, mains, material and supply pressures, and the same subject is now under consideration by the S.A. Institution of Electrical Engineers. It is agreed by all parties that the standardisation of rules and regulations of supply and the other items mentioned would be of immense advantage to all concerned, by enabling manufacturers to carry stocks in South Africa of practically all kinds of apparatus required with a minimum of outlay. It is not the intention of the Association to depart from existing British standards, but rather to choose as few as possible, and not to go outside them.

We have received from the hon. secretary (Mr. B. Sankey) a copy of the *Proceedings* of the First Congress, 1915, of which a report appeared in our issue of January 7th, 1916; the volume contains the papers read and the discussions which followed, and compares favourably with the records of other and older societies.

Australian Association of British Manufacturers.—This Association has offered its assistance and co-operation in connection with a scheme of the Imperial Government for a travelling exhibition of British manufactures, which is to visit Africa and all the principal parts of Australia. The Association had before it, at its annual meeting in December, the following resolution:—

> No representative of British manufacturers who enters into any agency agreement, or in any way represents any manufacturer whose principal works are situated in any country decided by the Executive Council to be, or to have been, hostile or unfriendly, shall be entitled to membership of this Association, nor shall be allowed to continue membership.

The result of the ballot is to be considered at a general meeting of members. The Association decided to form a guarantee fund to fight any case that, in the opinion of the Council, is necessary for the benefit of members generally.

Lighting Restrictions in Germany.—It is considered that the lighting restrictions which have now been brought into operation in Germany by order of the Federal Council will have a far-reaching effect on the working and financial results of gas and electricity supply works, particularly in regard to the lighting consumption in large towns and public lighting also in the country. Hitherto, the war has exercised influence on these works in two directions. On the one hand, the war has caused a great limitation in building work, and has, consequently, curtailed the establishment of new connections, while, on the other, the scarcity of petroleum has brought about an influx of new customers for the electric light and gas, so that the initial decline in the case of these two illuminants was rapidly overtaken, and a further increase was recorded. As compared with this state of affairs, the working of the gas and electricity supply works was rendered more costly, owing to the advance in coal prices and the absence of English coal, which was formerly largely used in gas works, and a fresh increase in the cost of production will now take place as a result of the new advance in the sale prices for coal which was made on January 1st, 1917.

The order for exercising economy in lighting agencies will presumably be of detrimental influence on the working results chiefly of gas and electricity works, because these are largely in muncipal ownership. The number of public supply works rose from 1.978 in 1909 to 4.040 in 1913, and the aggregate value of the connections passed from 1.860.860 kw. to 3.725.769 kw. in the same years respectively. These figures represent an augmentation of almost 100 per cent. in four years, whilst the capacity of the works in machinery and accumulators advanced from 1.161.609 kw. to 2.095.666 kw. in the same period. As to the division of the supply between lighting and power customers, it appears that out of the total value of the connections in 1909, 40·7 per cent. devolved upon lighting and 59·3 per cent. on power connections: but in 1913 a further displacement took place to the disadvantage of the lighting connections, which receded to 35·8 per cent., whereas the power connections rose to 64·2 per cent. The number of places supplied with current advanced from 4.700 in 1909 to 17.500 in 1913, and it is assumed that an aggregate capital of £125.000.000 was invested in public electricity works at the end of 1913, exclusive of the value of the connections from the distributing mains to the consumers' premises.

It is impossible to form any definite opinion as to the extent of the influence which the lighting economy scheme, which also applies to supply to tramways, will have upon the electricity works. A geat deal will depend upon the limitations in private lighting, the course of coal prices (which are now much higher), and of the prices of other raw materials, and the sale price for electricity, which has already been raised at Frankfort-on-Main. On the other hand, a partial compensation for reduced lighting consumption is looked forward to in the direction of an increased delivery of energy for power purposes, especially in connection with the industries engaged on war work.

Inquiries.—We are asked for the names of makers of the McNicol boiler, "American Interstate Novelties," and "Titan" electric lamps.

Research in Glass and Optics.—A Standing Committee on glass and optical instruments has been established by the Government's Department of Scientific and Industrial Research. Sub-Committees have been appointed to deal with various special problems, including raw materials for glass and glass-making, general physical and chemical properties of glass and glassware for scientific and industrial purposes, X-ray glass apparatus, &c.

Engineering Labour.—The Executive Committee of the Amalgamated Society of Engineers suggests that the only way to bring about an amalgamation of the engineering and shipbuilding industries is by bringing about, first of all, a fusion of two or three societies. The amalgamation of the A.S.E., the Boilermakers, and the Ironfounders would bring into being a single union capable of effectively controlling the industry, and the adherence of the smaller societies would follow.—*The Times.*

War Loan.—Last week a successful War Loan rally took place among the employés of the British Thomson-Houston Co., Ltd., at Willesden Switchboard Works. Meetings were held during the week, at which great enthusiasm was shown, the response to appeals made being extremely gratifying; over 700 15s. 6d. War Loan certificates were applied for on Friday and Saturday alone.

Excess Profits Duty—In response to an application by the Cape Electric Tramways, Ltd., the Board of Referees has ordered that the statutory percentage as respects the carrying-on of electric tramway business in Cape Colony in which the whole of the share capital is held by companies registered in the United Kingdom, the tramways not being carried on by municipalities, be increased to 7½ per cent. for a company or other body corporate, and to 8½ per cent. for any other trade or business.

The London Omnibus Owners' Federation applied for an increase, and has been given an increase to 8 per cent. in the case of a company or other body corporate, and to 9 per cent. for others.

Electric Light Switching Exams.—During the war Messrs. A. P. Lundberg & Sons have discontinued giving prizes; those wishing to investigate the subject can start working a paper without delay, a certificate being awarded if the paper merits it. Those interested should write to the firm at 477-489, Liverpool Road, London, N.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The Newport (Mon.) Council has approved a recommendation to increase the salary of Mr. A. Nichols Moore, tramways manager and borough electrical engineer, by £100 per annum, increasing the maximum from £400 to £500.

The Battersea B.C. is recommended to sanction the following increases in the salaries of officers in the electricity department:—Mr. H. F. G. Thompson, assistant electrical engineer, from £285 to £310 per annum; Mr. T. Bennett, station superintendent, from £205 to £225; Mr. E. S. Colley, shift engineer, from £160 to £170; Mr. C. E. F. Evans, shift engineer, from £160 to £170; Mr. H. V. Healy, shift engineer, from £160 to £170; Mr. W. T. Magrath, mains assistant, from £132 10s. to £150; Mr. W. Mears, meter superintendent, from £156 to £166; Mr. A. S. Knight, installation inspector, from £125 to £130; Mr. J. C. Adams, office clerk, from £107 10s. to £115; Mr. H. T. Strugnell, storekeeper, from £125 to £130; Mr. E. N. F. Grant, commercial assistant, from £104 and commission to £168 per annum and no commission.

The Wigan Electricity Committee has awarded a grant of £25 to Mr. Bull as an appreciation of his services during the four months that he has been acting as electrical engineer; a similar grant has been made to Mr. Beck.

The staff of the Lincoln municipal electricity works has presented a clock to Mr. J. W. Halkes, only son of Coun. T. C. Halkes, on the occasion of his marriage to Miss M. M. Elkington, also of Lincoln.

The Bradford Electricity Committee recommends advances in salary to officials in the department as follow:—Mr. Thos. Roles, city electrical engineer, £800 to £900; Mr. J. H. Shaw, deputy engineer, £350 to £450; Mr. James Fairburn, works superintendent, £300 to £350; Mr. C. E. Allsopp, commercial assistant, £250 to £300. The Tramways Committee recommends advances as follows:—Mr. J. W. Dawson, assistant electrical engineer, £295 to £325; Mr. T. Stirk, traffic superintendent, £270 to £300; Mr. T. B. Moseley, chief clerk, £200 with £20 bonus to £225 without bonus.

The Maidstone T.C. has decided to increase the salary of Mr. Lambert, manager of the tramways, from £275 to £300 a year, as from January 1st last.

The Reading T.C., on the recommendation of the Tramways Committee, has decided that Mr. J. McLellan Calder, chief assistant engineer of the undertaking, be refused leave of absence for military service.

General.—Congratulations to Lieutenant-Colonel Alfred Ernest Le Rossignol, London Electrical Engineers, upon his appointment as C.B. (Civil Division). Also to Mr. V. L. Raven, now Superintendent of Woolwich Arsenal, who was lent to the Government by the North-Eastern Railway, for which he was chief mechanical engineer, who receives the honour of knighthood; to Mr. Wm. Weir, a well-known Scottish engineer, and Scottish Director of Munitions, who receives a similar honour; and to Sir R. Sothern Holland, H.M. Trade Commissioner in South Africa from 1908 to 1913, who becomes a baronet.

Trooper H. Girdlestone, of the Queen's Own Yorkshire Dragoons, and of the B.T.H. Co.'s Sheffield staff, and son of Mr. J. O. Girdlestone, of the Westminster Engineering Co., Ltd., has returned from service in France to take up a commission in the R.N.V.R., for electrical duties with the Naval Air Service. Mr. Girdlestone joined the Yorkshire Dragoons in August, 1914, and has been in France for 19 months.

Mr. C. F. Butler, A.M.I.E.E., has joined the staff of the British Engine, Boiler & Electrical Insurance Co., Ltd., as assistant engineer in the electrical department at the company's head office at Manchester.

Roll of Honour.—Second-Lieutenant L. A. O'Meara, East Lancashire Regiment, who was recently killed, aged 19, was the only surviving child of Major W. A. J. O'Meara, late R.E.

Private W. Crowe, Manchester Regiment, who was on the staff of the Bury (Lancs.) Corporation electricity works, has died of disease whilst on military service, aged 42 years.

Private C. V. Moore, Durham Light Infantry, who has fallen in action, enlisted 18 months ago, whilst with Messrs Cox-Walker, of Darlington.

The Military Medal for distinguished conduct in the field has been awarded to Corporal A. J. Potter, K.R.R., who was with Messrs. Willans & Robinson, of Rugby.

Sergeant Charles Elliott Atkins, who joined the Signal Section of the R.E. whilst with the British Thomson-Houston Co., Ltd., of Rugby, has been awarded the Military Medal for gallantry in action.

Private William Booth, of the Grenadier Guards, who has died in a South of England hospital, aged nearly 19, whilst undergoing training, was, prior to joining up, with the Halifax electricity department.

Lieutenant Cecil Hopkinson, R.E. (Signal Officer), youngest son of the late Dr. John Hopkinson, F.R.S., has died of wounds received in action, aged 25 years. He was wounded in the head on November 24th, 1915, and died at Cambridge on February 9th, 1917. The *Times* states that at the outbreak of the war he was at Sir Charles Parsons's works at Newcastle-on-Tyne. Lieutenant Hopkinson had been mentioned in one of Sir D. Haig's dispatches.

We regret to announce that Mr. W. E. Evans, chief clerical assistant at the London showrooms of the Edison Swan Electric Co., Ltd., died last week, after only three weeks' service with the Royal Flying Corps.

Obituary.—The Duke of Norfolk.—We regret to record the death of the Duke of Norfolk, which occurred on Sunday last, from gastric influenza, at the age of 69 years. The late Duke was Postmaster-General from 1895 to 1900. Though His Grace was naturally occupied with innumerable and vast affairs, mechanical and electrical engineering matters formed for him a congenial hobby, in which he had long displayed a considerable and intelligent interest.

Mr. Chas. E. Spurrier.—The death has occurred, as the result of a motor cycling accident, of Mr. Chas. E. Spurrier, the proprietor of the oldest established firm of contracting engineers in Wolverhampton. The Wolverhampton Electric Fittings & Installations Co. was established by him about 25 years ago, and he was responsible at that time for some of the earliest installations of electric lighting in the town, the municipal supply not being then inaugurated. During the past few years he had taken an interest in the development of hydro-electric schemes in connection with the lighting and power requirements of farms and villages. He was a member of the Electrical Contractors' Association, and of the Committee of the Wolverhampton & District Engineering Society.

Will.—The late Sir George Franklin left £108,167 gross and £98,625 net.

NEW COMPANIES REGISTERED.

New Switchgear Construction Co., Ltd. (145,964).—Private company. This company was registered on February 9th, with a capital of £10,000 in £10 shares, to carry on the business of electrical engineers, manufacturers of and dealers in switchgear, transformers, heating, and lighting apparatus, &c. The Board of Trade has authorised the company to acquire part of the undertaking of the Switchgear Construction Co., Ltd., the books and documents of which are liable to inspection under the Trading with the Enemy Act. The usual provisions to ensure the British character of the new company are inserted in the Memorandum of Association. The subscribers (each with one share) are:—J. Hall, The Haven, St. James Road, Sutton, Surrey, electrical engineer; C. E. Cleeves, Heddfan, Sketty, Glam., managing director of private company. Table "A" mainly applies. Solicitor: W. E Singleton, 37, Essex Street, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Seear, Scott & Co., Ltd.—Particulars of £1,000 debentures created January 26th, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Tyne Electric Steel Foundries, Ltd.—Issue on January 25th, 1917, of £2,700 debentures, part of a series of which particulars have already been filed.

Sheerness and District Electric Power & Traction Co., Ltd.—A memorandum of satisfaction in full on January 1st, 1917, of debentures dated November 4th, 1913, securing £200, has been filed.

Banbury and District Electric Supply Co., Ltd.—A memorandum of satisfaction in full on December 30th, 1916, of debenture dated March 26th, 1913, securing £100, has been filed.

Woking Electric Supply Co., Ltd.—A memorandum of satisfaction to the extent of £3,000, between May 2nd, 1914, and February 2nd, 1915, of debenture stock issued under trust deed dated March 1st, 1906, securing an indefinite amount.

D. P. Battery Co., Ltd.—Particulars of £6,000 debentures created January 18th, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Oliver Arc Lamp, Ltd. (90,880).—Capital, £2,000 in £1 shares. Return dated December 6th, 1916. 1,407 shares taken up; £7 paid, £1,400 considered as paid. Mortgages and charges £15,000

CITY NOTES.

Metropolitan Railway Co.

At the annual meeting, Lord Aberconway said that they were sparing no pains to lay the foundation for increased business. Judging from the actual passenger traffic, there was a normal and steady increase in the sources from which they might expect to derive their passenger revenue in the future. They hoped also that the development of their goods traffic would correspond. The company's position in the matter of reserves was stronger than it had ever been before. What the position of railway companies generally might be after the war it was impossible to say. There might be legislation involving a continuance of Government control in some form, or there might be even more radical changes; but, whatever happened, it would be all to their advantage that their reserves were substantial and their financial position generally a thoroughly sound one. If, when the present Government control and guarantee were terminated, they reverted to the position of independence that they occupied before the war, they, in common with other railway companies, would be faced with very largely increased expenditure, and unless they were permitted to take steps to enlarge their revenue by the raising of fares and rates it would not be an easy matter to make ends meet.

Edison Swan Electric Co., Ltd. A meeting of the first debenture stock holders was held on Monday, at which the scheme of arrangement was approved. Mr. C. J. Ford, the chairman of the company, explained the scheme. He said that it provided for £100,000 of new money being brought into the business, through the medium of the issue of 100,000 preference shares; for the increase of the interest payable upon the first debenture stock from 4 to 5 per cent. per annum, together with the increase of the interest upon the second debenture stock from 5 to 5½ per cent. per annum; for the provision of an annual sinking fund for the redemption of both classes of debenture stock, and the ultimate merging of the second debenture stock with the first debenture stock into one class, bearing interest at 5 per cent. per annum; and for the relinquishment of the security which both classes of debenture stock held on the £2 per share uncalled upon the partly-paid "A" shares. Four years ago, when he first became connected with this company, it was apparent to him and to others interested that further working capital was urgently required if the company was to maintain a proper place amongst the greater electrical undertakings of this country, and a scheme was brought before the debenture-holders having with its object the provision of further working capital, but the majority of them did not see their way to sanction the directors' proposals. Since that time the company's trade had very largely increased, and the necessity for further capital had become very much accentuated, so much so that unless this could be provided the company's present position and prospects would be seriously prejudiced.

Adelaide Electric Supply Co., Ltd. The gross profit for the year ended at August, 1916, was £136,541, as against £119,897 for the previous year, an increase of 17 per cent., as against 7 per cent. in the previous year. After paying debenture interest and charges, management and general expenses, and putting £3,000 to reserve for excess profits, the credit balance is £52,046. An interim dividend of 5 per cent. was paid in June last, and the following are now recommended:—A final dividend of 5 per cent., free of income-tax, on the ordinary shares, making 10 per cent. for the year; a bonus of 2 per cent., free of income-tax, a final dividend of 5 per cent., free of income-tax, on 19,784 ordinary shares (new issue), a bonus of 2 per cent., free of income-tax, on amounts paid up, leaving £9,160 to be carried forward.

Yorkshire Electric Power Company. The report shows that for the year ended December, 1916, the net profit, after payment of mortgage and other interest, was £29,112, as against £21,209 for 1915, and £20,535 for 1914. Including £2,478 brought forward, the total available is £31,590, out of which 6 per cent. on the preference shares absorbs £9,408, £12,000 is transferred to general reserve fund, 3 per cent. is to be paid on the ordinary shares (£6,316), and £3,866 is to be carried forward. Seventy-eight members of the staff are with the Forces; five have laid down their lives. The staff have rendered loyal service to the company during the year, under very difficult conditions. Costs of labour and supplies have been heavy, but the company has returned to the steady progress interrupted by the war. The advantage of the supply is being realised, and to meet the demands in every part of the area (especially in the southern and eastern divisions, where collieries and steel works are being rapidly developed), additional generating plant has been ordered. Owing to urgent requirements, £60,000 is being advanced by the Government towards the cost of the extension. This is secured by second mortgage. Of the £71,640 in cumulative preference shares authorised in September last, £34,490 has been taken up, and the balance is being allotted as applications are received. The whole of the £47,000 debenture stock of the Waste Heat Co. has now been taken up. Annual meeting: February 20th, at Leeds.

The Compagnie Madrilene d'Electricité. The misfortunes of this company, which at one time absorbed the English Supply Co. at Madrid, and in which French capital is also interested, have been set forth in the Spanish capital. The *Gaceta* of January 3rd, for instance, contains a notice that, in accordance with the judgment of insolvency of December 13th, 1916, the company or its legal representative was required to produce the company's general balance sheet within a week. The *Economista* states that the company's appeal was rejected, and bankruptcy was therefore inevitable. The assets, which were represented by shares and debentures, amounted to a nominal value of 20,000,000 pesetas (£800,000), less approximately 2,500,000 pesetas (£100,000) of securities removed for the company's needs before the suspension of payment. The committee of debenture-holders appointed in November, 1911, is said to have made an excellent campaign, and obtained happy results from a judicial point of view. Negotiations were continued with the French debenture-holders, who were represented by the Association des Valeurs Mobilières, in order to harmonise the objects in view. The matter of the Supply Co. (the English company absorbed by the Madrilene Co.) has also been investigated, a company which is declared to be "a legacy burdened with cost of administration in England and fiscal charges in Spain, in notable disproportion to the amount of the debt, which suggests the seeking, if possible, of a formula which would cause the English company to disappear promptly." The committee has not neglected an examination of the possible solutions which would permit, within the limits of the guarantee which the declaration of bankruptcy has given to the debenture-holders, of the finding of an arrangement with the company, but so far no practical results have been achieved. On the other hand, the committee has been able to appreciate the prosperous course of the Union Electrique Madrilene, which is all for the benefit of the Compagnie Madrilene and is the sole asset of the debenture-holders.

Swiss Electrical Companies. The *Wait, A.G. fur Elektrische Unternehmungen, of Glarus*, which is closely associated with the Zurich Bank for Electrical Undertakings, and is also an investment company, reports that any further extension of activity in 1915-16 was stopped through the conditions of war, so that the investments were again limited to those prevailing in the previous year. The net profits for 1915-16 amount to £9,000, as contrasted with £18,000, and the dividend on the ordinary capital is 3 per cent., as against 5 per cent. in 1914-15.

The Columbus, A.G. fur Elektrische Unternehmungen, of Glarus, which belongs to the Brown-Boveri group, and was formed three years ago to acquire the majority of the shares in the Compania Italo-Argentina de Elektricidad, of Buenos Aires, reports net profits of £51,000 for 1915-16, as compared with £46,000 in the previous 12 months, on an ordinary share capital of £800,000. It is proposed to pay 5 per cent., being the same rate as in 1914-15. The directors state that the machinery export difficulties in Europe in the past year continued to hamper the development of the Buenos Aires Co., whose works, however, were to be enlarged, the present output representing approximately 27,000 KW.

The War Loan.—Since our last reference to applications from electrical and allied firms for War Loan, the following have been announced. The figures in parentheses represent new loan:—

	£	£
Anglo-Argentine Tramways Co.	(240,000)	650,000
Victoria Falls & Transvaal Power Co.	(400,000)	500,000
Brisbane Tramways Co.		108,400
Babcock & Wilcox	(140,000)	500,000
Phosphor Bronze Co.	(20,000)	20,000
British Mannesmann Tube Co.	(50,000)	50,000
Marconi Wireless Telegraph Co.	(100,000)	200,000
Marconi International Marine Communications Co. ...	(50,000)	50,000
British Electrical Federation, Ltd	(220,000)	355,000
Ditto, Staff Scheme	(10,000)	
Beving & Co. and Electro Metals, Ltd., and Managing Directors	(12,000)	
Auckland Electric Tramways Co.	.	50,000
Para Electric Railway & Lighting Co.	(25,000)	
Stewarts & Lloyds	(400,000)	500,000
Indiarubber, Gutta-percha & Telegraph Works Co., Ltd	(30,000)	
Lodge Sparking Plug Co.	(20,000)	25,000
James Scott, Ltd.	(1,000)	
Vulcan Boiler & General Insurance Co.	(25,000)	50,000
O. C. Hawkes and O. C. Hawkes, Ltd.	(20,000)	
Falk, Stadelmann & Co.	(26,100)	54,000
Sterling Telephone & Electric Co.	(25,000)	25,000
Liverpool Overhead Railway		10,000
Mersey Power Co.	(5,000)	5,000
Brown, Boveri & Co.		4,000
General Electric Co. and its Allied Companies' Staff and Employés	(26,500)	26,500

National Gas Engine Co., Ltd.—The net profit for 1916, after providing amply for depreciation of buildings, plant, tools, &c., and allowing for management, salaries, and income-tax, was £95,915. After paying the preference dividend, and 7½ per cent., less income-tax, on the ordinary shares, plus a bonus of 9d. per share, £46,334 remains to be carried forward.

Crossley Bros., Ltd.—Dividend on the ordinary shares, 7 per cent. per annum for the past half-year, making 6 per cent. for the year.

Telegraph Construction & Maintenance Co., Ltd.—The directors propose to distribute, in addition to the interim dividend of 5 per cent. paid in July last, a further dividend of 10 per cent., together with a bonus of 12s. per share.

Electrical & Industrial Investment Co., Ltd.—For 1916 there was a profit, after payment of all management expenses and interest on debenture stocks, of £13,489, plus £10,877 brought forward, making £24,367. The directors recommend a dividend of 5 per cent. on the preferred ordinary shares, carrying forward £13,367. They have continued to act on the principle of adding to reserve the profits made on sales of investments and of charging losses on realisation against the reserve.

Tottenham District Light, Heat & Power Co.—Dividends for the past half year at the following rates:—5 per cent. on the preference stock, 5 per cent. on the "A" stock, and 3½ per cent. on the "B" stock, all less income-tax.

Metropolitan District Railway Co.—Dividends: On the four per cent. guaranteed stock for the last half-year, 2 per cent., making 4 per cent. for the year; on the four and a-half per cent. first preference, 2¼ per cent., making 4½ per cent.; on the five per cent. second preference stock, 1½ per cent., making 3 per cent., carrying forward £20,688.

Underground Electric Railways Co.—The full interest to 31st December on the six per cent. first cumulative income debenture stock is to be paid and 2 per cent., free of tax, on the six per cent. income bonds of 1948, making 5 per cent., free of tax, for the year; carry forward, £30,000. The revenue shows a reduction of £27,000, while the increased income-tax and loss in foreign exchange exceed £56,000.

Blackpool & Fleetwood Tramroad Co.—The net earnings for 1916 after the payment of debenture interest and fixed charges were £18,256, making, with the amount brought forward, £22,505. The directors recommend the payment of final dividend of 4½ per cent. (making 6½ per cent. for the year), placing to general reserve account £1,000, to depreciation reserve account £5,000, writing down value of investments in railway stock £3,005, and carrying forward to next account, subject to excess profits duty, £3,750.—*Financial Times.*

Davis & Timmins, Ltd.—After allowing for depreciation and other charges, and including £39,092 brought forward, the net profit is £103,242. £5,000 is put to general reserve, £5,784 to income-tax account, and £1,672 to depreciation on investments. The dividend on the ordinary shares is 8 per cent. for the year, free of income-tax, and a bonus of 17 per cent. is to be paid, free of income-tax, leaving to be carried forward, subject to special taxation, £75,436.

Liverpool Overhead Railway Co.—Final dividend for the last half of 1916 at the rate of 5 per cent. per annum (less income-tax) on the preference shares and 4 per cent. per annum (less income-tax) on the ordinary shares, making for the year 5 per cent. on the preference and 3¼ on the ordinary shares.

London Electric Railway Co.—Dividend, 2 per cent. for the past half-year on the preference, making 4 per cent. for the year; ¾ per cent. on the ordinary, making 1½ per cent. for the year, carrying forward £24,474.

Central London Railway Co.—Dividend on the undivided ordinary stock for the past half-year, 1¾ per cent., making 3½ per cent. for the year; 4 per cent. is paid for the year on the preferred ordinary, and 3 per cent. on the deferred ordinary, carrying forward £12,079.

City & South London Railway Co.—Dividend on the consolidated ordinary stock for the past half-year, ¾ per cent., making 1½ per cent. for the year, carrying forward £17,245.

National Electric Supply Co., Ltd.—The gross profit for 1916 was £12,180. The directors recommend a dividend of 3s. 6d. per ordinary share, making 6s. per share (against 7s. for 1916). £4,000 is reserve for depreciation, and £2,038 interest on bonus.

Smithfield Markets Electric Supply Co., Ltd.—The dividend for 1916 is 1 per cent. (as against 2 per cent. for 1915), carrying forward £1,000.

Central Electric Supply Co.—In the accounts for 1916, after payment of interest on debenture stock, £19,557 is placed to depreciation fund, and £1,257 to writing off (one-half) discount on issue of debenture stock. £6 is carried forward.

Underfeed Stoker Co., Ltd.—Dividend at the rate of 5 per cent., less tax, for 1916.

STOCKS AND SHARES.

Tuesday Evening.

The interesting point of speculation is how soon Stock Exchange markets will recover from the effect of the enormous amount of money which has been put up in payment for War Loan stock. For nearly a month the War Loan has appropriately assumed the first place in everybody's consideration; and, as we have said before, one of the surprising parts about the colossal issue is the fact that existing securities should have suffered so comparatively little. Prices have gone down, of course; they were bound to do so. Had the fall been much more extensive in its area, however, no one would have been astonished, particularly as so many people sold good securities in order to apply for the new loan.

There is an idea current at the time of writing that the subscription lists may be kept open a little longer than the previously advertised time; but most people would be glad to find this report turn out to be incorrect, because if the lists remained open it would certainly lend the impression that the loan has not been the triumphant success which we feel sure the final figures will show it to have scored.

Markets, of course, are listless and quiet. It is hardly to be expected that they will take a turn for the better until two or three weeks have elapsed from the closing of the War Loan lists, because, quickly as money accumulates, it will probably take a month for conditions to settle down into the normal again The chief point of interest this week has been the extraordinary demand for War Loan sweepstake tickets, which have gone off like the proverbial hot cakes, only quicker. The sweep comprises 950, 1,900, or 2,700 tickets of £1 each, with nine prizes per £1,000 War Loan attached; and the organisers find that they can dispose of a batch in less than an hour, outsiders as well as members of the House being amazingly keen on this form of investment.

Apart from the sweepstakes, Home Railway dividends claim a good deal of attention. In the Underground group, the reduction of the interest payment on the 6 per cent. income bonds of the Underground Electric Railways of London was a sharp disappointment, and led to a drop of 6¼ points in the price. The previous rise had brought out a good deal of stock; and those who bought are now talking about the "knowing old corpse" who figures as the deceased account said to have been responsible for the amount of stock available.

The company's explanation of the reason for the decline—namely, the advance in income-tax and working charges—is comprehensible enough, but certainly there were very few who looked for a lowering of the dividend this half-year. The £10 shares have come down from 2⅛ to 1⅝, and the vague hopes entertained of a possible dividend on these are incontinently shattered for the time being. The shilling shares are quoted about 5s.

Other members of the group have not done at all badly. On Central London deferred the dividend is at the rate of 3 per cent., as against 2 per cent. this time last year. The District Co. is paying 3 per cent. on its second preference stock, the London Electric 1½ per cent. on its £10 shares, and the Central London 3½ per cent. on the ordinary stock, all these being the same as the distributions of a year ago. The London General Omnibus Co. declares a dividend making 8 per cent. for the year, as against 12 per cent. for 1915.

Amongst the steam-electric lines, the Brighton Co. announces 4 per cent. on its deferred stock, as in 1915, and this is something of a disappointment, because the optimists had looked for 4½ per cent.; while the maintenance of the London & South-Western dividend, upon which we commented last week, also failed to meet the hopes of something better as compared with last year. The result is that most railway stocks are lower on the week.

Central London deferred non-assented stands out as a conspicuous exception with a rise of 5 points at 32½, but other stocks in this section are dull. London Electric ordinary shares fell to 2⅜. Districts dropped to 16, and steam-electric issues are somewhat heavy. London United Tramways 4 per cent. debentures declined to 41. London General Omnibus debenture stocks are a little easier.

The electric supply section had another pleasant disappointment in the shape of the Westminster dividend, making 7 per cent. for the year, the same as that declared in the previous twelvemonth. This was a decided improvement upon anticipation. No change occurred in the price of the shares, but the market generally is harder. The turning up of the lights in certain parts of London cast a modified brightness upon the market, although the difficulties experienced by householders in the way of obtaining coal supplies was a sharp reminder that illumination companies have probably suffered similarly.

The telegraph market is inclined to be dull. There is not much doing in the stocks, but the usual buyers have been putting their money into the War Loan, so that would-be sellers who wanted to realise their stock for the same purpose found that they had to accept lower prices. Consequently, the Eastern group is dullish, Indo-Europeans are 50s. down, Great Northerns £1, and in one or two cases it has been none too easy to find buyers, even for the best-class shares. This is the sort of thing which, of course, will be rectified before very long, because as soon as the call for patriotic investment is silent, the bargain-hunter will be out looking for cheap stock; indeed, his presence has been observed in several markets this week.

Amongst foreign issues, the American-Canadian power companies' shares are inclined to droop, and Kaministiquia stands out with a fall of 5 points at 125½. The shock administered to Wall Street by the possibility that the United States might enter the active theatre of hostilities is practically over, and many prices have regained the falls which they experienced upon Germany's defiance of America in connection with the submarine warfare. "America won't fight," say a good many men in the City.

Brazilian stocks and shares of all classes, including Brazilian Tractions, have been disposed to dulness; and the Argentine group is also somewhat heavy. British Columbia electric issues have sympathised with the general tendency; business in these has been quiet, like that in other markets of the Stock Exchange.

The quietude of markets and the issue of the War Loan have been jointly responsible for the rumour that the Stock Exchange Committee are discussing the suggestion for closing the House at one o'clock, instead of leaving it open until three o'clock, as to which there may be an official pronouncement in the course of the next few days.

The industrial market is reasonably steady. There are scarcely any changes in the manufacturing shares of electrical and cable companies. The iron and steel division is still dull; and rubber shares, notwithstanding a further rise in the price of the commodity to 3s. 3½d. per lb., are inanimate. There is nothing fresh to add in regard to the market for copper shares, while that for other base metal descriptions is slightly weaker. Victoria Falls preference eased off to 19s. 9d., the ordinary shares giving way in sympathy to 12s. 6d. The reason given for the shrinkage is the same as that which has been uniformly put forward since the War Loan lists were opened.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1914.	Dividend 1915.	Price Feb. 13, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary ..	5	5	3⅜	—	7 8 2
do. do. do. 4½ Pref..	4½	4½	$8\frac{5}{16}$	+ $\frac{1}{16}$	6 16 10
Chelsea	5	4	3	—	6 18 4
City of London	9	8	11	—	7 5 5
do. do. 6 per cent. Pref.	6	6	9¾	—	6 3 1
County of London	7	7	10	—	7 0 0
do. 6 per cent. Pref.	6	6	9½	— ½	6 6 4
Kensington Ordinary	9	7	6⅜	—	6 10 3
London Electric	4	8	1¼	—	7 2 10
do. do. 6 per cent. Pref.	6	6	4¼	—	7 1 2
Metropolitan	8½	8	2¼	—	6 13 4
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 4 0
St. James' and Pall Mall ..	10	8	6	—	6 13 4
South London	5	5	2⅞	—	6 19 0
South Metropolitan Pref. ..	7	7	$1\frac{3}{32}$	—	6 7 8
Westminster Ordinary	9	7	5⅜	—	6 4 5

Telegraphs and Telephones.

	Dividend 1914.	Dividend 1915.	Price Feb. 13, 1917.	Rise or fall this week.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	94½	—	6 7 2
do. Def.	80/-	33/6	22	—	6 16 4
Chile Telephone	8	8	7	—	5 14 3
Cuba Sub. Ord.	5	5	8½	—	6 8 6
Eastern Extension	7	8	13¾	— ⅛	*5 16 4
Eastern Tel. Ord.	7	8	125	—2	*5 18 6
Globe Tel. and T. Ord.	6	7	11¾	— ⅛	*5 19 2
do. Pref. ..	6	6	9¼	— ⅛	6 3 1
Great Northern Tel.	22	22	34	—2	6 9 5
Indo-European	13	13	46½	—2½	6 19 9
Marconi	10	10	2⅞	—	3 9 6
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord. ..	10	10	2	— ¼	5 0 0
United R. Plate Tel.	8	8	6⅜	—	*6 5 6
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13¾	— ⅛	*5 16 4

Home Rails.

	Dividend 1914.	Dividend 1915.	Price Feb. 13, 1917.	Rise or fall this week.	Yield p.c.
Central London, Ord. Assented	4	4	62½	—	6 8 0
Metropolitan	1½	1	23xd	— ¼	4 7 0
do. District	Nil	Nil	16	— ⅛	Nil
Underground Electric Ordinary	Nil	Nil	1⅝	— ⅜	Nil
do. do. "A" ..	Nil	Nil	6/-	—1/-	Nil
do. do. Income	6	6	84	+6½	5 19 1

Foreign Trams, &c.

	Dividend 1914.	Dividend 1915.	Price Feb. 13, 1917.	Rise or fall this week.	Yield p.c.
Adelaide Sup. 6 per cent. Pref.	6	6	$4\frac{15}{16}$	—	6 1
Anglo-Arg. Trams, First Pref.	5½	5½	3	—	9 4
do. 2nd Pref. ..	5½	5½	2¾	—	—
do. 5 Deb. ..	5	5	64½	—	7 15 0
Brazil Tractions	4	4	47½	—1½	8 10 2
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	61	—	8 4 0
do. do. Preferred	—	Nil	43	—	Nil
do. do. Deferred	—	Nil	37½	—1	Nil
do. do. Deb.	4½	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	25	—	Nil
do. 6 per cent. Bonds	—	Nil	22½	—	Nil
Mexican Light Common ..	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	14½	—	Nil
do. 1st Bonds ..	Nil	Nil	27½	—	—

Manufacturing Companies.

	Dividend 1914.	Dividend 1915.	Price Feb. 13, 1917.	Rise or fall this week.	Yield p.c.
Babcock & Wilcox	14	15	2⅝	— $\frac{1}{16}$	5 14 3
British Aluminium Ord. ..	5	7	27/-	—	5 13 6
British Insulated Ord.	15	17½	11⅞	—	7 7 4
British Westinghouse Pref. ..	7½	7½	2¼	—	6 13 4
Callenders	15	20	12¼	— ¼	8 4 0
do. 5 Pref.	5	6	4	—	6 5 0
Castner-Kellner	20	22	$8\frac{3}{16}$	+ $\frac{1}{16}$	6 19 3
Edison & Swan, £3 paid ..	Nil	—	$\frac{7}{16}$	—	Nil
do. do. fully paid ..	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	61½	—	6 10 1
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9½	—	6 6 4
do. Ord.	10	10	13¼	—	7 5 6
Henley	20	25	15½	— ¼	8 1 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12¼	—	*8 3 4
Telegraph Con.	20	20	38	—	*6 5 0

* Dividends paid free of income-tax.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month. £	£	No. of weeks.	Total to date. £	£	Route miles open.	Inc.
Bristol (Trams) ..	Jan. 26	18,972	+ 329	..	16,975	+ 1,629	30·5	..
Cork	„ 25	1,593	— 198	4	1,593	— 198	9·89	..
Dublin	„ 26	22,588	+ 105	4	22,588	+ 105	54·25	..
Hastings	„ 28	3,712	+ 657	4	3,712	+ 657	19·3	..
Lancashire United	„ 31	6,750	+ 312	5	7,792	+ 323	42	..
Llandudno-Col. Bay	„ 26	740	— 18	8½	1,562	— 12	6·5	..
Anglo-Argentine ..	„ 28	19,849	+2,878	4	19,849	+ 2,878	..	..
Auckland	„ 12	23,977	+1,109	28	150,674	+ 1,966	26·59	..
Calcutta	„ 27	18,839	+1,126	4	18,839	+ 1,126	..	..
Kalgoorlie, W.A. ..	Nov.	2,555	..	..	28,538	..	20.5	..
Madras	Jan. 31	4,787	+ 360	4	4,787	+ 360	..	..
Montevideo ..	Jan.	33,341	— 911	39	93,109	— 855	..	..
Dublin-Lucan Rly.	Jan. 26	432	— 26	4	432	— 26	7	..

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances

Wednesday, February 14th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec
a	Acid, Oxalic	per lb.	1/6	..
a	Ammoniac Sal	per ton	£75	..
a	Ammonia, Muriate (large crystal)	„	£54	..
a	Bisulphide of Carbon	„	£23	..
a	Borax	„	£34	..
a	Copper Sulphate	„	£66	..
a	Potash, Chlorate	per lb.	2/6	..
a	„ Perchlorate	„	2/-	..
a	Shellac	per cwt.	156/-	12/- inc.
a	Sulphate of Magnesia	per ton	£16	..
a	Sulphur, Sublimed Flowers ..	„	£25	£6 inc.
a	„ Lump	„	£19	£3 inc.
a	Soda, Chlorate	per lb.	1/-	..
a	„ Crystals	per ton	120/-	..
a	Sodium Bichromate, casks ..	per lb.	..	..
	METALS, &c.			
c	Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c	„ Tubes (solid drawn) ..	„	..	..
c	„ Wire, basis	„	..	..
c	Copper Tubes (solid drawn) ..	„	1/8¼ to 1/8¾	½d. inc.
g	„ Bars (best selected) ..	per ton	£170	£4 inc.
g	„ Sheet	„	£170	£4 inc.
g	„ Rod	„	£170	£4 inc.
d	„ (Electrolytic) Bars ..	„	£147	£5 inc.
d	„ „ Sheets ..	„	£172	£7 inc.
d	„ „ Wire Rods	„	£155	£4 inc.
d	„ „ H.C. Wire	per lb.	1/6¾	½d. inc.
f	Ebonite Rod	„	3/-	..
f	„ Sheet	„	2/6	..
n	German Silver Wire	„	2/3	..
h	Gutta-percha, fine	„	6/10	..
h	India-rubber, Para fine	„	3/4½	2d. inc.
i	Iron Pig (Cleveland warrants) ..	per ton	Nom.	..
l	„ Wire, galv. No. 8, P.O. qual.	„	£38	..
g	Lead, English Pig	„	£32 5	..
g	Mercury	per bot.	£19 15	..
e	Mica (in original cases) small ..	per lb.	6d. to 3/-	..
e	„ „ „ medium	„	3/6 to 6/-	..
e	„ „ „ large ..	„	7/6 to 14/- & up.	..
d	Silicium Bronze Wire	per lb.	1/10	..
r	Steel, Magnet, in bars	per ton	..	..
g	Tin, Block (English)	„	..	..
n	„ Wire, Nos. 1 to 16	per lb.	3/-	1d. inc.

Quotations supplied by—

a	G. Boor & Co.	*g*	James & Shakespeare.
c	Thos. Bolton & Sons, Ltd.	*h*	Edward Till & Co
d	Frederick Smith & Co.	*i*	Bolling & Lowe.
e	F. Wiggins & Sons.	*l*	Richard Johnson & Nephew, Ltd.
f	India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.	*n*	P. Ormiston & Sons
		r	W. F. Dennis & Co.

Henley's War Relief Fund.—In aid of this Fund a successful concert was held on Friday last at the Cripplegate Institute, where members of the staff, and other volunteers, delighted a large and appreciative audience. The large hall was packed. In addition to a number of turns by the staff, the following friends gave their services :—Mr. Bernard Flanders, A.R.A.M., who acted as accompanist ; Miss Jessie Fisher ; Mr. Wilfred Alderton, the Royal Campanologist ; and Mr. Grant Molene and his company of the Warwick Repertory Club. In the unavoidable absence of the managing director of the company (Mr. George Sutton), Mr. W. J. Potter took the chair, and in the course of the proceedings referred to the good work done by the Fund, the contributions to which, since the inauguration, had amounted to over £2,300. The parcels of little luxuries sent once a month to the Henley men at the Front, or prisoners in Germany, have almost, without exception, reached the men, and have been much appreciated. At the start of the war the Fund was more than sufficient to cover expenses, and various contributions were made to the Red Cross Fund and other war charities, but the number of Henley employés in khaki had now increased to a total of nearly 800, and although the Fund had, so far, been able to keep pace with the demand, the gradual increase had depleted the Fund, so that some assistance was now necessary. He announced that the proceeds of the concert would clear £25, and that other contributions brought the proceeds up to £65. Attention was also drawn to the facilities offered by the company to its employés who wished to contribute to the War Loan, *i.e.*, that the company would advance money to any of its employés, free of interest for two years, to enable them to do so.

The Price of Gas.—Addressing the half-yearly meeting of the Gas Light and Coke Co., Mr. John Miles (the Governor) said that it would be necessary in the near future to raise the price of gas. It would be impossible for the company to continue to supply gas at an increased price of only 20 per cent. when the prices of raw materials had increased so far in advance of that figure. Since the beginning of the war, coal had advanced in price 50 per cent., coal freights 400 per cent., and oil, including freights, 30 per cent. With a deficit of £129,000 in a half-year, and with the cost of oil and other items still rising, it was quite impossible for gas to remain at 3s.

IMPROVED METHODS OF POWER MEASUREMENT.

[Communicated.]

The following account of some new instruments intended to assist the supply authority in justly assessing the charges to be made to different classes of consumers will be of interest.

It appears obvious that a consumer who regularly takes the same power during the same hours each day should not be charged at the same rate as the consumer whose load is intermittent. In the first case the installation, particularly the cable, can be carried out with the minimum of expense, and operated at the maximum efficiency, whilst in the second case, the installation throughout must be capable of dealing with peak-load periods, which may easily be four or five times the average load, necessitating much larger cables, meters, &c., even though the average load over a month may be the same in both cases.

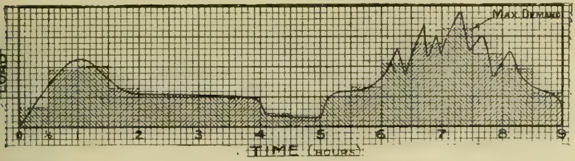


Fig. 1.—Load Curve.

Another important consideration must be borne in mind, namely, the hours during which the consumer takes his power, the power companies being able to supply a day or night load much cheaper than an evening load during the peaked lighting periods.

It is clear, therefore, that to charge by the unit on the total monthly units as measured on an integrating wattmeter is manifestly unfair to many consumers, and the "peaked demand" consumer should be penalised accordingly. For this purpose, a knowledge of the maximum demand is essential, and several ingenious devices have been designed to record this. These, however, are only partially successful, as they do not indicate at what period the maximum demand occurred, and if a fair basis of charging is to be developed this consideration is of great importance.

There are certain consumers whose "peak" or "maximum demand" is bound to occur at the same time each day, as, for instance, in the case of a spinning mill, and that time can be assumed with reasonable accuracy, a comparatively simple mechanism indicating this "maximum demand" with quite good results. But in the cases of consumers who are likely to demand heavy "peaks" at any period, the knowledge of the time at which this "peak" occurs is essential.

Two types of meters have, therefore, been developed by the British Westinghouse Co.:—

1. The "Maximum Demand Meter," indicating the maximum demand only.

2. The "Printometer," which records a printed record of the loads and the time at which they occurred.

To make the scheme possible, the "peak" period should have a moderate time limit, as a very short "peak," lasting one or two minutes, would not affect the supply to any great extent, and, if an isolated instance, should not be considered. When several such "peaks" occur in a short time, or an increasing demand occurs, these "peaks" must be registered.

The "maximum demand," therefore, should be the average rate at which power is consumed over a predetermined time. The time interval is determined from the conditions of the installation, and is usually either one half-hour or one hour, although 15 minutes is often utilised. Fig. 1 shows a rather improbable load curve divided into half-hourly periods. The shaded area under the dotted line indicates the total units integrated by the meter and recorded on the dial each half-hour, and the height of the ordinate to the dotted line gives the average rate at which the electrical energy passed through the meter during that half-hour, and which should be indicated by the "maximum-demand" pointer.

Both these features, namely, the total units passing and the maximum average rate at which the power was supplied—in other words, the "maximum demand"—are obtained with the British Westinghouse "Maximum Demand" Meter.

Figs. 2 and 3 show a polyphase watthour meter, on which the recording dial has in addition a large pointer which indicates the "maximum demand" during the period decided upon. Besides driving the ordinary recording mechanism, the rotating meter movement also drives a train of wheels, which in turn drives the maximum-demand pointer. This train of wheels is controlled by a suitable hair-spring, and when operating, drives against this spring, gradually winding it up. After the predetermined time has elapsed, the train of wheels is disengaged from the main recording mechanism, and the spring resets the wheels to the zero position.

The maximum-demand pointer is driven in one direction only by means of a small dog on the train of wheels, and when the mechanism resets itself to zero, the maximum-demand pointer remains stationary, being held in position by means of a small friction clutch.

The disengagement of the train of wheels is controlled by means of a time switch. This switch makes contact every half-hour or other period selected, and excites a small electromagnet, the armature of which is carried on the framework of the maximum-demand wheel train, this framework being suitably pivoted.

As soon as the armature is pulled up all the wheels return to zero practically instantaneously, although a period of about three seconds is allowed.

Assuming the meter is in operation, after the predetermined time interval has elapsed the maximum-demand pointer will indicate a certain reading.

During the following time interval, should the rate of consumption of current be greater than it was during the previous time interval, the maximum-demand pointer will be carried further round its scale, and when the mechanism resets itself a higher reading—the "maximum-demand"—will be indicated. On the other hand, should the rate of consumption of current be less than that during the previous time interval, the mechanism will not be carried round sufficiently to re-engage with the maximum-demand pointer, and the original indication of the earlier period remains.

The Printometer.—This instrument has all the features of the "Maximum-Demand" meter, with an important addition: that all the "peaks" are recorded together with the time at which they occur. In other words, a complete load curve is immediately obtainable. Figs. 4, 5, and 6 give various views of the instrument.

The principle is rather different from the indicating maximum-demand meter, there being no periodical resetting. The total units are recorded on an ordinary dial, the mechanism of this dial being also engaged with another recording mechanism.

The second mechanism—the "printer"—has three cyclometer dials with specially raised figures, with a carbon paper interposed between them and the paper recording chart. Under the paper are three plungers, operated by an electromagnet, which in turn is controlled by a time switch. Every

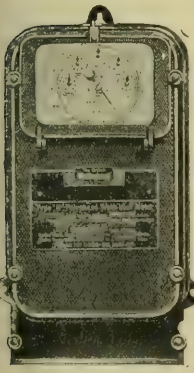


Fig. 2.—British Westinghouse Type "N."

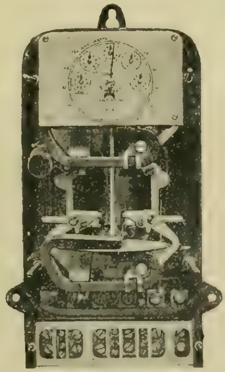


Fig. 3.—Maximum Demand Meter.

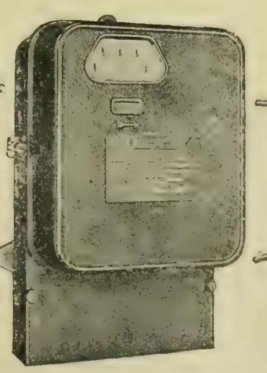


Fig. 4.
"Printometer."

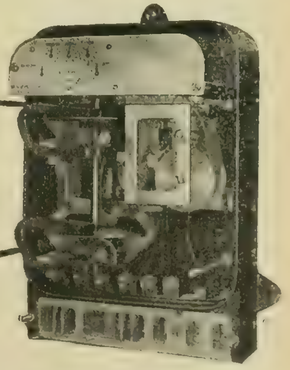


Fig. 5.
Type "N" Meter.

half-hour, or whatever the predetermined time is, the plungers strike the chart and carbon paper against the figures on the printing dials, thus giving a printed record of load and time of occurrence. The chart is driven forward by means of the time switch at the instant the "printer" mechanism operates, and lasts from 10 to 20 days, dependent on the time interval. A simple spool device permits of easy and quick renewal of the chart.

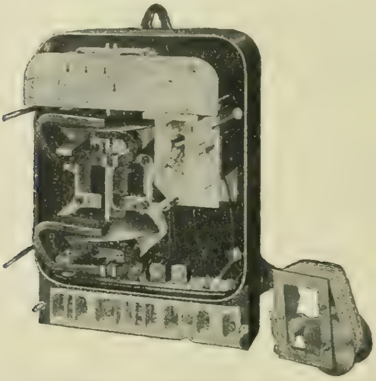


Fig. 6.—"Printometer" Meter, showing Chart Removed.

The "printer" mechanism does not reset to zero each period, and the total units up to time are recorded, both the ordinary and "printer" dials registering the same units. By subtracting the previous reading the "peaks" can be obtained, and if required a load curve may be plotted.

Below is given a table in the first column of which are the figures as recorded by the "Printometer." The second column,

Recorded total units up to time.	Load per half-hour in kw.-hours.	Maximum demand. kw.
300	—	—
310	10	20
325	15	30
352	27	54
384	32	64
405	21	42
415	10	20
423	8	16
450	27	54
504	54	108
525	21	42

obtained by subtracting the previous readings, gives the actual load in kw.-hours passing through the meter every half-hour. The third column gives the "maximum demands" which, in the case of half-hour time intervals, are double the second column. Fig. 7 shows these results plotted. The total units up to any period, the actual load curve, and the "maximum demand" are easily obtained at any time.

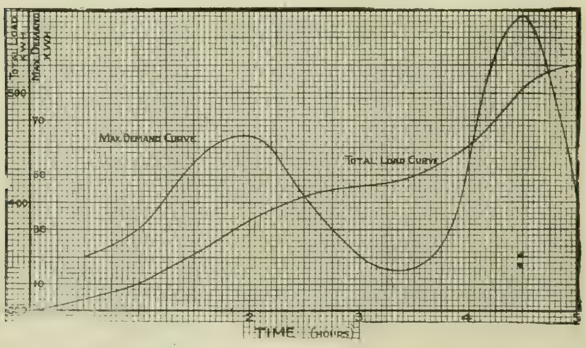


Fig. 7.—Curves deduced from "Printometer" Records.

There is undoubtedly a wide field for this instrument, which overcomes several difficulties experienced by supply companies.

Any standard time switch can be used with this instrument, but it is a matter of conjecture whether the hand or electrically-wound type is best; the latter loses most of its advantages when weekly or fortnightly visits have to be made to the meter.

(*To be concluded.*)

BOILER-HOUSE OPERATION AND MAINTENANCE.

(*Continued from page* 149.)

At all the stations except Vereeniging the ashes are dumped over the back of the grate into open hoppers below, from which they are discharged into coco-pans pushed by natives through the ash basement.

At Brakpan the average percentage of ash in the coal as fired is about 27 per cent., at Vereeniging about 18.5 per cent., and at Rosherville and Simmerpan about 17 per cent.

The average maintenance cost of ash haulage is .50d. per ton of coal burnt. This includes the maintenance of tracks, repairs and replacement of coco-pans, haulage ropes, and repairs to reduction gears and motors.

The above system was also installed at Vereeniging, but when burning anything over 1,000 tons of coal per day it was almost a physical impossibility for the natives to keep the basement clear of ashes. To overcome this a Zimmer vibrating conveyor has been installed; so far this has been a success. A conveyor is erected under each line of five boilers, discharging on to a cross conveyor, which discharges the ashes into a bin, from which they are fed into coco-pans and taken up to the dump by a rope haulage. It is found essential to saturate the ashes with water as they fall from the hopper on to the conveyor troughs; unless this is done the troughs become overheated and badly buckled.

The provision for dealing with ashes is often an afterthought in station design, but the efficient handling is a matter of the utmost importance at a power station running at a high load factor and burning any considerable tonnage of coal, and especially is this the case when it contains a high percentage of ash.

All the boilers, 102 in number, are of the Babcock and Wilcox marine type; the first eight boilers at Brakpan and the first 16 installed at Simmerpan have Green's economisers (steel cased) above the boiler; all other boilers have Babcock & Wilcox economisers integral with the boiler.

Draught in all cases is provided on the Prat ejector system. The Prat system is very convenient, and the maintenance costs are low, but the system is not as efficient as the ordinary plain induced draught.

In the case of one of the large fans working on two large boilers at Simmerpan (with 4-in. mixed coal fires, grate area 252 sq. ft. per boiler; 11.5 per cent. CO_2), the h.p. taken varied from 85 to 110, the corresponding draught at chimney uptake from economiser for each boiler varying from .7-.65 to 1.6-1.5 in. Figures are given for an official test of a Babcock & Wilcox marine boiler unit; the coal analysis showed moisture 3.4 per cent., vol. matter 22.8 per cent., fixed carbon 58.8 per cent., and ash 15.0 per cent.; similarly, ash showed moisture .20 per cent., vol. matter 1.0 per cent., fixed carbon 18.9 per cent., and ash 79.9 per cent.

The energy distribution of the coal burnt was as follows:—To water 80.6 per cent., to chimney gases 8.35 per cent., unburnt fuel 5.0 per cent., radiation and unaccounted for 5.05 per cent. The average evaporation was 7.21 per lb. (actual), but during the last five hours 7.40 lb. per lb. (actual); resulting efficiency 82.8 per cent.

The power taken to produce the draught was 60 h.p.—at 11 lb. per h.p.-hour, draught production took 1.52 per cent. of the steam generated.

The commercial test figures on a bank of four boilers, at Vereeniging, which were isolated from the other plant and supplied steam to a 12,000-kw. turbine, its turbine-driven auxiliaries and one steam turbine-driven feed pump, are shown in Table II.

The coal was crushed slack (0-⅞), of an energy value of 2.88 kw.-hours/lb.

A further test was made at Vereeniging on 18 steaming boilers, nine burning crushed slack and nine burning large crushed and nuts. An excessive amount of dust was present, due to a defect in the crusher, and the efficiency of the boilers burning slack fell from 75 to 67.7 per cent.

The most important factor affecting efficiency is the different character, energy value, and size of the coal burnt. The tendency is for duff coal, which constitutes the great bulk of the coal burnt, to contain more and more absolute dust, which clogs up the fire or falls between the links of the grate. Such coals must be mixed with other coals for efficient burning, and care is taken that this is done in the conveyor from the outside to the overhead bunker.

It is general knowledge that duff coal burns better when wetted; unless wet it goes over the grate like a blanket, and at a low furnace temperature, and increasing the draught breaks up the fuel bed into ridges, letting in excess coal air and lowering the efficiency.

Burning dry duff alone about 6 per cent. CO_2 only is obtained, but if wetted 10.5-12 per cent.

By experience, it is found that it pays to wet all coals, whether mixed or duff, except only clean peas and nuts, but the wetting has to be uniform, and the most successful scheme has been to spray the coal as it leaves the overhead bunkers and enters the chute to the stoker hopper, though this can only be done when the feed is constant, as alteration results in too wet or too dry coal.

TABLE II.—Commercial Test on a Bank of Four Boilers. Babcock & Wilcox Marine Type, Vereeniging. (Slack Coal Test.)

1.	Period of test	96 hours.
2.	Boiler heating surface	5,920 sq. ft.
3.	Superheater heating surface	2,247 „
4.	Economiser heating surface...	2,290 „
5.	Grate area	252 „
6.	Energy value of coal burnt (slack) ...	2·88 KW.-hr./lb.
7.	Total coal burnt	1,259 tons.
8.	Coal burnt per sq. ft. grate	28·5 lb./hr.
9.	Average evaporation per boiler per hour ...	38,100 lb. actual.
10.	Average evaporation per lb. of coal ...	5·80 lb.
11.	Average evaporation per sq. ft. of boiler heating surface	5·96 lb.
12.	Average steam pressure at turbine stop valve	181 lb./sq. in.
13.	Average steam temperature at turbine stop valve	354° C.
14.	Boiler house efficiency	75 per cent.*

* This includes pressure and temperature losses up to the turbine stop valve. The actual boiler efficiency is slightly higher than the figure given.

Too wet coal is liable to stick in buckets, bunkers, chutes, &c.

At the Brakpan plant, owing to not being able to mix the various coals, a low-grade fuel ((2.25 KW.-hr.-lb.—32-36 per cent. ash) has to be burnt alone in the new boiler-house, but though the boiler-house efficiency has fallen off, the economy has improved.

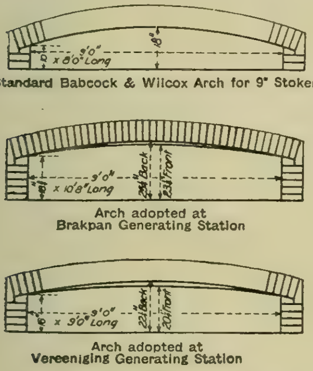


Fig. 5.—Standard Furnace Arches.

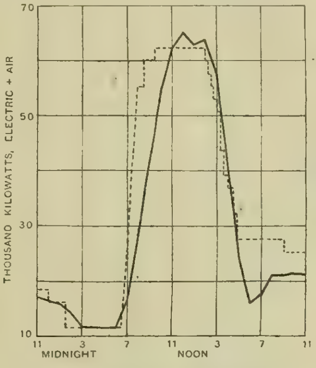


Fig. 7.—Load Curve, Rosherville; dotted line for boilers steaming.

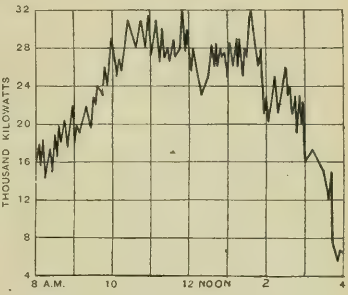


Fig. 8.—Load Curve, Simmerpan Station.

The low-value coal referred to—2.25 KW.-hr.-lb.—containing 32.5 per cent. ash, is so near the limit of what can be burnt commercially on chain-grate stokers that a slight variation downwards in value causes serious loss in efficiency, and it is often necessary to relight fires with higher value coal and reheat the arch before a fire can be got going again. The principal factors in burning such low grade fuels are: (1) Arch design, (2) grading, (3) draught, (4) saturation of duff or slack with water.

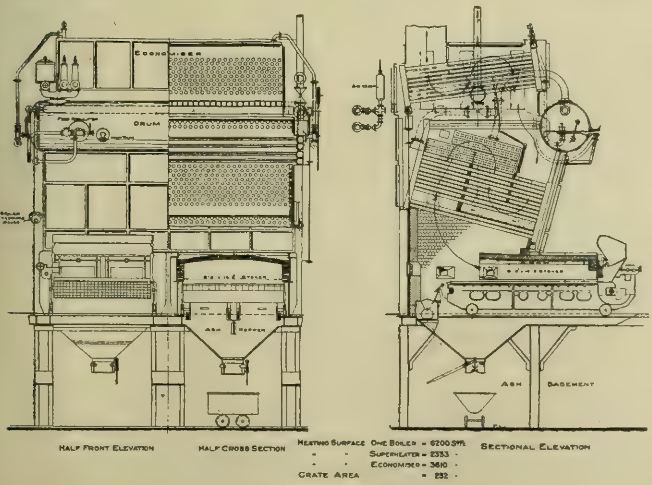


Fig. 6.—Self-contained Boiler Unit.

TABLE III. Boiler-house Efficiencies, Load Factors, &c.

Brakpan.	1914.	1915.	1916 (4 months)
Units sent out	36,324,000	116,725,000	42,185,000
Boiler-house efficiency ...	76·2 %	72·7 %	71·2 %
Rosherville.			
U.S.O.	253,650,000	203,800,000	67,430,000
Load factor	40·2 %	34·3 %	33·7 %
Boiler-house efficiency ...	73·2 %	73·5 %	74·6 %
Simmerpan.			
U.S.O.	118,800,000	152,700,000	53,600,000
Load factor	39·8 %	48·6 %	52·5 %
Boiler-house efficiency ...	73·3 %	76·4 %	76·1 %
Vereeniging.			
U.S.O.	229,600,000	269,400,000	86,050,000
Load factor	59 %	67·4 %	66·5 %
Boiler-house efficiency ...	70 %	72·1 %	74·8 %

Boiler-house efficiency includes pressure and temperature losses up to turbine stop valve.

The arches standardised for conditions at Brakpan are shown in fig. 5; they are 10 ft. 8 in. long, as against the standard arch of 8 ft., and stand a furnace temperature of 1,200-1,300 deg. C. with low-value coal, but have a relatively short life with higher temperatures. The conditions giving the best results with low-value coals are:—

	Peas ($\frac{1}{2}$ in. — $\frac{7}{8}$ in.).	Slack (0 in. – $\frac{1}{2}$ in.).
Fire thickness	6 in.	4¾ in. — 5 in.
Grate speed	No. 3	No. 4
Draught at uptake ...	1·2 in. — 1·3 in.	1·7 in. - 1·8 in.
Draught over fire	·50 in.	·50 in
Coal burnt per sq. ft. per hr.	32 lb.	35 lb.

The conditions have to be maintained steadily, and load variations met on those boilers burning better coal. The coal is now graded into the two sizes shown. The boiler-house efficiency at Brakpan is about 72.5 per cent., and will probably increase to 74.5 per cent.

While at Brakpan the problem is to burn low-grade fuels, at Simmerpan and Rosherville the difficulty is obtaining high boiler-house efficiency with the relatively low load factors at which the stations run.

At Rosherville, the load factor is 30-40 per cent.; 28 boilers are required for the day load, and only six at night, and efficiency suffers from having to keep so many boilers alight without doing any work. Fig. 7 shows the load curve. The coal burnt in banked boilers is over 3 per cent. of the total coal burnt; in addition, the average evaporation is only about 70 per cent. of the rated capacity of the boiler, due to the time taken to bring the boiler up to full capacity and for it to die down. The station operates under set conditions, and men are trained to a stereotyped set of operations. Mixed coal and duff are burnt, having energy values between 3.36 and 3.46 KW.-hr.-lb.

The Simmerpan station takes up the large load variations as shown by the load curve fig. 8. The switchboard staff communicate direct with the boiler-house staff by signal indicating rising or falling load.

At Vereeniging station the small by-product coal was insufficient in quantity, and a crusher was installed; the combination of low grade and the large size and wide grading was a difficult problem.

(To be concluded.)

PRINCIPLES INVOLVED IN COMPUTING THE DEPRECIATION OF PLANT.

The paper by Messrs. F. Gill and W. W. Cook was read and discussed at a meeting of the Manchester Local Section of the Institution of Electrical Engineers on January 16th.

Mr. S. L. Pearce (chief engineer and manager, Manchester) said members generally would agree with the definition of the respective functions of the engineer, accountant, and financier, and with the emphasis laid upon the need for the closest co-operation. Within the last few years there had been examples of such co-operation in connection with electricity undertakings in this country; for instance, at Bristol between Sir Wm. Preece and Prof. Dicksee, and recently at Southampton, where Sir John Snell was associated with an eminent accountant. When all had been said on this point, it remained true that the engineer had to bear the brunt of the correctness or otherwise of the depreciation charges, because it devolved upon him at the start to estimate the factors which determined it, namely, the first cost and the lives of various portions of plant. After making clear what was meant by "depreciation," the authors resolved it into two components, renewals and improvements. The first of these was provided for already in the case of local authorities, who were compelled by statute to form a sinking fund in connection with electricity undertakings; but everyone did not appear alive to the necessity of making provision against the possibility of having to scrap portions of the plant before the physical life was at an end. It was desirable to emphasise that depreciation was as much a working charge as fuel, and it had to be settled on a well-defined basis, not dependent upon the amount which a company desired to pay in dividends or a local authority to allocate to the relief of rates. Contrary to the authors' opinion, there appeared to be a fair measure of agreement amongst engineers with regard to the question of the life of plant, upon which, of course, the renewals chiefly depended; but the trouble lay in the fact that the recommendations and opinions of experts were very often ignored. The question of obsolescence or improvement introduced the realm of speculation, and there was a divergence of opinion as to the percentage allowance for residual values. It was almost impossible at the present time to forecast correctly future progress, or when the scrapping policy would become desirable; therefore, whilst agreeing with the authors' method from a strictly logical and scientific point of view, it was doubtful whether in practice two sets of elaborate calculations were necessary. One would appear reasonably to satisfy all practical requirements if based on the life of plant, either physical or economic. If the former basis were adopted it would be prudent to build up a general reserve fund to a substantial amount, which, of course, would depend entirely upon local conditions, in order to provide for the possibility of having to scrap a portion of the plant before the physical life came to an end. Regarding the Local Government Board practice in granting loans, 10 or 12 years ago it was usual to allow long periods for repayment, periods which were undoubtedly in excess of the economic lives of portions of the plant, if not in excess of the physical lives. Since 1906, the Board seemed to have leaned to the other side, and the periods were unduly short. It was not clear whether the Board now intended to cover both physical and economic lives; indeed, it was open to doubt whether the new policy was based upon any definite ideas at all. The bulk of the paper dealt with the question of sinking-fund method against straight-line method. The former was adopted by municipalities, and a very strong case was made out in its favour. The choice between the methods became more important when making a valuation of plant. The authors laid undue stress upon the difficulties of carrying out the modernisation of existing plant. Many at the present time were compelled to adopt a big scrapping policy, schemes were being held up, and engineers had to modernise existing stations so as to increase outputs, and difficulties arose when no provision had been made for an improvement fund. The difficulties were not to be exaggerated, as the practice of local authorities was well established. The Local Government Board would grant borrowing powers corresponding to the full value of the new plant required, less the amount outstanding on the old plant. During the period the old plant had still to run, the undertaking carried a double burden, the annual charge on the old plant and the annual charge on the new plant. Obviously, every engineer deciding upon the policy of scrapping a certain amount of plant would have to take all these facts into consideration. It was to be borne in mind that the cost of reproducing plant was not necessarily the same as the original cost. The authors were right in making a strong point of the fact that the life of plant should be reckoned by the work done, and not merely as a number of years. In many electrical undertakings the load factor was going up, and likely to increase still further in the future, and that was to be taken into account in estimating the economic life of the plant. He did not agree that the maintenance costs might be considered not to increase with age of plant. There was no reference in the paper to the provision, in addition to the fund for expiring capital outlay, of a further fund for the acquisition of new plant without recourse to the raising of new capital, commonly known as the double provision basis. Presumably the authors disagreed with such a policy. Regarding those electrical undertakings compelled to contribute to certain sums annually by way of relief of rates, he held that in the event of this policy being abolished the whole of the benefit accruing therefrom should not go to the consumer. The aim of all undertakings should be self-capitalisation spread over a cycle of, say, 40 or 50 years.

Mr. J. Beckett (borough treasurer, Accrington), representing the Lancashire and Cheshire Branch of the Institute of Municipal Treasurers and Accountants, gave examples which proved the scope for a wide divergence of opinion on the question of depreciation. In addition to individual differences of opinion, there was in practice always some oscillation between physical necessity and financial expediency, between actual present needs and available means. The measure of rate aid should not be the answer to the question how much the undertaking would produce. That policy would clearly handicap an undertaking in competition with other forms of light and power, and the solution was a fixed basis of contribution to rate funds. Referring to exhausted plant, the authors suggested that the cost of making changes should be part of the annual charges, but he submitted that it was no part of the annual charges in respect of plant. It might be prudent to make provision for it by way of reserve if there was surplus revenue available for that purpose, but it was certainly not true accounting to charge against the plant for any period more than had been taken out of the plant within that period in earning the revenue. The true principle appeared to be that plant might be discarded and replaced by more economical plant out of capital when the result of so doing upon the revenue account was not only to maintain a state of equilibrium, but resulted in a positive financial advantage to the undertaking. When scrapping plant, the question for the engineer to consider was whether the economies to be effected thereby would compensate for the additional capital charges thrown upon the undertaking, and until that point was reached no engineer would be likely to recommend a change to new plant, or a renewal or improvement of the old. Moreover, local authorities could not give effect to the proposal of the authors, for they were restricted to a reserve fund and a surplus revenue of 5 per cent. upon the capital outlay. Depreciation might be defined as: "The charge against revenue of any given period of that proportion of the cost of production during that period which represents the consequent fall in value due to wear and tear of the producing machinery and plant, or the repayment to capital out of the revenue earned during a given period of such proportion of the original outlay as has been absorbed or consumed in earning such revenue." The authors declared that the function of the engineer was to provide the information necessary regarding the plant, such as first cost, residual value, and life. Depreciation as such was not, as the authors said, a financial operation; it was clearly a physical process having no necessary relation to finance. It was, of course, expressed in terms of finance, but an engineer put into a power house for the purpose of determining the depreciation of the plant might well proceed in terms of percentages without any relation to finance whatever. Again, depreciation had no relation whatever to improvements. The fall in value arising from obsolescence, supersession, antiquation, or the introduction of improved machinery could not be dealt with along mathematical lines. These things were distinct from depreciation of fixed capital, and therefore the speaker was directly at issue with the authors' definition. The primary object of depreciation was the preservation of the original capital, and the measure of the annual charge was the amount of capital annually consumed by the production of the year. Contrary to what was repeatedly stated in the paper, depreciation had no relation to the return on capital outlay. Supposing a period of trade depression or losses occurred over several years; surely the depreciation would not be suspended meanwhile? It was a fact that some undertakings made an annual loss and were subsidised by rates. The process went on, profit or no profit, and if the authors had kept that fact in mind it would have saved them the necessity of making calculations in the paper which needlessly took account of the return on capital, because the return on capital had nothing whatever to do with the question of depreciation. The authors stated, "The depreciation fund is not required until the end of the life," and the question was raised as to the placing of the annual amounts meanwhile. If the money was not required in the undertaking, it would earn interest elsewhere. An accumulating depreciation fund with a fixed minimum rate of interest for the accumulating period came very near the solution of the problem submitted. Meanwhile, the fund represented capital, either in a fixed or liquid state, awaiting its true function of restoration. It was difficult to believe that anyone would defend the straight-line method, for the simple reason that the method extracted from revenue the total amount of capital in the name of depreciation regardless of interest, which properly belonged to the depreciation fund. An accumulating method also provided a flat rate of charge over the whole period of the estimated life, but the fund required and obtained interest earned; the speaker was, therefore, in agreement with the authors on the question of the character of the fund to be employed for depreciation. The purpose of the sinking fund, speaking of municipal accounts, was fundamentally different from that of the depreciation fund. The sinking fund had to provide capital. Granted a municipality obtained a loan of £100,000, and spent £100,000 on plant and machinery, it would acquire nothing, but the sinking fund was called in to acquire capital. Hence, the local authority with a true depreciation fund, plus a sinking fund, carried a double burden, first for the restoration of capital, and second for the acquisition of capital. The use of both would handicap enormously the initiation of any municipal scheme when compared with private concerns. Items of charges against revenue did not include any charge for what the authors defined as improvements. Regarding maintenance and rerenewals, the frontiers between these were not well defined, and no provision was made in the scheme to meet the cost of this work. In the paper it was assumed that the cost of maintenance was constant each year. With depreciation fixed upon first cost, and maintenance constant, and taken for granted that it would not increase with age, in what part of the scheme was provision made for the items which combined repairs and renewals? In dealing with the subject of average life and equated life, the authors seemed to have been somewhat confused. Quoting from the paper, "There is a great danger if the difference between average and equated lives is not appreciated"; and again, "For a complex plant, use of the average life will result in inadequate provision, because the equated life is always shorter than the average life." How could this be if, as stated in the paper, "the depreciation fund is not required until the end of the life," and, again, "It is clear that an equated life arranged for all the plant provides money for the renewal of every part"? The speaker asked for a further explanation of the difference between equated and average life, as he had always understood them to be interchangeable. The following resolution, passed at a special general meeting of the Incorporated Municipal Electrical Association in 1902, was of much interest:—"That in the opinion of this Association, electricity supply undertakings having to be maintained in a thorough state of efficiency out of revenue, no depreciation or further writing-off of capital is necessary, when the period allowed for repayment of loans is not greater than 30 years, as the equated life of the plant exceeds that period."

Ald. Walker said that there did not appear to be any necessity for two depreciation funds, as proposed by the authors. If it were decided that plant was not to be run for the whole of its physical life, but for a shorter period termed the economic life, the amount set apart for the sinking fund should be something which at the end of such life fulfilled the object for which it was created. The economic life was the period after which it was justifiable to scrap the plant; therefore, in his opinion, it was incorrect to estimate for more than scrap value. In the case of distributing systems, the value of recovered copper ought to be assumed as the same for both periods. Sound as the system appeared, much still depended upon estimates. Plant should not be thrown out simply because its steam consumption was high; obviously the most economical plant in a station was run with the highest load factor, and the uneconomical plant was only brought into use during the period of peak load. Consequently, any gain shown by replacing such plant might be very small, and it was necessary in such cases to consider the actual contribution of the plant to the total output of the station. In connection with the Manchester undertaking, it was interesting to know that the capital expenditure was over £3,000,000, and there was already raised by the sinking-fund method £1,270,000, leaving a loan debt of £1,730,000. The earlier Local Government Board loans were for the whole sum over a fixed period, and for portions of the plant the periods were undoubtedly too long. Mr. Pearce had made a valuation of what he considered to be the true economic lives; buildings were taken at 40 years, plant and machinery at 20 years, mains and services 20 years, motors 10 years, which periods were very much shorter than those fixed on former occasions. It was decided to establish a renewals suspense account and to transfer from revenue account each year the amount which, put into the renewals suspense account, would be sufficient to meet the deficiency in the sinking fund as shown by the calculated shorter life of the plant. The total amount paid into that account had been about £344,000, but certain renewals had been made, and it now stood at £191,000. This was in addition to the reserve fund. The speaker was of the opinion that the later policy of the Local Government Board in fixing very much shorter periods, and dividing up the loans in accordance with the plant on which they were going to be spent, was bringing the sinking fund itself closely approximate to the economic life. The loan for boilers only allowed 17 years, consequently it was unnecessary to make any further provision, as the economic life of the boilers would certainly not be shorter than the repayment period. In proof of this, there were boilers in commission to-day where every penny had been paid off, and which had yet many years of useful life. The speaker favoured sound depreciation, high maintenance charges, and the amount shown as profit as low as possible. The Finance Committee of the Manchester Corporation in October, 1912, in adopting a policy of rate-aid, actually decided that the amount should be calculated on the capital expenditure. A more false principle could not possibly be put forward, because, as already shown, £1,200,000 of the capital borrowed had been repaid, and to a large extent the assets which had represented it had gone out of commission and ceased to earn any revenue. Supposing 1 per cent. was allowed on £3,000,000 capital expenditure, when in fact there was plant valued only at one million; it meant actually charging 3 per cent. against revenue-earning plant belonging to the undertaking. This was one of the things which would have to be fought keenly by accountants and engineers, and by representatives on public bodies. Any amount fixed for rate aid should be upon the outstanding loan debt, and not upon the capital expenditure, otherwise it would become a growing charge which would jeopardise the existence of the station in competition with other suppliers. It had been argued that a municipality ought to pay into its sinking fund the statutory amount, and that, in addition, it ought to create a renewals account which would enable it to have sufficient capital at the expiration of the economic life to replace the plant without further borrowings. This meant that the present generation of users would hand over as an absolutely free gift to the next generation of users a power station free of all cost. This would be grossly unfair if carried out, but such an attempt would defeat itself, because it would mean such high charges for current that consumers would not buy.

The authors will reply in the *Journal* of the I.E.E.

THE RÖNTGEN SOCIETY.

The Optophone.

At the meeting on February 6th, Mr. E. E. **Fournier d'Albe**, D.Sc., lectured on the properties and applications of selenium. He said that the peculiarity of the light action on selenium could not be due to heat, as had been suggested, and he believed that some kind of ionisation theory would be propounded as a final solution of the whole question. Selenium was actually capable of discovering light too faint to be visible to the eye. He calculated that with the aid of selenium one ought to be able to discover stars three magnitudes lower than those visible in the ordinary way. The usual limit for naked-eye vision was about the sixth magnitude, so that with selenium one ought to be able to obtain the ninth magnitude, and selenium would keep this start over the eye whatever optical contrivances might be used. He had been able to make a star record itself chronographically, and even ring a bell in its passage, which was quite a simple thing to do, considering the very delicate relays now at one's disposal.

Dr. d'Albe then passed on to deal with some applications of selenium. One of its first applications, he said, was to the measurement of light, but the "recovery curve" was a distinct difficulty in selenium photometry. Another proposed application was for automatic shutters in cameras, but while this was possible theoretically, it was doubtful whether the advantages gained outweighed the trouble of introducing relays. Another application was to multiplex telegraphy by means of a sound disk flashing intermittent light upon the selenium, the flashes being at different rates, and picked out at the other end by means of tuning forks; by this means it was possible to analyse 12 different sets of Morse signals sent along the same wire at the same time. Then there was the interesting application of selenium to phototelegraphy, or the transmission of pictures along the wire. Selenium had been displaced in this work, however, by another method, that of swelled gelatine. The fascinating problem of television was one which, he thought, would certainly be solved in the not distant future by means of selenium, and another practical thing was the automatic lighting and extinction of lighthouses and lightbuoys. The lecturer showed a small model lighthouse which he had constructed; the little lamp was automatically extinguished when a large lamp representing the sunrise appeared in its vicinity.

The device in which he was personally most interested was called the optophone, for enabling blind persons to read ordinary type. His experiments on this instrument were made before the war, but the impossibility of getting the Nernst filaments, which had the advantage of giving an intense line of light, caused the experiments to be left in abeyance until recently, when he found that the new half-watt lamp would act equally well. A disk, revolved by a motor and perforated like a siren disk, was illuminated by a lamp behind it, and the image of the line of dots was converged upon an aperture in a slab above which a line of letterpress was slowly moved. The light thus reflected from the type fell upon selenium bridges which were connected by a telephone relay, and sounds corresponding to each letter in turn were sent through the telephone. Whatever the difference in shape between any two letters, it expressed itself in tone. Thus the letters gave a sound code which the pupil had to learn. The maximum sound was heard when white paper was exposed through the aperture, and the minimum when black paper was exposed, and all that the blind person had to do—a task obviously requiring a great amount of practice—was to familiarise himself with the range of differentiation between these extremes. Dr. d'Albe's demonstration was carried out with large single letters, but he said that by using a focusing device, printed type of ordinary size could be read, and a system of alignment would make it possible for people ultimately to read by ear a column in a newspaper or a page of a book.

Sir James Mackenzie Davidson and Mr. T. Thorne Baker took part in the discussion.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

RUSSIA.—A Decree of the Russian Minister of Finance, dated November 26th/December 9th, prohibits the exportation of various articles, including electrical apparatus of all kinds, accessories and parts; ferro-silicon; salts and acids of chrome, manganese, molybdenum, titanium, tungsten, vanadium, copper, tin, mercury, nickel, lead, and zinc.

SWEDEN.—The exportation of quartz and felspar has been prohibited as from December 20th.

SWITZERLAND.—The Federal Council have decreed the prohibition of exportation of crude, flake, or powdered asbestos as from December 4th.

NICARAGUA.—The Collector-General of Customs has issued a Circular directing that, as from February 1st, bills of lading containing erasures, interlineations, or alterations shall not be accepted at any Custom House in the Republic unless such erasures, &c., have been duly certified by the agent or representative of the steamship company at the port of shipment.

VENEZUELA.—According to recent Presidential Decrees, the undermentioned goods, when imported into Venezuela, are to be declared in the Consular invoice, and to pay duty, as follows:—

Article.	Declaration for Consular invoice.	Class of the tariff under which suitable.	Total import duty (including surtaxes).
Electrical accumulators.	Acumuladores eléctricos.	III.	0·391 bolivares per kilog. gross.
Electric stoves weighing each up to 60 kilogs. net.	Cocinas eléctricas que pesen hasta sesenta kilogramos netos. cada una.	III. plus 80 p.c. specific.	0·704 ditto.
Electric stoves weighing each more than 60 kilogs. net.	Cocinas eléctricas cuyo peso neto exceda de sesenta kilogramos.	III.	0·391 ditto.

It is important to preserve the exact (Spanish) wording shown above in the "Declaration for Consular Invoice." (Bolivar = 9.6d.; kilog. = 2.2046 lb.)

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Published expressly for this journal by Messrs. W. P. Thompson & Co, Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

1,412. "Electrical governors or speed regulators for electrical motors, &c." S J. Anderson. January 29th.

1,437. "Electrical pushes." E. A. Graham. January 29th.

1,449. "Electrical switch slabs or panels, &c." W. J. Jenkins. January 29th.

1,460. "Wireless telephony." Soc. Francaise Radio-Electrique. January 29th. (France, February 15th, 1916.)

1,465. "Electric warning attachment for ships' telegraphs." J. L. Murphy. January 30th.

1,478. "Detachable instrument for varying timing of ignition of motor-car automatically." C. L. Whatley. January 30th.

1,482. "Dry cells." F. C. Tammadge & F. R. Tammadge. January 30th.

1,490. "Toy electric motor." A. C. Gilbert Co. January 30th. (U.S.A. April 18th, 1916.)

1,491. "Toy motor installation." A. C. Gilbert Co. January 30th. (U.S.A., April 18th, 1916.)

1,501. "Storing and correcting defective telegraphic signals preparatory to transmission." J. H. Dunbar & The Eastern Telegraph Co. January 30th.

1,511. "Systems of ship propulsion." British Thomson-Houston Co. (General Electric Co., U.S.A.). January 30th.

1,514. "Telegraphy." J. S. Withers (J. C. Cox). January 30th.

1,515. "Frequency changers and generators of alternating electric current." N. Oboukhoff. January 30th.

1,517. "Automatic telephone system." H. Symes. January 30th. (New Zealand, October 10th, 1916.)

1,525. "Order telegraphs." G. T. Marsland. January 30th.

1,544 "Dynamo-electric machines." Soc. Anon. pour l'Eclairage Electrique des Vehicules. January 31st. (France, February 4th, 1916.)

1,546. "Electric thermo-radio massage machine." G. Fuller & J. W. Watkins. January 31st.

1,555. "Electrolytic production of metal wire and strip." S. O. Cowper-Coles. January 31st.

1,575. "Contact-breakers for ignition mechanism of internal-combustion engines." F. H. Farrer, G. Funck & Villiers Engineering Co. January 31st.

1,576. "Fly-wheel magneto devices for internal-combustion engines." F. H. Farrer, G. Funck & Villiers Engineering Co. January 31st.

1,577. "Magneto devices for internal-combustion engines." F. H. Farrer, G. Funck & Villiers Engineering Co. January 31st.

1,578. "Method of electrical edge-welding." T. E. Murray. January 31st. (U.S.A., March 2nd, 1916.)

1,581. "Vacuum-type electric converters." British Westinghouse Electric and Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.). January 31st.

1,587. "Polyphase transformers." F. E. Berry & British Electric Transformer Co. January 31st.

1,588. "Electric furnaces, and transformers for use therewith." F. E. Berry & British Electric Transformer Co. January 31st.

1,609. "Liquid resistances for use in rotors of induction motors for ship propulsion, &c." Brush Electrical Engineering Co. & C. C. Sutton. February 1st.

1,612. "Sparking plugs." A. E. Tonks, E. Tonks & Sons, C. W. Tonks, E. Tonks & G. A. Tonks. February 1st.

1,629. "Ignition magnetos for internal-combustion engines." M-L Magneto Syndicate & E. A. Watson. February 1st.

1,636. "Electrolytic production of metallic tubes with closed end." S. O. Cowper-Coles. February 1st.

1,641. "Electro-magnetic switches." British Thomson-Houston Co (General Electric Co., U.S.A.). February 1st.

1,653. "Electric transmission of signals." E. A. Laidlaw. February 1st.

1,661. "Electric furnaces." C. E. Hearson. February 1st.

1,670. "Automatic ignition for internal-combustion engines, &c." F. A. Saxelby. February 2nd.

1,674. "Electric furnaces for melting or refining non-ferrous alloys." V. C. Faulkner. February 2nd.

1,678. "Portable electric hand-lamps, &c." N. McLean. February 2nd.

1,687. "Lighting outfit for road vehicles." G. Boothwell. February 2nd.

1,692. "Magnetic compasses." C. F. Ryland. February 2nd.

1,712. "Apparatus for producing sound waves for signalling." W. V. Foulis. February 2nd

1,713. "Electrical measuring instruments." J. H. Care. February 2nd.

1,729. "Wiring ships, buildings, &c., for distribution of electricity." L. M Waterhouse. February 3rd.

1,732. "Process for manufacture of zinc tubes." S. O. Cowper-Coles. February 3rd.

1,739. "Flexible-cable funicular traction system." Compagnie Generale Electrique. February 3rd. (France, February 7th, 1916.)

1,748. "Electric bells." J. Davis & Son and W. H. Davis. February 3rd.

1,754. "Electric motor control and apparatus therefor." British Thomson-Houston Co. & H. C. Hastings. February 3rd.

1,762. "Stimulating growth of hair by weak currents of electricity." A. C. Stewart. February 3rd.

1,764. "Dynamo-electric machines." P. A. H. Mossay. February 3rd.

PUBLISHED SPECIFICATIONS.

1915.

5,319. Process of and Apparatus for Testing Electricity Meters. O. T. Blathy. April 8th. (April 9th, 1914.)

10,722. Electrical Heating Apparatus. C. G. Nobbs & W. W. Nobbs. July 23rd. (January 21st, 1916.)

17,581. Automatic Telephone Call Distributing Systems. Western Electric Co. December 16th. (December 19th, 1914.)

1916.

The numbers in brackets are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

471. Electrical Condensers. Marconi's Wireless Telegraph Co. & C. S. Franklin. January 11th, 1916. [102,997.]

477. Ignition Devices for Internal-combustion Engines. M. A. Codd. January 11th. [102,998.]

487. Magnet Systems for Magneto-electric Machines for Ignition Purposes in Internal-combustion Engines. W. Schmidt. January 11th, 1916. [100,018.] Convention date not granted.

519. Secondary Batteries. G. Pearson. January 12th, 1916. [102,999.]

541. Ignition Dynamos. C. T. Mason. January 25th, 1915. [100,031.]

579 Starting of Synchronous Dynamo-electric Machinery, and means therefor. J. Mould. January 13th, 1916. [101,809.]

581. Electrical Apparatus for producing Hot and Cold Currents of Air for Drying Hair and for other purposes. E. B. Wright. January 13th, 1916. [103,153.]

599. Radio Receiving Circuits. C. F. Elwell & C. J. Close., January 13th, 1916. [103,004.]

676. Automatic Steering and Self-propelled Torpedoes and other Projectiles. V. Pascore, C. J. Beaver & E. A. Claremont. January 15th, 1916. [103,007.]

721. Electro-magnetic Shuttle-throwing Gear for Weaving Looms Bachelet Shuttle & Loom Co, and W. Routledge. January 17th, 1916. [103,157.]

802. Electric Switches. British Thomson-Houston Co. (General Electric Co., U.S.A.). January 18th, 1916. [103,167.]

876. Telephone Systems. Relay Automatic Telephone Co. & L. C. Bygrave January 19th, 1916. [103,173.]

999. Sparking Plugs and the Manufacture of the same. T. Crosbee and Sons & W. J. Spicer. January 21st, 1916. [103,179.] (Addition to 4,808/15.)

1,417. Cores for Pupin Loading Coils, Electromagnets, and the like Western Electric Co. (Western Electric Co., U.S.A.). January 29th, 1916 [103,188.]

1,976. Electric Diaphragm Horns for Automobiles and the like. A. W Hulbert. July 25th, 1916. [103,018.]

2,065. Radio-telegraphy. J. Bethenod & E. Girardeau. February 11th, 1915. [100,075.] (Addition to 1,597/16.)

2,076. Magnetic Compasses. F. Barker & Son and E. W. Barker. February 11th, 1916. [103,019.]

2,256. Electric Batteries. R. S. Baxter. February 15th, 1916. [103,020.]

2,916. Railway Signalling. W. R. Sykes Interlocking Signal Co. & R. W. Tarrant. February 26th, 1916. [103,026.]

3,161. Battery Cells. W. L. Walker. March 17th, 1915. [100,170.]

3,286. Electric Cable Drums, Reels, or the like. H. G. Wood & E. Edwards. March 4th, 1916. [103,206.]

4,192. Sparking Plugs for Internal-combustion Engines. R. A. Griffiths and W. P. Gilbart. March 21st, 1916. [103,044.]

4,558. Electric Discharge Apparatus. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 28th, 1916. [103,046.]

4,697. Electric Oscillators. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 30th, 1916. [103,047.]

5,257. Sparking Plugs for Internal-combustion Engines. A. B. Back. April 11th, 1916. [103,051.]

5,422. Portable Military Telephones. J. W. Dungey & C. B. Kersting. April 13th, 1916. [103,227.]

5,934. Electric Locomotives. British Thomson-Houston Co. (General Electric Co., U.S.A.) April 25th, 1916. [103,235.]

5,972. Points for Tramways, Railways, and the like purposes. R. B. Holt. April 26th, 1916. [103,236.]

6,355. Telegraphic Transmitters and Relays. Orling's Telegraph Instruments Syndicate & A. Orling. May 3rd, 1916. [103,238.]

6,618. Location Indicators for Electric Press-buttons. E. D. A. Bagot May 9th, 1916. [103,059.]

THE
ELECTRICAL REVIEW.

VOL. LXXX. FEBRUARY 23, 1917. No. 2,048.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: February 23, 1917. [No. 2,048.

	Page
Science and Industry	197
The Control of the Electric Motor-Vehicle Business	198
Substitution in Electricity Works	198
Our Canals	198
The Good Time Coming	199
Canadian Water-Powers (*illus.*)	199
New Electrical Devices, Fittings and Plant (*illus.*)	202

Correspondence—

American and English Research	204
Localising a Fault	204
Fuse Failures (*illus.*)	205
Telephones and War Surcharges	205
Curious Trouble with Lead-Sheathed Cables (*illus.*)	205
British *v.* German Turbines	206
Boiler-House Operation and Maintenance (*concluded*)	206
War Items	207
Legal	208
Business Notes	208
Substitution in Electricity Works	212
Notes	212
City Notes	216
Stocks and Shares	218
Frequency Changers, by R. Townend (*illus.*)	219
Improved Methods of Power Measurement (*illus.*) (*concluded*)	222
The Great Need of Promoting Research in America	223
New Patents Applied for, 1917	224
Abstracts of Published Specifications	224
Contractors' Column	Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY

OFFICE :—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

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AUCKLAND N.Z: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.

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MILAN: Fratelli Treves.

NEW YORK: D. Van Nostrand, 25, Park Place.

PARIS: Boyveau & Chevillet, 22, Rue de la Banque.

PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Loescher & Co., Corso Umberto 1° 307.

SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.

TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE "ELECTRICAL REVIEW'S"
ELECTRICAL & ALLIED TRADES DIRECTORY
(THE RED BOOK),

1917 EDITION,

IN PREPARATION.

H. ALABASTER, GATEHOUSE & KEMPE,
4, Ludgate Hill, London, E.C.

SCIENCE AND INDUSTRY.

Sir Isaac Newton, shortly before his death, said:—"I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me"—yet Leibnitz estimated that Newton had achieved far more than all other mathematicians put together from the beginning of history. Lord Kelvin, at his jubilee, in reply to the homage of the whole scientific world, said:—"One word characterises the most strenuous of the efforts for the advancement of science that I have made perseveringly during 55 years; that word is *failure*." Yet he towered above all his scientific contemporaries, and was, perhaps, the greatest savant that the world has known. It is, in fact, a trait common to all who have spent their lives in the pursuit of knowledge, and have acquired a profound acquaintance with the hidden mysteries of Nature and Science, that they, more than all others, realise the immensity of the field that lies open before them—shrouded in mists, it is true, and beset with pitfalls, *culs de sac*, false clues, but also holding treasure in store of inconceivable richness for the reward of those who patiently grope amid its gloomy fastnesses. We have as yet but ventured over the border of that illimitable expanse; the further we penetrate into its depths the better we appreciate the wealth that lies beyond, and the greater becomes our strength to overcome the difficulties that confront us. We see, too, how far we have strayed from the true path in the complacent past, when we thought we had approached finality in one or other quest.

These thoughts are prompted by the striking appeal addressed to our American colleagues by Dr. Whitney, in the *Electrical World*, the gist of which we reprint elsewhere in this issue. We have often drawn attention to the splendid work that has been accomplished by the research laboratory of which he is the head, and quite recently Mr. A. P. M. Fleming has reminded the Institution of Electrical Engineers, at Manchester and Newcastle, of the vast resources and assiduous attention which are devoted to industrial research by manufacturing firms in the United States, as well as in Japan and Germany. In cannot be suggested that America has neglected the possibilities of industrial research. Of what, then, does Dr. Whitney accuse a nation which, above all, is noted for utilitarianism and practical common-sense? It is of ignoring the claims of research in pure science, research directed solely to the advancement of human knowledge, without an eye to the commercial results that may accrue. He declares, in effect, that the United States, from the scientific point of view, is a parasitic nation, depending almost wholly upon the labours of the scientists of Europe, who have provided it with the means to cure disease, to communicate by ethereal waves, to radiograph the internal organs of the body, to rid the Isthmus of Panama of the pestilence that made it a death-trap for the engineers of de Lesseps, to transmit power from its waterfalls over hundreds of miles. And, indeed, it is true that, with rare and brilliant exceptions, such as Franklin, Henry, and Langley, the history of the United States can boast of no great pioneers in pure science as opposed to industries—inventors it has had in plenty, but few discoverers.

Now, there is in this a lesson for ourselves. Engineering in particular, and electrical engineering above all, is built upon science as the foundation. Primary and secondary cells, the dynamo, the arc light, wireless telegraphy and the X-rays, electro-deposition, the electric furnace, the manufacture of aluminium, alkali, and other products of electrometallurgy and electrochemistry, the fixation of nitrogen, the telegraph, and countless other triumphs of electrical engineering, all derived their origin from the laboratories of men who wooed Science for herself alone, without thought of personal profit—many of the foremost of them, we are proud to recall, of British race. We do not overlook the fact that on the basis of these discoveries, industrial research has given rise to innumerable inventions of the utmost importance to mankind, such as the glow lamp, the telephone, the steam turbine, the polyphase system, the submarine cable, and other commercial developments, in which also our fellow-countrymen have played a leading part. But we live in a time of difficulty and danger, when attention is pre-eminently directed to the commercial possibilities of invention and research, and there is no little risk that in the struggle for commercial supremacy we may lose sight of the higher aims—the general welfare of humanity, and the claims of pure scientific research upon our labours and our purse. Let us, then, lay to heart the spirit of Dr. Whitney's appeal. Although almost ignored by the public and the State, our scientists in the past have won their place in the foremost rank of progress; now that the nation has awakened to the necessity of scientific work, let us take care that while industrial research is not neglected, pure science shall receive that whole-hearted support which hitherto has been denied to it. For upon the due observance of this precept rests not only our scientific culture, but also our industrial existence.

The Control of the Electric Motor-Vehicle Business.

The somewhat interesting question has arisen as to whether motor car agents shall have a monopoly of the sale not only of petrol motor vehicles, but also of those propelled by electricity. Thus, in the last issue of the *Motor Trader*, in a report of a meeting of the Scottish Advisory Council of the Motor Trade Association, we read that " a clause in a draft of a Bill to be promoted by a Municipal Association under which powers are sought to store, charge, inspect, and repair electric vehicles was considered. It was agreed to write to head office requesting that the clause, if sought to be passed into law, be opposed, and stating that this Council disapproves of the matter being left in the hands of the Electric Vehicle Committee of the Society of Motor Manufacturers and Traders, agents' interests not necessarily being those of that Committee."

The subject is considered by our contemporary of such importance that it devotes a long leader to the matter, from which we are glad to learn that, as the leading organ of the motor traders, it has not hesitated, when finding itself unable to see eye to eye with a certain section of its readers, to speak out, and strongly urge that the best interests of all will be served by motor agents adopting an attitude of sympathy and tolerance towards the problem.

The writer states that a good deal of interest has been created in certain trade circles respecting the promotion of a Bill authorising local authorities to cater for the electric vehicle trade, and that the Bill indicates a very significant development on municipal trading lines. It is pointed out that if the authorities take full advantage of its provisions, their interest in the electric vehicle will exceed the mere operation of charging, and will comprise the repair and maintenance of vehicles and the sale of everything in the electrical line requisite for these vehicles. Our contemporary holds that there is no ground for the assumption that the Bill embodies a deep laid scheme on the part of the public service bodies to appropriate what may become an important branch of the motor trade.

What mainly concerns the opponents of the Bill is the plain issue as to whether the interests of the retail motor trade are threatened. They urge that if the electric vehicle is to command public approval anything like commensurate with the petrol vehicle the motor agent should be taking prompt and adequate measures to secure the business.

Those who believe with us that the electric vehicle is destined to make great progress in this country and that its development has been delayed largely by the lack of charging facilities, maintain that while the motor trade is indifferent to the great promise of this branch of the industry, the offer of the local authorities to supply the stimulating factor in the shape of charging stations and repair and supply facilities is entitled to approval and support.

If we remember rightly, there has already been a little friction between the M.T.A. and the Agents' Section, Ltd., on the one hand, and electrical engineering traders on the other, with regard to the sale of the many electrical accessories associated with petrol cars. It is, therefore, greatly to be hoped that the M.T.A. will not adopt the attitude advocated by its Scottish Advisory Council with respect to electrical motor vehicles, but, rather, the saner course suggested by the *Motor Trader*, a course that will go far in removing any wrong impressions that may exist, and in building up a more favourable view of the M.T.A.'s objects and intentions in electrical circles.

Substitution in Electricity Works.

We print on another page an important memorandum, issued by the Reserved Occupations Committee for the guidance of electrical undertakings in effecting substitution of, and releasing, men for the Army. The demand for young fit men in the Army is apparently so great that most other considerations have now to be set aside, and from the end of this month substitution must be more extensively applied than previously even in electricity works, upon which the manufacture of munitions so vitally depends. We do not know when the memorandum was circulated among members of the I.M.E.A., or whether it has been sent to non-member undertakings, but the Committee issued it as long ago as February 5th. The matter is one of great importance to all electricity undertakings and their employés, whether represented by the Association or not, and there is only a week before the " exceptionally favourable reservation " practice is withdrawn. Therefore we give the document full publicity at once, though it has only come to our hands while going to press.

Our Canals.

It is now many years since we began in these pages our advocacy of the better use of the canals of the United Kingdom in the interests of trade, industry, and agriculture. In season and out of season we joined with others in the demand for modernisation and fuller utilisation of this means of transportation; we described the various systems of electrical operation that had been proposed or adopted in this and other countries. It was commonly believed that the canal system was being strangled or ignored by the railway companies for selfish ends. To-day we see how deplorable it is that suitable measures for improvement were not adopted in time. A past Government referred the whole subject to a representative Canals and Waterways Commission, and exhaustive evidence was collected from many quarters, here and abroad, but it is only in war-time, when the Government has the railways under its control, that anything in the shape of definite action is taken. It were waste of words now to spend much space showing how greatly we should have had our tasks simplified during the last year or two, when the pressure upon the railways was phenomenal, if we had also been able to depend upon a continuous traffic of barges on an up-to-date network of waterways. Whatever regrets may be in our mind, we must count it all for future good, as well as helping us in the remaining stages of the war, that Government action has at last been taken which will prevent the matter from ever falling back into its former position. With its control of the railways, the Government naturally assumed control of the railway-owned canals, and it is now announced that the Board of Trade is also taking possession, for the period of the war, of any other canals, non-railway owned, that may be required for essential traffic. It is intended to set up an executive committee to control the canals and all the buildings, barges, machinery, &c., that go with them. Whether railway-owned or otherwise, they will come under this Committee, and every effort will be made to secure for the nation their best use for the conveyance of food, munitions, materials, &c. Truly, this horrifying war is lifting us as a people out of many of our old ruts.

The Good Time Coming.

The Minister of Labour has been giving further expression to his views on after-the-war industry. He continues to speak with the greatest optimism, foretelling a period of booming trade. As we suggested in our reference to one of his earlier speeches, his opinions are those of an authority on the iron and steel trades, and we entirely agree with him in regard to the outlook therefor. Everybody connected with those trades and with the engineering industries, knows well enough what large arrears of work, even of the normal kind, are accumulating. Railway companies, tramway companies, electrical undertakings, &c., are unable to spend what is almost imperatively necessary even on maintenance, and extension work is more often than not only a dream, though verging in cases, we fear, upon nightmare. In all the work of rehabilitation and satisfying the needs of the world, the share of the iron, and steel, and engineering trades cannot fail to be enormous, and it must inevitably spread itself out over many years. But perhaps the most urgent need of all will be the new shipbuilding, upon which armies of workers will need to work at high speed to make up for recent and anticipated losses. Activity in the shipbuilding industries means high-pressure prosperity in iron and steel and engineering industries, and these form so large a part of our national industrial operations that it is reasonable for Mr. Hodge to suggest that every other trade may boom in sympathy. Thoughts such as these respecting the future are, however, overshadowed by the knowledge that we are at the greatest crisis of the war, and may have strange ways yet to tread before the palms of victory are won for Civilisation. We have yet to put all our strength into the contest, and have sacrifices and losses to bear, but beyond it all we trust that there lies unbroken Peace, which will be treasured and understood as Peace never was before in our day. With the period of Peace between the nations, let us have harmony in the industries at home, and, while still at war, prepare in those industries themselves, as the Minister of Labour once again suggests to us, those schemes for greater efficiency of organisation, operation, and production which may go far to secure that harmony.

CANADIAN WATER-POWERS.

The Water-Power Branch of the Canadian Department of the Interior has recently issued a very complete and excellently illustrated description of the developed and undeveloped water-powers of Canada, and we have received a copy from the Canadian Government Trade Offices in Basinghall Street, E.C.

The volume is a reprint of five monographs prepared for distribution in connection with the exhibit of the Dominion Water-Power Branch in the Canadian Pavilion at the Panama-Pacific International Exposition, San Francisco, 1915 : it deals in sections with the water-powers of British Columbia, the Prairie Provinces, Ontario, Quebec and the Maritime Provinces. An introduction by the Superintendent of the Dominion Water-Power Branch points out the important part played by water power in the industrial development of the Dominion, which, with the continual advance in electrical science, is expected to become even greater in the future. Practically every commercial centre from coast to coast, except only a few in the middle Prairie Provinces, has abundance of water power available for present and future needs.

Within the provinces of the Dominion of Canada, and excluding the North-West Territories, practically all the Yukon, and the Northern and Eastern portions of Quebec, it is estimated that 17,746,000 H.P. are available, inclusive of Canadian developments permitted by international treaties. The developed powers—for electrical, pulp, milling and other purposes, aggregate 1,712,193 H.P., distributed as follows :—Nova Scotia, 21,412 H.P. ; New Brunswick, 13,390 H.P. ; Prince Edward Island, 500 H.P. ; Quebec, 520,000 H.P. ; Ontario, 789,466 H.P. ; Manitoba, 56,730 H.P. ; Saskatchewan, 45 H.P. ; Alberta, 33,305 H.P., British Columbia, 265,345 H.P. ; and Yukon, 12,000 H.P. If the present rate of increase in development is continued in the future, the 8,000,000 H.P. estimated to be available within range of present markets will be entirely in use within 15 years.

The Dominion Government controls navigable streams and their water powers throughout the Dominion and the water powers in general of the provinces of Manitoba, Saskatchewan, and Alberta. The administration of all water powers in British Columbia, Ontario, Quebec, New Brunswick, and Nova Scotia is under respective provincial control.

As is well known, British Columbia has been prodigally endowed with natural water-power sites on its numerous rivers and lakes, and it is estimated that within reasonable distance of the cities of Vancouver and Victoria there are possible water-power developments aggregating 750,000 H.P. situated within an area of 20,000 sq. miles ; in addition, it is estimated, roughly, that other available powers in the province would bring the total up to 3,000,000 H.P.

Amongst the principal powers developed may be mentioned those of the West Kootenay Power and Light Co., 23,000 H.P. ; the Lake Buntzen plant of the B.C. Electric Railway Co., of 84,500 H.P. ; and the Jordan River plant in Vancouver Island, of the same company, 25,000 H.P. ; the Western Canada Power Co.'s plant at Stave Lake, 26,000 H.P. ; Ocean Falls Co., 11,200 H.P. ; Power River Co., 24,000 H.P., &c.

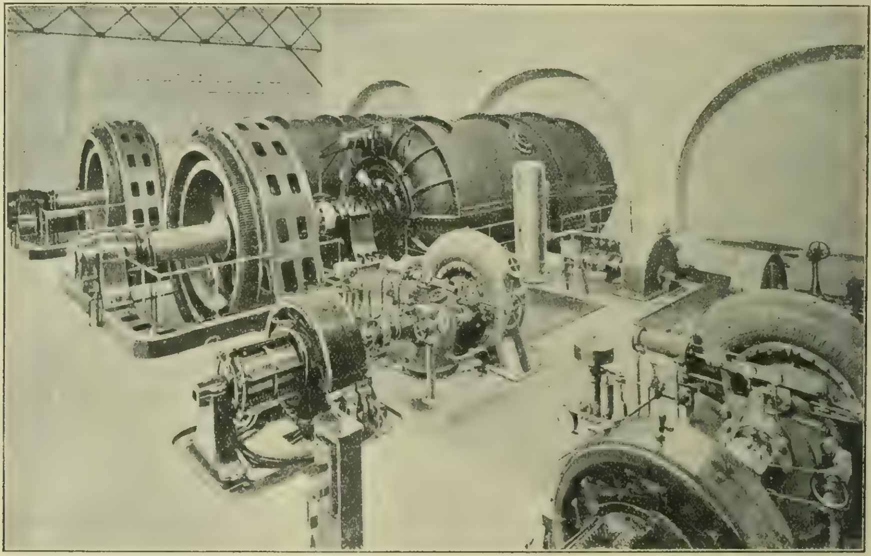
The undeveloped powers include many large blocks of 25,000—80,000 H.P., and it is pointed out that great opportunities exist for the electrochemical and electrometallurgical industries, there being many water-powers similarly situated to those in Scandinavian countries, and wonderful possibilities of transport by water freight to suitable markets.

The establishment of electrometallurgical refineries for copper in the neighbourhood of Vancouver or Prince Rupert, where the plants could be erected on excellent water-front sites, would add to the incentive already existing to develop the copper, zinc, lead, and other mineral resources of the province.

In the Prairie Provinces, Lakes Manitoba, Winnipeg, and Winnipegosis are the largest bodies of water. Lake Winnipeg has an area in excess of Lake Ontario, and into it flow the Winnipeg, Red, and Saskatchewan and other rivers, while its outlet to Hudson Bay is the Nelson River. The northern part of Manitoba is drained by the Churchill River, and the northern parts of Saskatchewan and Alberta by the Athabaska and Peace Rivers. The Winnipeg River is one of the most important power rivers on the continent, and offers many available power sites in proximity to the City of Winnipeg ; a systematic survey of these sites has been carried out by the Government, and six undeveloped sites are noted within 52—74 miles of Winnipeg, these representing 162,700 H.P. under present conditions and over 300,000 H.P. after the storage facilities are provided. The Winnipeg municipal power plant at Point du Bois, 77 miles from the city, will have an ultimate capacity of 76,000 H.P. ; its present installation amounts to 51,500 H.P., and may be increased to 119,000 H.P., the energy being stepped up to 66.000 volts for transmission.

The Winnipeg Electric Railway's power plant at Pinewa Channel is 65 miles from the city, and has some 28,200 H.P. installed and a 60,000-volt transmission.

Another concern, the Winnipeg River Power Co., has made arrangements for the immediate construction of a plant consisting of eight 21,000-H.P. generating units on the du Bonnet site, a 110,000-volt transmission to Winnipeg being proposed.



The Stave Falls Plant of the Western Canada Power Co., British Columbia.

The development of the Bow River above Calgary on suitable lines would give about 50,000 H.P. on six sites : the Calgary Power Co.'s plant at Horseshoe Falls on this river consists of two 3.750-H.P. turbine units and two 6,000-H.P. units, energy being transmitted at 55,000 volts to Calgary. The same company's Kananaskis Falls plant contains two 5,800-H.P. turbine units.

Some 60 miles above Edmonton a power site on the North Saskatchewan would produce 30,000 H.P. ; at Cole Falls, 25 miles below Prince Albert, a power plant is being constructed for that city. Below the forks of the Saskatchewan at least five power sites are available, one at Grand Forks offering 40,000 continuous H.P.

Passing over numerous smaller developments, we come to the Nelson River, which offers immense prospective water powers, there being 19 power sites that would produce from 77,000 to 235,000 H.P. at the turbine shaft, and give a total of 2½ million estimated H.P.

A summary of the undeveloped and developed waterpowers in Ontario shows total potential powers amounting to nearly 5,000,000 H.P., of which 722,000 H.P. are developed, 574,000 being utilised for electrical purposes.

The actually developed power of the Ottawa River and tributaries is 71,000 H.P., Great Lake tributaries 137,000 H.P. ; Hudson Bay slope, 22,000 H.P. ; James Bay slope, 30,000 H.P., and International boundary rivers, 462,000 H.P. Probably due to the work of the Ontario Hydro-Electric Commission, Ontario's water powers are better appreciated in this country than those of other parts of Canada ; the work of the Commission is regularly reviewed in our columns, and readers are referred to the latter for details.

The Ottawa River tributaries have provided many moderate sized power developments ; the Northern Ontario Light and Power Co., which supplies the Cobalt district, has two plants of 8,000 and 3,800 H.P. The Ottawa River itself, if regulated, would provide 606,000 H.P. between Lake Temiskaming and Carillon ; about 36,000 H.P. is now in use at the Chaudiere Falls, including about 9,000 H.P. by the Ottawa Electric Co., and 5,000 H.P. by the Ottawa Power Co.

Of the rivers flowing into Lake Ontario, the Trent and its tributaries would easily provide 75,000 H.P. by reason of the works of the Trent Canal, now nearing completion ; about 45,000 H.P. is now developed—the Electric Power Co. having seven plants of a rated capacity of 33,000 H.P. in operation, supplying a large territory along the lake front through 300 miles of 44,000-volt transmission. The undeveloped powers of the Trent system, having capacities ranging from 1,000 to 10,000 H.P., offer fine opportunties for new industries in the vicinity of Peterboro', Cambellford and Trenton.

The total low water capacity of all the Luke Huron tributaries is about 166,000 H.P., neglecting storage, and about 56,000 H.P. is at present developed.

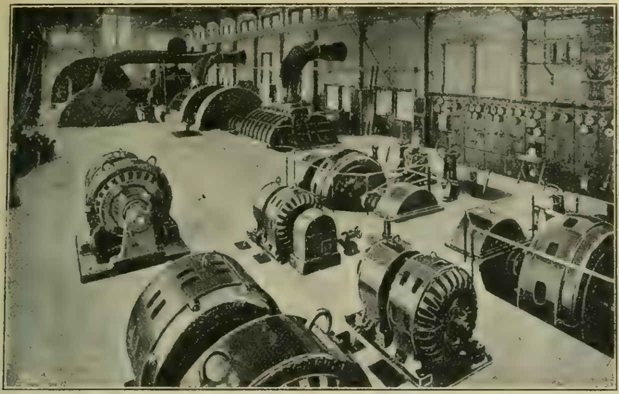
Of the most important undeveloped powers, the French River has three sites, each capable of producing 10,000 H.P. with storage, besides other smaller powers. On the Spanish River, the Canadian Copper Co. has 12,500 H.P. installed for operating its mines and smelters, while, lower down, the Spanish River Pulp and Paper Co. has 10,000 H.P. in use.

About 15,500 H.P. used in the cities of Port Arthur and Fort William is mainly derived from the plant of the Kaministiquia Power Co. at Kakabeka Falls ; these cities are also within easy transmission distance of the Silver Falls on the Kaministiquia River, where some 20,000 H.P. is available, and of the Nipigon River, the 40 miles of which with Lake Nipigon at the head, are estimated to be capable of developing 100,000 H.P.

The Winnipeg River (in this province) is roughly estimated to have available some 250,000 H.P., of which only 22,000 H.P. has been brought into use. The White Dog Falls on this river, with suitable storage, would alone produce 75,000 H.P., and several sites on the English River could be developed in blocks of 20,000 to 40,000 H.P. Accurate information regarding the rivers of the James Bay slope is not available, but it may be assumed that 1,500,000 H.P. is physically capable of development.

At present, there are two plants of the Northern Canada Light and Power Co. on the Mattagami River with 10,000 h.p. available; also the Abitibi Pulp and Paper Co.'s 19,500 h.p. plant at Iroquois Falls will shortly be at work.

On the international rivers, the Canadian plants on Niagara include those of the Canada Niagara Power Co., with 100,000 h.p.: the Electrical Development Co., 125,000 h.p.; and the Ontario Power Co., 180,000 h.p. On the old Welland Canal, about 12,000 h.p. is developed, supplying industries in St. Catherines, Merritton, and Thorold. The Dominion Power and Transmission Co. also has a 57,000-h.p. plant at Decew Falls which utilises the canal water, and transmits energy at 10,000 to 40,000 volts to a number of towns in the Niagara peninsula; the commercial prominence of Hamilton is largely ascribed to the power facilities offered by this company.



Power Plant of the Granby Consolidated Mining Co. B.C.

Between Lakes Superior and Huron is a difference in level of 20 ft., and the minimum flow at St. Mary's Rapids would produce 90,000 h.p., half of which belongs to Ontario; this power has partly been used in Canada and the States—in the former, about 17,000 h.p. is used by the Algoma Steel Corporation and allied industries.

The St. Lawrence river between Lake Ontario and Lake St. Francis offers a development of 1,000,000 h.p., of which 500,000 h.p. would be available for Ontario.

Such a development would require the co-operation of the United States, and be costly; moreover, a sufficient market for the power does not exist.

The undeveloped water power of Quebec represents about 5,000,000 h.p.; the developed power amounts to 520,000 h.p., of which 370,000 h.p. is used in the form of electrical energy.

There are many undeveloped falls and rapids on the Ottawa River (in Quebec); the Quinze River (a part of the Ottawa River) has some 90,000 h.p. available, and the Kipewa River 50,000 h.p. The Lievre River, a tributary of the Ottawa River, is estimated to be capable of generating 85,000 h.p., of which less than 10,000 is in use, while the Gatineau River would produce 225,000 h.p.

The Cedars Rapids, about 35 miles from Montreal, on the St. Lawrence, are capable of generating 160,000 h.p.; at present, the Cedars Rapids Manufacturing and Power Co. is producing 90,000 h.p., of which 60,000 h.p. is being transmitted to aluminium works at Massena and the remainder to Montreal.

On the opposite side of the St. Lawrence, the Canadian Light and Power Co.'s plant at St. Timothee furnishes 20,000 h.p. to Montreal for traction, and can be extended to 50,000 h.p. Some 13,000 h.p. is also developed on the Soulanges Canal for use in the city.

A diverting canal between Lakes St. Francis and St. Louis would give a head of 80 ft. and possibilities of over 100,000 h.p.

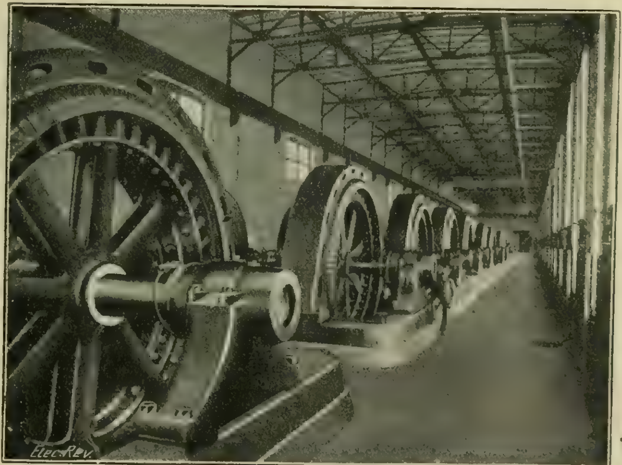
Still nearer Montreal, at Lachine, the rapids are estimated to be equivalent to 400,000 h.p., but only a portion is available for development, and an existing plant supplies 13,000 h.p. to the city, which also receives 20,000 h.p. from a plant on the Richelieu River at Chamley, and a certain amount from the well-known Shawenegan Falls development, nearly 100 miles distant on the St. Maurice River, so that the city receives in all about 126,000 h.p. from water developments. The St. Maurice River has possibilities of 650,000 h.p.: the most southerly power is at Le Gres Falls, 15 miles north of Three Rivers, where 60,000 h.p. is available.

The entire water rights of the Shawenegan Falls are owned by the company of that name: the plant is capable of generating 155,000 h.p., which is used locally in the aluminium, carbide and manufacturing industries, and transmitted to Montreal, Three Rivers, and other towns.

Situated about 12½ miles above the Shawenegan Falls are the Grand Mere Falls, with 100,000 h.p. available, which is being developed by the Laurentide Co. At La Tuque, on the same river, is a fall capable of developing over 75,000 h.p., and there are a number of smaller power sites.

In the vicinity of Quebec City are numerous undeveloped, or partly developed, powers, and the Saguenay River, 120 miles north of the city, provides two sites for developments of 300,000 h.p. continuously, which, with storage in Lake St. John, could be more than doubled. The Quebec Development Co. is the owner of water rights on this river.

On the North Shore of the St. Lawrence, between the Saguenay and the Atlantic, the country is scattered with large undeveloped water powers, the country itself being undeveloped; it is estimated that over a million h.p. is available.



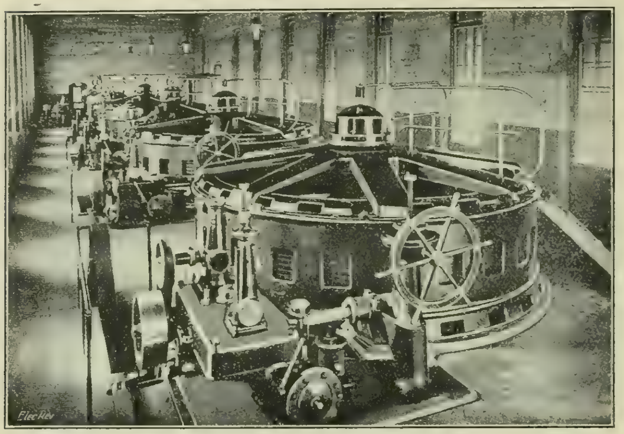
Winnipeg Electric Railway Power Plant at Pinawa.

In New Brunswick there has been developed about 13,000 h.p., 56 per cent. being for saw, grist, &c., mills; one plant has 3,800 h.p. installed.

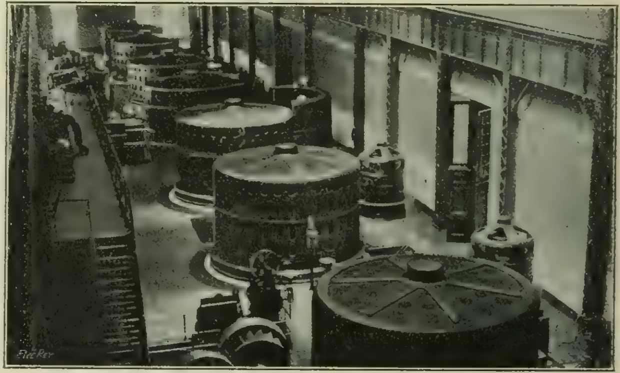
In Nova Scotia about 24,000 h.p. has been developed, mainly for pulp and paper making, though a number of small hydro-electric plants supply town lighting, &c.

There are two outstanding undeveloped power sites in New Brunswick—Grand Falls on the St. John River and Grand Falls on the Nepisguif River; as regards the former, an 80,000 H.P. development has been planned, while the Pokiok site on the same river is said to be capable of developing 30,000 H.P.

The other Grand Falls, about 20 miles from the town of Bathurst, could provide some 10,000 H.P. In Nova Scotia the Mersey River is considered to be capable of developing 30,000 H.P. on several sites, while lesser developments are possible on other rivers; generally speaking, there are a great number of minor power sites scattered over the Maritime Provinces. Though we have necessarily touched very briefly on the contents of this interesting volume, which contains some 360 pages of descriptive and illustrated matter, together with maps, &c., the reader will probably share with us the opinion that no other country in the world offers such immense scope for the development of water power, and of the industries — such as electrochemical, electro-metallurgical, and pulp manufacturing—which are peculiarly dependent on a steady natural source of power.



Hound Chute Power Plant, Northern Ontario Light and Power Co.



Power Plant of the Electrical Development Co., Niagara Falls.

It cannot be doubted that the water powers of Canada are an asset of incalculable value in the Empire's resources.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Multiple Cable Glands for Watertight Bulkheads.

The rapidly increasing adaptation of electrical energy to all kinds of auxiliary services on board ships of the Navy, as well as the mercantile marine, has confronted the shipbuilder and electrical engineer with problems to be solved which in days when the use of this form of energy was confined to electric lighting did not arise. One of these problems, and that not of least importance, is how to ensure water-tightness of those bulkheads through which electric cables have to pass. Some idea of the difficulty of maintaining these bulkheads watertight may be realised when it is stated that in large warships the number of individual cables passing through some of the more important bulkheads is not far short of 100. Up to the present, the method adopted has been to pierce the bulkhead with a separate hole and fit a gland for each separate cable. After threading through the cable, these glands are made as far as possible watertight by means of asbestos and grease, or in Naval practice a metallic packing pressed in around the cable by brass sleeves and nuts.

This system has many drawbacks, the chief of which are as follows:—(1) Where the number of cables is large the strength of the watertight bulkhead is greatly impaired by reason of the correspondingly large number of holes which have to be bored. In many cases doubling plates have to be riveted to the bulkhead to compensate for this weakening of the structure. All this means extra labour on the part of the ironworkers, riveters, and drillers.

(2) Watertightness of these glands depends upon the thoroughness with which the packing has been carried out—a matter depending largely upon the skill and conscientiousness of the man employed. Continuance of this state of watertightness depends upon the gland nuts remaining tightly screwed up in spite of vibration or similar causes; shrinking of the packing material due to its drying up in places exposed to a warm atmosphere must also be followed up by subsequent retightening of these nuts if the glands are to remain watertight. Where the number of glands is exceptionally large, human nature being what it is, the periodical inspection and retightening of slack nuts is almost certain to be neglected.

(3) Where lead-covered cables are employed, as is the practice in warships, great care must be exercised to ascertain that the packing material has been uniformly distributed round the cable, otherwise tightening up of the gland sleeves and nuts in order to compress the packing material will not render the gland watertight Again, too great pressure may, and does often, force the packing, particularly if it be metallic packing, into the lead sheath of the cable, and this may not be discovered at the time unless the damage done is sufficient to force the lead sheath through the rubber insulation and earth the cable.

All the foregoing objections to the present form of so-called watertight gland can be overcome by the adoption of a multiple cable gland, employing a plastic compound composed of the same or similar material as is at present used for the sealing chambers of paper insulated cables. By employing this type of gland, a much smaller number of holes, though of somewhat larger diameter than hitherto, suffices. Stiffening of bulkheads except in unusual cases, such as very thin bulkheads, becomes unnecessary. The knowledge that the gland is perfectly filled with packing material becomes a certainty, as it can be forced in under pressure until it exudes through inspection holes. Initial watertightness and continuance of the same in no way depends upon nuts or similar devices remaining tightly screwed up, and those other than the fixing nuts may, in fact, be removed altogether without impairing the efficiency of the gland.

Fig. 1 shows in part-section the side view of a gland of the foregoing description in position on a steel bulkhead, the top half being cut through to illustrate more clearly the cables passing through the gland. No. 4 is a piece of steel tube fitted in position in the bulkhead (1), and secured and made watertight by means of the nuts and washers (2) and (3), which are screwed up tightly against an asbestos insertion joint smeared with red lead and placed between the washer (3) and the structure (1), to which it is fitted; this joint serves to prevent the passage of water in that direction between one compartment and another. In each end of the steel tube (4), in which a recess has been arranged, are fitted two end plates (6) and (7), designed so as to be fitted in one position only, and bored with holes somewhat larger in diameter than the cables. In the inner end plate (6) at each end of the gland are fitted split adaptors (8), which are slipped over the cables after they have been passed through. The outer end plate (7) is then placed in position against the adaptors, and both plates and adaptors are locked in position by means of end ring nuts (5), in such a way as to prevent their being forced out while subjected to an internal pressure during the course of filling. Any subsequent slackening of these end ring nuts (5) will not affect the watertightness of the gland, as the adaptors (8) and inner end plates (6) are held securely in place by the sealing compound which adheres to every portion with which it comes into contact.

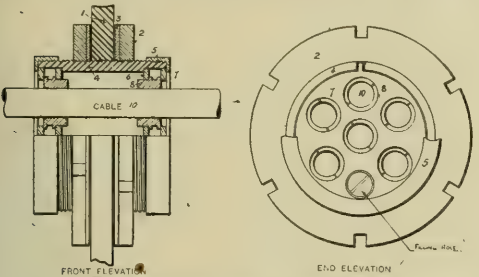
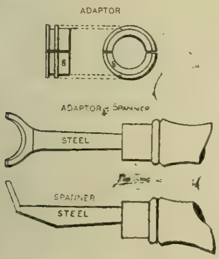


Fig. 1. Fig. 2.

Multiple Cable Gland.



Figs. 3 and 4.

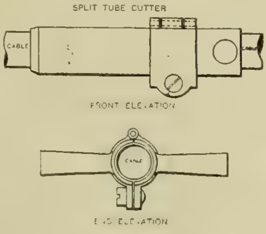


Fig. 5.

Fig. 2 shows an end view of the gland arranged for the passage of six cables; the end ring nut (5), being broken, shows the slot in the steel tube (4), which permits of the plates (6) and (7) being fitted in one position only; at the bottom of the end plates a filling aperture is arranged, into which the filling pump is fitted, the compound being forced in at the bottom of the gland in a liquid state. An aperture being arranged in both ends of the gland permits of the filling operation being carried out from either side of the bulkhead as found most suitable.

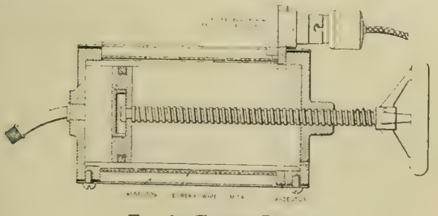


Fig. 6.—Filling Pump.

Fig. 3 shows an end and side view of the split adaptor (8), and fig. 4 a special spanner for use when it is desired to withdraw the adaptors from their position in the gland. Fig. 5 is a split tube cutter, by means of which a damaged cable can be withdrawn from the gland and replaced. When it is desired to replace a cable which is fitted in a sealed gland, the adaptors through which the cable passes are warmed by means of a blow-lamp, and with the adaptor spanner drawn from their position. The split tube cutter is then clasped over the cable and heated at the cutting end, after which it is forced through the compound in the gland, completely severing from the remainder the compound in direct contact with the cable to be withdrawn. The old cable then being free can be removed, leaving the hole free for the passage of the new one. After the new cable has been passed through, and the adaptors have been again placed in position, the pump being charged and fitted in the filling aperture, the gland is heated uniformly until the sealing medium resumes a liquid state, when an additional charge of the compound again renders the gland watertight.

Fig. 6 shows the general arrangement of the filling pump. The compound, having been heated in a suitable receptacle, is poured into the pump chamber by means of a filler; a heating element wound round the chamber generates sufficient heat to maintain the compound almost at boiling point; when the pump is fitted in position in the gland the piston is forced into the chamber by means of the screw, thereby forcing the compound into the gland under considerable pressure, with the result that not only is the gland sealing chamber filled, but also all crevices and clearances, making the passage of water, even when subjected to considerable pressures, impossible.

Summary of Advantages and Disadvantages of Present and New Types of Gland.

Present Gland.	*Multiple Cable Compound Gland.*
1. Weight of glands required, 100 per cent.	1. 60 per cent.
2. Holes to be bored in fixed structure, 100 per cent.	2. 20 per cent.
3. Packing operations, 100 per cent.	3. 10 per cent.
4. Cost of packing material, 100 per cent.	4. 25 per cent.
5. Space necessary for fitting, 100 per cent.	5. 60 per cent.
6. Cost of glands, 100 per cent.	6. 90 per cent.
7. Water test (uncertain) depending on workman's skill, and finally on amount of vibration and shrinkage with heat.	7. Tested to 20 lb. with water for several days, and is not affected by vibration or shrinkage.
8. Possibility of failure to maintain its effectiveness due to the large number of nuts and joints to be kept tight.	8. Greatly reduced, being applicable only to fixing nuts, which are reduced to 20 per cent.
9. Great care must be exercised to prevent injury to the cable sheathing by the watertight packing.	9. No such danger, as compound is liquid and subjected to uniform pressure.
10.—Difficulty of access to adjust glands or replace cables due to the method necessary of grouping the glands in the available space.	10. Cables being arranged in groups of 10 as a maximum, and passing through one gland, permit of the glands being arranged more suitably.

The Multiple Cable Compound Sealed Gland forms the subject of Letters Patent, and is manufactured with all accessory appliances by Messrs. W. McGeoch and Messrs. Bradbury, Glasgow and Birmingham.

Motor Vehicle Inspection Lamp.

Messrs. Simplex Conduits, Ltd., of Garrison Lane, Birmingham, have produced a very useful electric inspection lamp for the rapid examination of the inaccessible parts of chassis or engine. The lamp is strongly made, in two patterns; one is 26 in. long, with the lamp guard 1½ in. in diameter, fitted with a switch in the handle; the other is only 15 in. long, and the lamp guard is only ⅞ in. in diameter, so that it will pass quite small apertures. The device is sent out wired complete, and can be supplied with lamps of high voltages for garage and factory use, or with low-voltage lamps for running off 6 or 8 or 12 volt batteries for use on the road

D.C. Lighting and A.C. Power from one Set.

Messrs. T. W. Broadbent, Ltd., Huddersfield, have introduced a three phase alternator ("T" type) designed specially for the purpose of motor driving in mills, &c., a novel feature of which is that the continuous-current generator supplied as its exciter is large enough to provide, in addition, for the lighting of an average sized electrically-driven works, factory, or mill. This system of combining an alternator and a dynamo for the respective purposes of motor driving and lighting offers many practical advantages. By this means are combined the simplicity and reliability of the three-phase current for power transmission, and the good pressure regulation of continuous current for lighting. In practice, the ratio of the demand for lighting to that required for power, in such cases, does not vary greatly; and the relative proportions of the machines have been arranged to suit ordinary conditions. The continuous-current generator can, however, be made relatively larger or smaller, as may be necessary to suit special requirements. The standard winding of the alternators is for 460 volts, and a frequency of 50 cycles per sec. The exciter is compound wound for 115 or 230 volts. As shown in the accompanying illustration, each set is mounted on a combined bedplate, and the outputs at present listed range from 60 to 400 kW.

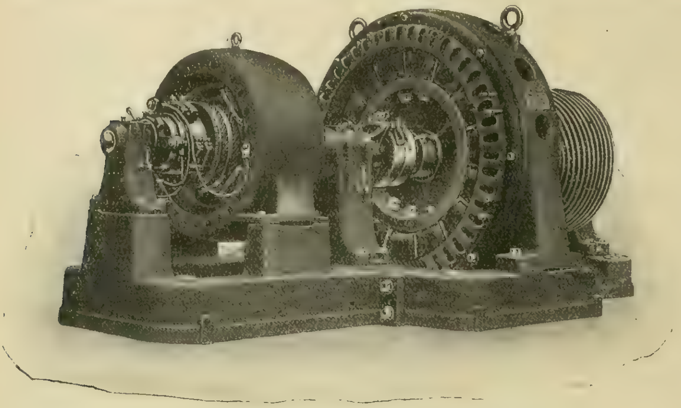


Fig. 7.—Broadbent "T" Type Power and Lighting Set.

Cantie Patent Fuse Gear.—In our last issue, in referring to the above on pp. 174 and 180, we should have stated that these fuses are made for capacities up to 150 amps. per way, not being limited to the sizes mentioned.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

American and English Research.

The summary, on page 138 of your journal, of Mr. Fleming's lecture on American research makes interesting reading, and when compared with the article by Dr. Whitney, printed in the *Electrical World* on January 6th last, is all the more so.

Dr. Whitney, chief of the research department of the American G.E. Co., apparently emphasises the point that, compared with English and German research, his own country lags behind; whilst Mr. Fleming evidently considers that we are much behind America. Neither of these eminent engineers appears satisfied with the state of affairs in his own country, and, quite rightly, they are endeavouring to alter this. Dr. Whitney's article is complete, whilst Mr. Fleming's is only partially reported, so that one cannot form a definite conclusion on his remarks. May I ask if you could publish a summary of Dr. Whitney's article, as I think it would greatly interest your readers?

The closing remarks of Mr. Fleming, where he speaks of the need and importance of combination, are worthy of much thought. One wonders where in this country are the firms who could successfully enter into competition for really big jobs with such companies as the American Westinghouse and G.E. Co., the German A.E.G., and the Siemens group. If, as a nation, we do not seem to look with much favour on combines—and some of those already existing here are highly successful—we ought to do something definite to secure a greater degree of combination and co-operation than has hitherto been the case; otherwise the future for electrical engineering, at any rate, does not seem to be particularly rosy.

A faint gleam of hope arises, however, after perusing the B.E.A.M.A. report.

W. H. B.

[An abstract of Dr. Whitney's article appears on p. 223 of this issue.—Eds. Elec. Rev.]

Localising a Fault.

With regard to the correspondence under the above heading, may I point out that although Mr. Chubb sheds light on one of the probable sources of error in the test given by Mr. Wardle, there are still two others, either or both of which will completely upset both the tests so far given. These conditions are (1) variable resistance fault, (2) partial or complete burn-out. The following procedure, identical in part with that of Mr. Chubb, although not professing to be a completely satisfactory solution of the problem, will be found to deal in a rather more comprehensive manner with faults of the "no return" type.

The instruments used are the usual portable milli-voltmeter, ammeter, and ignition accumulator.

The resistance in ohms of the circuit made up of (1) "bad" cable up to fault, (2) earth, sheathing, or "shorted cable" return, (3) the fault itself, is measured from each end of "bad" cable by sending about 10 amperes round this circuit, and measuring the "drop" across its ends. The two resistance values so obtained are converted into equivalent yards of the "bad" cable, or, in the case where a "shorted cable" is used for return, into equivalent yards of route (lead and return) These two distances laid off from their respective ends will each overlap the fault by an amount equivalent, in the case of the earth return, to the resistance of the fault plus that of the earth return, and in the case of the "shorted cable" return, to the resistance of the fault only.

Taking the case of the earth return: Provided that the fault resistance remains constant during the two tests, that the resistances of the two earth returns are equal or insignificant, and, in the case of an earthed burn-out, that the fault resistances from the two sides of the burn-out are equal, then the two distances will overlap the fault by exactly equal amounts, and therefore the fault will lie at the point midway between the marked-off points. The formula for this test (The "Overlap") is merely for the purpose of finding this mid point; that is:—

$$\begin{array}{c}\text{Distance of mid. point}\\ \text{from end 1}\end{array} = \frac{\begin{array}{c}\text{Equiv. length by test from end 1} - \text{ditto}\\ \text{from end 2} + \text{length of } \textit{bad} \text{ cable}\end{array}}{2}$$

It is, of course, obvious that the assumptions made in this test are, in the majority of cases, totally unjustifiable, especially so in the case of the "earth" return. In the case of the "shorted cable" return the assumption regarding the equality of the return paths is eliminated, but the assumption regarding the constancy and equality of the fault resistance still holds. Practically the only case where this formula will give the correct position of the fault is that in which the copper and sheathing, or the two coppers, have been welded together into a constant, low-resistance fault. Exactly the same observations apply to both the tests already given.

In the above test, however, the two equivalent lengths obtained do give us the absolutely definite information that the fault cannot lie farther from either given end than the equivalent length obtained by test from that end, and, provided either of the equivalent lengths falls within the actual length of bad cable, this information restricts the range of further search.

In seeking to definitely narrow down the faulty length in this manner, advantage should be taken of every alternative circuit, that is, if all three cores are "down" circuits should be made up with each core and earth (or sheathing), and with each pair of cores, and that equivalent length taken which has the *lowest* value.

"Bridge" methods may, of course, be used instead of "drop" methods for obtaining the resistances, but heavy test leads then become necessary, and trouble is introduced due to contact resistances.

Where service tappings exist on the bad cable, the following modification is preferable to the above. It includes all the information given in the regular "Overlap," it is serviceable in a much greater number of cases, and its behaviour proves its trustworthiness or otherwise. The modification consists in correcting the "drop" reading for "fault resistance," and in actually measuring the "drop" per yard of route, instead of presuming earth paths negligible or equal.

The testing current is maintained at a steady value throughout the test. The total drop is taken at feeding end in ordinary way, sheathing being used for return path. Voltages are now taken between core and sheath at each service tapping on "bad" cable, and on far end of cable itself. Starting at feeding end, these readings should be carefully noted with maximum and minimum values of each, and amount of variation. If the variation is equivalent to any considerable number of equivalent yards of bad cable, the test must be treated with great caution. Should the far-end reading show an initial deflection of, say, 0.1 volt, immediately and steadily decreasing to, say, 0.01 volt., the fault contains a break, and it is the E.M.F. of the fault that is being measured instead of the "drop" in the fault due to testing current. In such a case the fault must lie in that span between two service tappings whose far end is the first point to show the effect.

Where no break exists, the succession of readings will show decreasing values until the fault is passed, being then constant at the value of the "drop" in the fault. Thus the fault must lie in that span whose far end is the first to show the constant reading. Decreasing values throughout show the fault to lie between the last two points. Constant values throughout indicate that the fault lies close up to the feeding end.

The difference between any two decreasing readings (not to include the constant reading) divided by the distance between their testing points, gives the drop per yard of route. The "constant" reading (minimum value, if slightly variable) gives the "drop" in the fault itself.

Total drop less fault drop, divided by drop per yard of route, gives yards to fault from feeding end. The same applies to the "bad" span; drop at near end, less drop at far end, divided by drop per yard of route gives yards from near end.

Repeat the whole test, feeding in from the other end of the bad cable. Then, if careful *minimum* values of fault drop have been taken, and distances obtained should overlap, the fault may confidently be sought within the overlap. Differences in value of "fault drop" obtained from the two ends, if constant, show a break at the fault.

If the section to which the fault is finally narrowed down is of any considerable length, uncover the cable at the most likely spot near the centre (joint box, &c.). If there are no joints or other probable bad spots, open out at the centre and connect the millivoltmeter across two or three feet of the sheathing of bad cable (testing current on as before, returning by sheathing); this will give by the direction of the deflection (moving coil instrument), the direction of the current in the sheathing, which must always be *away* from the fault, if positive pole of battery is connected to core. If no deflection is obtained, the fault lies nearer the feeding end. As a precaution, the testing current should be made and broken in order to make sure that the deflection obtained is due to testing current, and not to stray currents. Having found in which direction the fault lies, the same method is pursued in a second inspection hole opened out midway between the centre and the end of bad span, and so on until fault is found. Where a joint box is uncovered, it is opened and a compass laid directly on the copper, thus getting the direction of current in all cores branching at the joint, and so the direction of current travelling *to* the fault.

In all this it is presumed that it is impossible to obtain a sound return cable, and that the various compass and induction-coil methods have been found useless.

J. A. Beckett.

Spenborough Electricity Works, Cleckheaton,
February 13th, 1917.

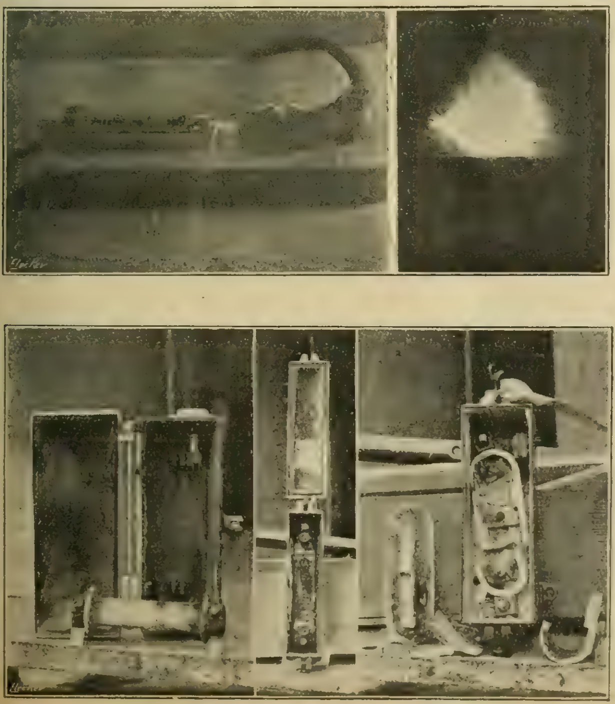
Fuse Failures.

Following the publication of Mr. Baynes's article and illustrations on the blowing of fuses, I beg to enclose for your perusal a few photos which were obtained some time ago. They were taken with a view to determine whether or not asbestos-covered wire was appreciably better than bare wires, and also whether certain fuse boxes could withstand a short-circuit current. The plant in use consisted of a 300-KW. 500-volt generator, controlled by fuses only. The test fuses were connected only a few yards from the dynamo terminals. The circuit was closed by means of a special quick-make device fitted up for the purpose, and the length of break in the test fuses was about 4 in., whilst the break in the fuse boxes varied from 4 in. to 8 in.

I am not sure whether any of the prints are suitable for publication, but you are quite at liberty to use them if you should consider them of interest to your readers.

W. H. B.

[We reproduce herewith a selection of the photographs. The upper views show the blowing of 20-amp. 500-volt tin fuses, asbestos covered and bare; the lower views show the condition of the fuse boxes (25 to 50-amp. capacity) after being fitted with a wire of the maker's rating, and blown on a dead short.—Eds. Elec. Rev.]



Views Illustrating Tests on Fuses.

Telephones and War Surcharges.

We think it only right on our part to correct the impression conveyed in the report of above in your last issue.

Our counter-claim was in respect of rental charges and non-removal of 64 wires which cross our premises (spare ground which we now wish to build upon), and are seriously interfering with our business, as they take up, roughly, 36 sq. ft., and are only 25 ft. above ground. The matter was reported, and commented on by you, in your issue of November 24th last, under the title of "Wayleaves."

Imagine our surprise when, at the hearing of the action, the plea as stated was propounded, and what seems to us extraordinary is that the Crown, having taken over a commercial undertaking, can repudiate the contracts and liabilities just as it chooses.

Surely there must be quite a host of people who, relying upon the well-known commercial status of the old National Telephone Co., are in a most unsatisfactory position, their contracts being only so many "scraps of paper." We have no intention of allowing the matter to rest in its present stage—in fact, such a thing is impossible.

The Stanneries Metal Works.

London, S.E., *February 19th*, 1917.

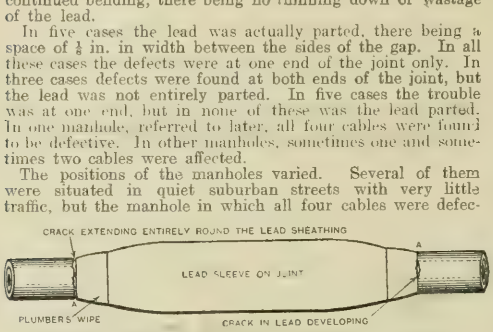
Curious Trouble with Lead-Sheathed Cables.

I have lately experienced a new trouble in connection with a route of about three miles of E.H.T. trunk mains, and think, perhaps, the information I am sending herewith may be of interest to your readers. Some of them may have had a similar experience, and may be able to explain the cause of the destruction of the lead sheathing at the end of the plumbed joints of the four concentric lead-covered cables to which I refer. They may also be able to suggest a remedy for the trouble.

The cables, which are four in number, are paper insulated and plain lead sheathed, drawn into a duct system. The manholes, most of which are in the footway, are of brickwork, and the cables, where they pass through the manholes, are always supported with iron hangers attached to wood battens, which, in turn, are spiked in brickwork. As an additional precaution against damage, each cable is separately served over the entire length of the manhole with a covering of woven asbestos, this material being 4 in. wide and about $\frac{1}{4}$ in. thick, and wound over the cable with a half lap. The joints which are in the manholes are covered with a sleeve of drawn lead, which is joined at each end of the joint to the lead sheathing of the cable by a wiped joint of plumber's metal, as shown in the attached drawing. When the asbestos covering was removed it was found in a number of cases that the lead sheathing of the cable was broken at the point A. In a few cases the lead had parted entirely over the circumference of the cable, leaving a gap of about $\frac{1}{8}$ in. wide. In the majority of instances, the crack did not extend all round the cable, nor was the lead cracked through its entire thickness. These cracks were found to be in every case exactly at the end of the plumbed joints at the point A of drawing, where the plumber's "wipe" joined the cable sheathing. The length between joints varies from 100 to 150 yds. The appearance of the crack showed no signs of electrolytic action or melting, and might have been caused by mechanical means, such as continued bending, there being no thinning down or wastage of the lead.

In five cases the lead was actually parted, there being a space of ⅛ in. in width between the sides of the gap. In all these cases the defects were at one end of the joint only. In three cases defects were found at both ends of the joint, but the lead was not entirely parted. In five cases the trouble was at one end, but in none of these was the lead parted. In one manhole, referred to later, all four cables were found to be defective. In other manholes, sometimes one and sometimes two cables were affected.

The positions of the manholes varied. Several of them were situated in quiet suburban streets with very little traffic, but the manhole in which all four cables were defective was in the carriageway of a main artery in London, and subject to a continuous stream of traffic of the heaviest character—motor 'buses, steam lorries, and traction engines with heavy trailers—and the vibration of the brickwork of this manhole was very pronounced.



STRAIGHT JOINT ON 7,000-VOLT CONCENTRIC L.S. CABLE.

The cables have been laid for a number of years, and our tests indicate that the trouble has probably only arisen during the last few months. The question of vibration has been considered, but, in view of the fact that several joints are damaged on one side only, and in many cases, as already mentioned, many of the manholes were in very quiet streets, and in other streets where traffic was heavy only one of the four cables appears to have been affected, it is open to question whether this is due to vibration or some other cause.

G. W. Partridge.

London, S.W., *February 14th*, 1917.

British v. German Turbines.

May I beg leave to take up a little of your space in connection with the above matter?

Mr. Nichols Moore appears to be convinced that German A.E.G. turbines are in advance of British-made turbines; I wonder if Mr. Moore has ever heard of some of the troubles experienced with these machines. For instance, has he ever heard of two turbo-blowers in South Wales that had recently to be rebladed after some three years' use? or of a turbine in Spain that had to be reconstructed entirely by an English maker in order to get it to work at all? Is Mr. Moore aware that one turbine on an important South African mine has completely failed during the guarantee period? The Shanghai and the Melbourne turbine failures are, of course, well known. Possibly Mr. Moore has not yet heard that several large turbines of German make in Japan are now being rebladed by British turbine makers.

When Mr. Moore's Newport turbine has run a few years he will no doubt know more regarding cracking of turbine blades, and be a sadder and, possibly, wiser man.

L. M.

BOILER-HOUSE OPERATION AND MAINTENANCE.*

(*Concluded from page* 191).

The grading of the coal improved matters, but the solution was in the design of the stoker arch (see fig. 5). The high arch gives equally good results with slack and large crushed coal, and it is believed better results still would be obtained if a still higher arch could be used.

With large crushed coal, clean boilers can steam continuously at 25 per cent. overload, and give 78-80 per cent. continuous efficiency; burning slack, the efficiency is 66-75 per cent., depending on dust. The coal (Cornelia) analyses 7 per cent. moisture, 22 per cent. volatile, 52.5 per cent. fixed carbon, and 18.5 per cent. ash.

As regards boiler-house losses, the fireman can readily obtain a good CO_2 chart by running a heavy fire at the back and allowing unburnt coal to go over with the ashes, and by running on reduced draught and thus reducing evaporation. The average percentage of CO_2 is, roughly, the same for all stations, viz., 10.5 per cent. when the boilers are steaming. With the same CO_2 the boiler efficiency will naturally vary with uptake temperature.

It has frequently been stated that it is possible to obtain the same efficiency with low as with high-value coal. In commercial working this is impossible, even with the same CO_2 and uptake temperatures; for instance, when burning either Cornelia coal at Vereeniging or Schapenrust coal at Brakpan, the chimney losses are never less than 14.5 p cent., whereas when burning Witbank district coals und exactly the same conditions of CO_2 and chimney temper ture the chimney losses are about 12.7 per cent. Furthe more, it is practically impossible to obtain the same furna efficiency, as the unburnt carbon in the ash is considerab higher with low-value coals containing a high ash percentag and there is a further loss with those low-value coals whic require saturating with water due to the evaporation of t added moisture.

The unburnt carbon in the ash is between 4 and 6 per cen of the energy value of the coal; the authors put radiatio losses from boiler and economiser casings at 5 to 6 per cent for the isolated boiler unit type.

Table IV shows the distribution of coal energy. In a calculations the higher calorific value has been used; wi the lower value the efficiencies would be somewhat highe

TABLE IV.—WEIGHTED AVERAGE BOILER-HOUSE EFFICIEN AND LOSSES.

	Brakpan.	Rosher-ville.	Simmer-pan.	Vereenig-ing.
Energy to water ...	71·2 %	74·6 %	76·1 %	74·8 %
Chimney losses ...	15·5 %	13·2 %	12·7 %	14·7 %
Loss in ashes... ...	6·5 %	4·5 %	4·5 %	5·5 %
Radiation and banking	6·8 %	7·7 %	6·7 %	5·0 %
	100·0 %	100·0 %	100·0 %	100·0 %

The authors say that it is difficult to arrange an equitab basis for a bonus scheme per fireman, and they therefo rely on intelligent supervision.

TABLE V.—TOTALS AND WEIGHTED AVERAGE MAINTENANCE COSTS—1915 RESULTS.

—	Costs.	Cost per boiler installed.	Cost per ton of coal burnt.	Cost per U.S.O.
	£	£	d.	d.
Brickwork	2,943	28·90	·690	·00525
Boiler mountings ...	1,025	10·00	·242	
Miscellaneous repairs to boilers...	1,456	14·27	·344	
Dumping bars and ash plates	729	7·15	·172	
Stoker gear boxes and chain-grate stokers ...	2,331	22·87	·548	
Internal and external cleaning of boilers and economisers	8,021	78·70	1·880	
	£16,505	£161·89	3·876d.	·00525d

102 boilers installed. Total tons coal burnt, 1,023,613.
Total steam hours, 505,520. Total U.S.O., 754,681,000.

The Vereeniging power station boiler maintenance costs fo 1915, under the same headings, were:—£2,816, £140.8 1.762d., and .0025d. respectively, with 20 boilers installed total tons coal burnt, 383,458; total steaming hours, 137,12 and total U.S.O., 269,400,000.

Load factor has a considerable effect in obtaining efficien results, but "utility" factor has also a powerful effect. Fo instance, a 100,000-KW. station, which has to be prepared t supply that load if required, but which never materialise may have a load factor of 80 per cent., even though th maximum load called for only, say, 50,000 KW. The utilit factor is relatively low, although the load factor is high.

The standing losses are those of a station of 100,000 KW and these divided over the units sent out will represent considerable fraction of the total consumption. The utilit factor is defined as the ratio of KW.-hours generated or sen out per annum to the capacity of plant installed in the powe station multiplied by 8,760, *i.e.*, the ratio of average load t installed capacity. The utility factor in the above case woul be:—

$$\frac{50{,}000 \text{ KW.} \times .80 \times 8{,}760}{100{,}000 \text{ KW.} \times 8{,}760 \text{ hours.}} = 40 \text{ per cent.}$$

The constant coal losses and running coal consumption i the power stations adjusted to a standard coal value basis o 3.40 KW./lb. are:—

Rosherville	... 100 tons and 2.13 lb./U.S.O.
Vereeniging	... 85 tons and 2.17 lb./U.S.O.
Simmerpan	... 80 tons and 1.93 lb./U.S.O.
Brakpan	... 80 tons and 2.12 lb./U.S.O.

Boiler maintenance is of equal importance to boiler opera tion in obtaining high efficiencies.

It has been proved by experiment that the gas film offer a resistance of between 95 and 98 per cent. of the total tem perature drop from the furnace to the water. It is evident therefore, that the external cleanliness of the boilers plays very important part in boiler efficiency, and indeed muc more so than a layer of scale of any reasonable thickness o the inside of the tubes.

The usual routine of maintenance is to rough soot eac unit once every fortnight or oftener if possible, thoroughl soot the unit every 500 hours, to clean the two or three bottom rows of boiler, and all the economiser, tubes internally each 2,000 hours, and to thoroughly clean the whole unit internally and externally every 8,000-12,000 hours.

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* Abstract of paper read before the SOUTH AFRICAN INSTITUTION OF ENGINEERS, by T. G. OTLEY and VERNEY PICKLES.

The steam drums are also opened out and cleaned each 2,000 hours, and the surfaces are rubbed down and painted with tar and graphite.

The practice is to charge everything to maintenance that is carried out on a boiler when it is out of commission, and charge to operation any work in the nature of sooting and lancing, &c., that is carried out when the boiler is either steaming or banked.

The average cost of the operations above mentioned are for a large boiler with integral economiser £48.

Table V gives the totals and weighted average costs of boiler maintenance for all four steam power stations covering 102 boilers installed.

It is only because of the particular attention that is paid to the make-up feed water that the boilers can steam 8,000 to 12,000 hours between thorough internal cleanings.

In order to find the effect of both external and internal dirtiness of a boiler the authors made tests covering long periods on boiler No. 40 at Rosherville, which was fitted with all the necessary instruments, comprising :—

Fery radiation pyrometer,
Three electrical resistance pyrometers,
Steam-flow meter,
Two CO_2 recorders, and
Two draught gauges.

The boiler in question had steamed about 12,000 hours since being last thoroughly cleaned internally. The usual routine programme of sooting and internal cleaning of the bottom rows and the economiser had been carried out. The summarised test results obtained before internal cleaning and after internal cleaning are shown below :—

TABLE VI

	Before.	After.
Date of test	November 7th.	November 21st.
Duration of test ...	12 hours	12 hours
Class of coal burnt ...	Coronation (mixed)	Coronation (mixed)
Energy value	3·46 KW./lb.	3·35 KW./lb.
Total coal burnt ...	68,400 lb.	72,000 lb.
Coal burnt per sq. ft. of grate area per hour ...	22·6 lb.	23·8 lb.
Average evaporation per hour (actual) ...	39,124 lb.	42,576 lb.
Lb. of water per lb. of coal (actual)	6·86 lb.	7·09 lb.
Average steam pressure	216 lb.	218 lb.
Average steam temp. ...	380° C.	349° C.
Average uptake temp. ...	210° C.	191° C.
Average furnace temp.	1,276° C.	1,270° C.
Draught at uptake ...	1·1 in.	1·1 in.
Draught over fires ...	·31 in.	·31 in.
Average CO_2 at uptake	11·3 %	12·5 %
Boiler unit efficiency ...	75·4 %	78·7 %

In each case the boiler had been cleaned externally, so that the difference in the result can only be that resulting from the thorough internal cleaning.

The parts of the chain grate stoker and furnace affecting efficiency are in order of importance :—(1) Ash plates and dumping bars, (2) sealing plates at side of stoker, (3) brickwork of arch, (4) curtain and feed bar.

In the authors' opinion too good a job of the ash plates, ash bearer bars, and dumping bars cannot be made, as unless they are maintained in good condition high efficiency cannot be expected.

In conclusion, the authors remark that it is difficult to see where any great advance in efficiency is to be made; chimney losses could be reduced by using larger economisers, but it is questionable whether it would pay; improved results might be obtained by easier steaming, but would involve more plant. Possibly larger boiler units would slightly increase efficiencies, but the authors look to obtaining larger outputs, not so much by extension of heating surface as by designing boilers to conform more to Osborne Reynold's law, and increasing gas speeds over heating surfaces. This will involve higher draughts, though not necessarily greater coal consumption per sq. ft. of grate.

WAR ITEMS.

The Board of Trade and Enemy Firms.—At the City of London Tradesmen's Club, the President (Mr. Frank Durrant) said he had had a most satisfactory interview with the President of the Board of Trade, in which Sir Albert Stanley assured him that it would be his endeavour to bring his Department into closer touch with the traders of this country. With regard to the enemy businesses, there were obstacles in the way of winding up, but Sir Albert said that no time would be lost, so far as he was concerned, in eliminating the enemy interest. The Department in future would be of real service to the trade of the country.—*Times.*

Trading with the Enemy.—The "London Gazette" for February 16th contains additional lists of firms, &c., in the following countries with whom trading is prohibited, also a number of removals from and variations in previous lists :—Argentine and Uruguay, Brazil, Chile, Colombia, Japan, Netherlands, Norway, Peru, Spain, Sweden, and Venezuela.

Munitions Case.—At Glasgow Munitions Tribunal, an electrical engineer, employed with a steel firm, asked for a clearance certificate in order to go to a situation as foreman armature winder, where he would get £5 a week. His present weekly wage was £2 12s. 6d. The firm's representative held that the appellant was doing work of more national importance in his present employment, but the employer who had offered the man the new situation having given evidence, the Sheriff granted the clearance certificate.

Aluminium Census.—The Ministry of Munitions has issued an Order requiring monthly returns of aluminium stocks to be sent in to the Director of Materials, A.M.2 (H), Hotel Victoria, Northumberland Avenue, London, S.W.

The State and the Coal Mines.—The Board of Trade is taking possession of all the coal mines in the United Kingdom for the period of the war. A new department is being set up, with Mr. Guy Calthrop, general manager of the L. and N.-W. Rly., at the head, which will control the mines and exercise all the powers of the Board regarding coal. Mr. Calthrop will be assisted by Sir R. Redmayne, H.M. Chief Inspector of Mines. According to the *Daily Telegraph*, the main features of the scheme are: (1) To control the coal mines of Great Britain during the war; (2) to organise an executive similar to the executive in the case of the railways; (3) to install machinery for economical handling and distribution; and (4) to pay colliery proprietors their pre-war dividends.

Exemption Applications.—At the Ilfracombe Tribunal, the Ilfracombe Electric Light & Power Co., Ltd., applied for renewal of certificates of exemption for their men, G. Dring, chief man in the station, and T. Saunders, mains and meterman, their original certificates granted by the Recruiting Officer being withdrawn under Army Council Instruction 2,342. Mr. H. J. Stewart, resident engineer and manager, appeared for the company, and stated that the work of these two men was of a highly technical character, many years' experience being necessary; they had tried very hard to find substitutes, but could not do so. These men, one of whom was 41 years of age, were the only two Class A men employed. The Chairman: Have you represented that to the military? Mr. Stewart: Yes; but the military are themselves advertising for similar men in lower classes for their own stations, so are very unlikely to be in a position to provide substitutes. The Tribunal granted temporary exemption to Saunders, and three months in the case of Dring. In the latter case, the Tribunal told Mr. Stewart to appeal again in the event of his being unable to obtain a substitute.

The Military Representative applied to the Fulham Tribunal for the revision of the certificate granted to Mr. S. Allen, an electrical engineer. It was stated that he was still engaged on important work connected with the electrification of the L. & N.-W. Rly. The work required most exceptional skill, and it was utterly impossible to get anyone else to do it. He was an expert, and had carried out similar work when the Metropolitan District Railway was electrified. The Tribunal declined to make any variation.

At Colne Tribunal, on February 16th, the electrical engineer appealed for four employés in the electricity department, two of whom were aged 18, one 19, and another 22. The electrical engineer admitted that he had no instructions to appear on behalf of the Electricity Committee. The Mayor said the youth of 19, who had been passed for C 3, must find work of national importance if called upon. The two of 18 must join the Army on March 17th, and the one of 22 was given three months.

Before the Berks Appeal Court, the Military Representative appealed against exemption until March 30th allowed to E. Slyfield (33), electrician with Mr. Benyon, of Englefield, Bradfield. The appeal was allowed, and the certificate cancelled.

At Uckfield (Sussex), Mr. D. W. Freshfield, J.P., of Wych Cross Place, Chelwood Gate, appealed for the retention of Mr. A. J. Thompson, his electrical engineer. The residence was being utilised as a war hospital. The appeal was respited for consultation with the Red Cross Society.

At Canterbury, on February 12th, Mr. C. A. Blascheck, city electrical engineer, asked for temporary exemption for B. Tapsfield, shift engineer, until he could be replaced. The Military Representative suggested that Tapsfield should be exempted until an efficient substitute was found, and this was agreed to.

Before the Canterbury Tribunal, on February 12th, Mr Terry, electrical engineer, appealed for three months' exemption for R. Elliot (28), electrical engineer. He is the only man left with Mr. Terry, who desired a short period to enable him to complete contracts, and to replace him. As Elliot is passed for general service, and the appeal was disallowed, but calling-up was deferred until March 12th.

A Ramsgate dealer in electric light fittings, in Class B 1, who had been given conditional exemption, was appealed against by the Military Representative. The certificate was withdrawn, and a final two months' exemption substituted.

At Hull, extended exemption was sought by an electric light and power engineer, aged 33, and in Class B 3. He said that he was engaged to attend to electric motors for various firms. Major Green suggested that applicant should sign an Army Volunteer form, when he would work under the Ministry of Munitions, and would be available to be sent to any place he was required. The Tribunal considered that applicant was at present doing important work, and had better stay where he was. They gave exemption until May 1st.

On the appeal of the Worcester Electric Traction Co., S. E Davis (30), electric tramway repairer, has been conditionally exempted, subject to substitution.

The Hastings Tribunal has given conditional exemption to Mr. A. J. Ryan, deputy electrical engineer; also to two engine drivers, a meter fixer and fireman, a skilled labourer, a fitter and turner, a junior engineer, two stokers, and a meter and sub-station attendant.

At Chelmsford, Messrs. Christy Bros., electrical engineers, secured exemption, as being in a certified occupation, for N. C. Barnard (38), foreman mechanic and fitter; W. Robinson (40), wireman and fitter; G. W. Balls (39), managing electrical engineer; and C. Parkins (40), pattern maker, &c.

The Surbiton Tribunal has given a fortnight, to enable him to find work of national importance, to an electrician engaged with Sir Ernest Cassel.

At Bath, Messrs. J. Lambert & Sons, electrical engineers, appealed for G. Clark (34), electrical fireman, on the ground that he is engaged on work of national importance. The Tribunal decided that he should get work of national importance in his own trade.

At Stoke-on-Trent, three men engaged at the Corporation electricity works were appealed for by Mr. C. H. Yeaman, borough electrical engineer. He said that they already had five women at one of the works. It was suggested that the men ought to be substituted by older ones, and Mr. Yeaman replied that men over military age had been proved to lack the intelligence to perform certain work. In one case the appeal was disallowed; the other two were each exempted for three months.

The Surrey Appeal Court has allowed an appeal for C. Morgan (29), shift engineer at the Reigate Corporation electricity works.

On the appeal of the Military, the East Kent Appeal Court has disallowed exemption to C. H. Lepper (18), articled pupil with the Folkestone Electricity Supply Co., Ltd.

Exmouth (Devon) Tribunal has conceded conditional exemption to W. H. Dowell (30), assistant in the electrical department of the Red Cross Hospital, who is classified in C 3.

At Dover, on February 14th, Mr. Woodman, borough electrical engineer, applied for exemption, until a substitute could be found, for R. S. Reeves (21), switchboard attendant, who had been debadged. He was passed in Class B 1, and suffered from curvature of the spine. Two months were allowed.

LEGAL.

Hewitson *v.* Newcastle Corporation.

At the Newcastle-upon-Tyne County Court, on 15th inst., his Honour Judge Greenwell gave his reserved judgment in the case, already reported, in which Miss Elsie Hewitson, a local typist, claimed £9 in respect of a suit-case and its contents, being personal luggage of hers, and delivered by her to the defendants, or their servants, to be carried with, and on behalf of, plaintiff while travelling as a passenger on the defendants' tramways, on September 24th, but which, in consequence of the alleged negligence of the defendants, or their servants, was lost. The case was heard on January 19th last.

His Honour, in giving judgment, said there was no substantial dispute about the facts. It appeared that for some years the Corporation had made a charge of one penny for parcels carried by them and placed on the footboard of the cars. Under the circumstances, it was contended by Mr. Mundahl, for the plaintiff, that the Corporation were common carriers, and, as such, were responsible for the loss; and that if not, they had not taken that reasonable care that it was their duty to take. There appeared to his Honour to be no evidence of negligence on the part of the defendants on which they could properly be held liable. He was clearly of opinion that the defendants were the common carriers of their passengers' luggage under 28 lb.; and the question arose whether they had, as contended by Mr. Meynell, for the Corporation, succeeded in freeing themselves of liability. Reliance could not be placed upon Sec. 28 of the Local Tramways Act, 1882, because of the charge made, and because of the removal of the luggage from the passengers' control. The defendants relied on the ticket issued in return for the penny. The printing as to the limitation of liability was very small, and he could not read it in the light available in the Court at that moment. As to this point, it seemed to have been settled, more than 40 years ago, by the judgment in Henderson *v.* Stevenson (which his Honour quoted), in which the then Lord Chancellor said there was nothing on the face of the ticket held by the respondent referring him to the back, and there was nothing said by the clerk who issued the ticket directing the respondent's attention to what was printed on the back. "Their Lordships, therefore, may take it as a matter of fact that the respondent was not aware of that which was printed upon the back of the ticket; consequently, so far as any intelligent knowledge of what was there printed is concerned, he cannot be taken intelligently to have agreed to the terms printed on the back of the ticket." His Lordship added that it did not, it seemed to him, depend on any technicality of law, but upon common sense. The Lord Chancellor concluded: "'Can it be held that, when a person is entering into a contract containing terms which, *de facto*, he does not know, and as to which he has received no notice, he ought to inform himself upon them?' My Lords, it appears to me to be impossible that that can be held." His Honour held that the facts there, and in the present case, were identically the same, and he, for that reason, said judgment must be for the plaintiff, with costs on scale B.

Bradbear *v.* Balfour, Beatty & Co., Ltd.

In the King's Bench Division, on Friday, Mr. Justice Bailhache and a special jury heard an action for damages for personal injuries brought by a workman against a firm of Government contractors and electrical engineers.

It appeared that the defendants were engaged in the erection of a large military camp in the North of England, and plaintiff was one of the workmen employed. His case was that while going across the grass to the hut where he slept, he collided with an obstruction, breaking his right ankle and leg, and that the defendants were liable for the act of their servants in leaving such obstruction. He was laid up for a considerable time, and he put his loss in wages alone at £90 12s. 6d. There was a permanent injury to his leg, though not of a very serious character. The defendants denied negligence, and pleaded contributory negligence on the part of the plaintiff.

The jury, after a brief deliberation, returned a verdict in favour of the plaintiff for £200 damages.

Judgment was entered accordingly, with costs.

Edmundson's Electricity Corporation, Ltd., *v.* Roscrea (Co. Tipperary) Bacon Factory, Ltd.

In the Irish High Court, Dublin, before Mr. Justice Kenny, plaintiffs sued defendants to recover £43 10s. 10d. for work done and material supplied under contract in connection with the factory, including a number of extras.

His Lordship, who said there was a considerable conflict of evidence in the case, found for the plaintiffs for the whole sum claimed, subject to certain deductions, which brought it down to £41 11s. 3d., and gave judgment for the balance between that amount and an amount lodged in Court. He explained that he based his decision mainly on unanswered letters and the absence of explanations as to accounts on the part of the defendants.

BUSINESS NOTES.

Trade Credit in Russia.—In the course of an article on "The Credit Situation in Siberia," the *Board of Trade Journal* quotes extracts from a report prepared by the Canadian Trade Commissioner at Omsk. In regard to the question of information regarding a customer's standing, it is stated that the success of German firms in the granting of credits in Russia was largely due to the assistance afforded by the home banks. German firms were also greatly helped by the fact that they frequently maintained their own resident agents, who were able to investigate carefully the credit standing of customers. In addition, valuable facilities were afforded by the mercantile agencies, whose ramifications in Russia were extensive. Apart from the assistance to be gained by these means, it is not always an easy matter for foreign firms to obtain information respecting the standing of prospective customers. Banks, as a rule, are only able to supply particulars as to the extent of credit which they consider it safe for them to grant to the party concerned. It is also claimed that the banks are not always in a position to give a disinterested estimate regarding the standing of a client. These considerations, however, apply practically to only a certain class of firms. It is nearly always possible to obtain satisfactory references regarding the standing of responsible and old-established houses.

The Warehouses of Manchester.—A very interesting 48-pp. booklet has just been received from the Port of Manchester Warehouses, Ltd., at Trafford Park. It comes with particular appropriateness just now when everybody is thinking so much about imports and storage accommodation. The company has a closed warehouse capacity exceeding 400,000 tons, the major portion of which has been constructed during the war. There are steel gantries fitted with electric cranes and magnets to stock 100,000 tons of iron and steel. The equipment includes 37 overhead electric travelling cranes, portable electric pilers, elevators and transporters, 300 railway wagons for exchanging traffic with ships in the Manchester Docks, and so on. The half-tone views of the interiors and exteriors of the warehouses, also those of the electric carriers and loaders, cranes, &c., are very effective. The advantages of the warehouses are specially tabulated at the end of the booklet.

Bankruptcy Proceedings.—Brown, F., Llanelly, electrician (formerly partner in Hugh Bros. & Brown).—March 7th is the last day for the receipt of proofs for dividend by Mr. H. W. Thomas, 4, Queen Street, Carmarthen, the trustee.

Catalogues and Lists.—The Edison Swan Electric Co., Ltd., of Ponders End, have issued a wall showcard showing five types of Ediswan batteries in their "natural" colours.

Messrs. Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Leaflet giving illustrations and prices of their inspection lamps for motor vehicle work.

Benjamin Electric, Ltd., 1a, Rosebery Avenue, London, E.C.—Section list No. 509 (16 pages) containing illustrated particulars and prices of their reflector fittings, lanterns, and lighting accessories for industrial and general installations.

Electrical Apparatus Co., Ltd., Vauxhall Works, South Lambeth Road, London, S.W.—The first issue of the "E.A.C. Quarterly Review" contains illustrations and descriptive matter relating to the company's motor-control panels, A.C. drum-type switchgear, automatic control for C.C. motors, house-service meters, and controller regulators for tramcars. The "Review," which opens with the company's Roll of Honour, is intended to form a connecting link between the works and the sales staffs.

Igranic Electric Co., Ltd., 147, Queen Victoria Street, London, E.C.—First part of a new catalogue of "Igranic" electric controlling devices. This consists of a bulky collection of leaflets which is a foretaste of bulkier things to come. It is the firm's aim to make the catalogue in its later form, as newly-issued leaflets appear, the most complete list of electric controlling apparatus ever compiled. The general index foreshadows the ultimate extent and arrangement: Part I will cover direct-current apparatus; Part II, alternating; Part III, controlling devices for lighting circuits (D.C. and A.C.); and Part IV, lifting magnets and magnetic specialities. The information given is descriptive of the manufactures, and tables of sizes, powers, dimensions, prices &c., are given, accompanied by half-tone views and diagrams. It is quite unnecessary for us to give a list of names of manufactures; the ground covered is fairly obvious from what we have already said. Many of the firm's standard types are not included in this first portion of the catalogue, but the trade will probably be aware of the fact that the company can supply control gear for purposes for which no standard patterns exist.

General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—Leaflet No. L2,092 gives illustrations and prices of electric bells for use on power circuits. Folder O.S.2,091 gives prices and other particulars of the "Usal" drawn-wire tungsten lamps for pocket lamps, &c.; these folders can be supplied overprinted for the trade.

British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park.—Circular No. 1,435/2A, of 68 pages, contains a general description of the British Westinghouse Rateau impulse-type steam turbines. In five sections there are dealt with: High-pressure turbines; low-pressure or exhaust turbines; mixed-pressure turbines; back-pressure and reducing turbines; and small turbines. Later in the list, a number of charts are given of official tests, also names of customers and the machines they are using. By means of a map, the distribution of the company's turbines in Great Britain is shown.

Messrs. Berry, Skinner & Co., 86, Newman Street, Oxford Street, London, W.—Illustrated list No. 5,191 (16 pages), in French, giving a description, with prices in the French coinage, code-words, &c., of "Masta" type fuse-switches.

British Thomson-Houston Co., Ltd., 77, Upper Thames Street, London, E.C.—Price list No. 10,502 shows and describes the B.T.H. type of 913 Form "A" hand lamp for workshop and factory use.

Dissolutions and Liquidations.—Railless Electric Traction Co., Ltd.—This company is winding up voluntarily, with Mr. A. Page, 28, King Street, E.C., as liquidator. A meeting of creditors is called for February 26th, at 28, King Street, E.C.

Electric Railway and Tramway Carriage Works, Ltd.—This company is winding up voluntarily, with Mr. L. E. Pickin as liquidator.

G. F. Milnes & Co., Ltd.—This company is winding up voluntarily, with Mr. L. E. Pickin as liquidator.

British Electric Car Co., Ltd.—This company is winding up voluntarily, with Mr. L. E. Pickin as liquidator.

Adams Manufacturing Co., Ltd.—A meeting is called for March 19th, at 8, Bream's Buildings, E.C., to hear an account of the winding up from the liquidators, Mr. L. Hardy and Mr. G. E. Corfield.

R. Organ & Sons, gas fitters and electricians, 88, Winchcombe Street, Cheltenham.—Mr. R. Organ, Sen., has retired from the firm, and the debts, &c., will be attended to by Messrs. R. Organ, Jun., and E. E. S. Organ, who will continue the business under the same name.

Gröndal Kjellin Co., Ltd.—For the purposes of reconstruction, this company is to be wound up voluntarily, with Mr. G. H. Hill, 20, Abchurch Lane, E.C., as liquidator. The new company will be the Gröndal Kjellin Co. (1917), Ltd. Creditors must send in the usual particulars by March 29th.

South Wales Wireless Training College, Ltd.—A meeting is called for March 22nd, to hear an account of the winding-up from the liquidator, Mr. G. F. Willett.

Trade Announcements.—The London address of Messrs. Oliver Arc Lamp, Ltd., is now 46-49, Granville House, Arundel Street, Strand, W.C. Telephone No. unaltered (City 3393).

The Woods-Gilbert (British) Rail Grinding and Milling Co., Ltd., has been formed for the purpose of acquiring from the Woods-Gilbert Rail Planer Co., Ltd., of Melbourne, all the assets, liabilities, and goodwill of the business hitherto carried on by them in Great Britain. They have taken premises at 170, Strand, W.C.

Messrs. Siemens Bros. & Co., Ltd., and Siemens Bros. Dynamo Works, Ltd., have removed their offices from Caxton House, Westminster, to Palace Place Mansions, Kensington Court, London, W. Telegraphic address: "Siemens, Kens. London." Telephone No.: "Western 6349."

The *Hardwareman and Ironmongers' Chronicle* has removed its offices to 265, Strand, London, W.C.

The *Engineering Review* has removed its offices to 13-16, Fisher Street, W.C.

Book Notices.—"*Journal* of the Institution of Electrical Engineers." Vol. LV., No. 263. February, 1917. This issue contains the following papers:—"Principles Involved in Computing the Depreciation of Plant," by Mr. F. Gill and Mr. W. W. Cook; "Post War Electrotechnics," by Dr. C. V. Drysdale; also a tenth list of the names of 81 members on military service.

"Science Abstracts." Sections A and B, Vol. XX, Part 1. January 31st, 1917. Index to Vol. XIX, Sections A and B. London: E. & F. N. Spon. Price 1s. 6d. each net.

"Hydro-Electric Power" (2 vols.) By L. Lyndon. London: Hill Publishing Co. Price, Vol. I, 21s. net; Vol. II, 15s. net.

"Underground Transmission and Distribution," by E. B. Meyer. London: Hill Publishing Co. Price 12s. 6d. net.

Journal of the Röntgen Society. Vol. XIII, No. 50. January, 1917. London: Percy Lund, Humphries & Co., Ltd. Price 4s. net.

"Depreciation and Wasting Assets." By P. D. Leake. London: Sir Isaac Pitman & Sons. Price 10s. 6d. net.

LIGHTING AND POWER NOTES.

Asiatic Turkey.—It is reported that German electrical engineering concerns are looking forward to an important trade in electrical material in Turkey and Asia Minor. One important scheme that is being developed is a plant to utilise certain waterfalls near El Scheab in Syria. It is stated that about 9,000 H.P. will be available, and that the current generated will be utilised for the Damascus-Jerusalem Railway, and for lighting and power purposes in the villages and towns in the district.

Barnes.—Proposed Bulk Supply.—A request having been received from the Ealing T.C. to confer on the question of bulk supply, the chairman of the Council, the chairman of the Electricity Committee, and the electrical engineer were appointed to discuss the matter.

Canada.—On January 1st the Edmonton Power Co. started clearing the ground for the big dam it is proposing to build, 75 miles south-west of Edmonton, on the North Saskatchewan River. It is estimated that the construction of the plant, which will develop 55,000 H.P., will take several years, and cost $5,000,000. In connection with the scheme a contract has been let for the construction of a railway from Edmonton to the dam site.

The British Mining and Smelting Co. is extending its hydro-electric plant at Britannia Beach, Howe Sound, 20 miles north of Vancouver, by the addition of a 2,500-K.V.A. generator coupled to two 1,850-H.P. impulse water wheels, which will operate under a static head of 850 ft., obtained by a diversion of the South Valley River.—*Can. Electrical News.*

Dundalk.—Loan Sanction, &c.—At a meeting of the Urban Council, a letter was read from the L.G.B. for Ireland, in reference to the Council's application for a loan of £5,000 for the extension of the electricity undertaking, and the inquiry held into the matter. The Board stated that it had decided to sanction a loan of £3,000, repayment to be spread over 20 years. It expressed the opinion that the Council had no power, under the Act of 1882, and the Dundalk Electric Light Order, 1897, to borrow the further £2,000 to recoup the Council for repayment of capital or payment of interest on capital or for working capital, and pointed out that it was the clear duty of the Council to provide for balancing the working account of the undertaking by the addition to local rates of about 10d. in the £ in the estimate for the coming financial year, at the opening of which, it is anticipated, the accumulated deficit will be £1,260.

Harrogate.—Boiler By-Product Recovery Plant.—The borough electrical engineer (Mr. Wilkinson) has been authorised by the T.C., on the recommendation of the Electricity Committee, to prepare specifications, and advertise for tenders, in connection with the erection of steam plant, designed by himself, which embodies the features of smokeless combustion with the recovery of tar and ammoniacal liquors as by-products, the necessary authorisation for construction having been obtained.

London.—Shoreditch.—The Electricity Committee recommends a further advance of 5 per cent. (making 25 per cent. in all) on the schedule charges for electricity for lighting, power and heating, from the date of the March, 1917, meter readings.

Market Drayton.—Street Lighting.—The U.D.C. has agreed to the offer by the Electricity Co. to accept £50 in settlement of its account of £100 for public lighting for the half-year ended December 31st last,

Rochdale.—The Electricity Committee has decided, subject to the consent of the Bolton Electricity Committee, to call in Mr. W. J. H. Wood, borough electrical engineer at Bolton, as consulting engineer for three months, so that he may prepare a report on the present situation, and advise the Committee on the best means of overcoming the difficulty of meeting the demands for electricity. Although the position at the works is improving, the recent frost has prevented the completion of the extension scheme.

Roslea (Co. Fermanagh).—Electric lighting has been installed in the sawmills, clog factory, and scutch mills, the work being carried out by Messrs. McCartney Bros., of Clones.

Salford.—Year's Working.—The annual report of Mr. Robertson, borough electrical engineer, shows that 24,856,000 units were sold during 1915-16, as compared with 20,600,000 in the previous year; the increase was mostly accounted for by the increasing power supply, for which purpose 13,650,000 units were supplied, as against 9,900,000 in 1914-15. Both lighting and traction units were also ahead of the previous year, by 12·2 and 2·4 per cent. respectively. The effect on the generating plant is shown by the load factor improving from 26·6 to 30·2 per cent. and by the reduction in total works costs from ·74d. to ·67d. per unit, despite the higher price of fuel, &c. Altogether 29,117,000 units were generated and 1,178,000 purchased; the maximum load was 9,400 KW. and the lighting and power connections totalled 27,726 KW. It is interesting to note that works costs fell from ·56d. to ·50d., and coal costs from ·339d. to ·335d. per unit sold; the cost of the purchased energy (at ·9d. per unit approximately) is distributed over the works costs. During the year a second 5,000-KW. turbo-alternator was installed—a duplicate of the first which was illustrated in our columns in the early days of the war—and a third turbine set of the same size was expected to be in commission for the winter's load. Two Babcock boilers, with economisers, superheaters, and induced draught, have been ordered to supplement the steam plant, and we also note (and draw the E.V. Committee's attention to the fact) that two petrol motor-wagons have been obtained for ash removal and other work. A new agreement has been entered into with the Lancs. Power Co. for bulk supply under more favourable terms; a new sub-station has also been opened and a 3,000-KW. sub-station is being erected. The consumers totalled 3,707 at the close of the year. The financial results, in brief, were a revenue of £134,678, a gross profit of £64,538, and, after meeting interest and loan charges, a net profit of £16,598, of which £8,000 went to rate relief and the balance to the renewals account—the latter fund having a balance of £28,000 in hand. The balance-sheet, apparently, shows that a total of £102,658 depreciation has been written off, and that some £31,000 has been expended on capital account out of revenue.

Sheffield.—Year's Working.—The report on the working of the Corporation electricity undertaking for the year to March 31st last is one of the most interesting we have seen. It is, of course, generally known that the Sheffield undertaking has made tremendous strides since the war commenced, and this is borne out by the output sold—77,868,000 units, as against 44,873,000 in 1915, and 26,546,000 in 1914; the whole of the increased output represented power and traction (or low-price units), but the net surplus of £33,296 is the largest yet recorded (roughly 51 million power and 20 million traction units were sold). The total units generated amounted to 90½ millions, and we note that 131,000 tons of coal were consumed. The generating plant capacity was 42,225 KW., and the maximum demand was 31,706 K.V.A., while the total KW. connected was 83,834, which included 69,074 H.P. of motors.

We note that at the time of the report 28,000 KW. of additional generating plant was being added, and that 18,000 KW. of additional load was awaiting connection, and since that time, as our readers will have gathered, it has been decided to provide another large generating station on a new site.

The capital cost per KW. on electric supply plant had fallen in 1916 to £41 per KW.

The disproportionate increase in the cost of fuel resulted in a small increase in the total costs per unit, from ·41d. to ·44d., fuel cost having risen from ·19d. to ·27d. per unit, the costs being those of the Sheaf Street, Neepsend, and Kelham stations combined. The average price per unit sold was ·85d., power supply averaging ·71d. per unit.

The total revenue was £314,437; gross profit, £133,409; and surplus, after meeting interest and loan charges, £33,296, which, with accrued interest, left £40,278 for appropriation. Of this sum, £39,778 was devoted to renewals, and £500 to the hire-motor fund.

The renewals fund has a balance in hand of £53,000, and the reserve fund, of £10,000, but the total appropriation for renewals and reserve to date amounts to £109,000. In passing, we congratulate the Electricity Committee and its engineer, Mr. Fedden, on the policy which has been adopted of keeping the surpluses in the undertaking; charity, in the form of rate aid, at the expense of a municipal undertaking which has to replace its contribution with borrowod money at a high rate of interest, and necessarily passes the added cost on to the consumer, to the detriment of local trade and industry, is an empty gift in any case.

Southend-on-Sea.—Proposed Extensions.—The Electric Lighting Committee has considered the extension of the generating plant in order to cope with the increasing demand for current, and has decided (subject to the usual sanction) that application may be made to the L.G.B. for leave to borrow £45,520 for the provision of additional generating plant at the electricity works. An application was received from the Southend Gas Co. for a supply of current for power purposes at the gasworks.

Stratford-on-Avon.—The T.C. has decided to continue the agreement under which the Electricity Co. can charge a higher rate per unit for current, for another year.

Swinton and Pendlebury.—The Lancashire Electric Power Co. has notified the Council that it will be necessary to increase the charge for electricity by ·2d. per unit, owing to the increased cost of fuel.

Torquay.—Supply Data.—During the 12 months ended December 31st, 1916, 1,286,460 alternating-current units were generated, as against 1,208,258 units in the previous year. As regards direct-current units, the figures were 1,166,460, as against 1,080,860. The public lighting decrease was equivalent to 78·2 per cent. The units sold to the Tramway Co. showed an increase for the year of 4·22 per cent.

Troon.—The town clerk reported to the T.C. that he had communicated the Council's decision to the engineer regarding the proposal to use overhead cable to supply a hosiery factory. It was recommended that the attention of the B. of T. be drawn to the use of overhead cable without the consent of the local authority, and in violation of its wishes.

Whitstable.—The U.D.C. has decided to give the Electricity Co. seven days in which to take such proceedings as will define the legal position between the Receiver and itself; otherwise, the Council will feel bound to take such steps as may be necessary to protect itself from further liability.

TRAMWAY and RAILWAY NOTES.

Blackburn.—Accidents.—On Sunday last a collision occurred between two cars, one following the other, in a thick fog, one driver being injured; on Thursday, last week, a collision occurred between two cars travelling in opposite directions at Oswaldtwistle, due to the slippery rails, and two passengers and a driver were injured.

Bolivia.—Railway construction in Bolivia is in a backward state owing to the difficulties of the country; as a consequence, attention is mainly directed to the conversion to electric traction of such lines as are already in existence. Where new lines are projected, only those suitable for electrification are favoured. In either case, Bolivia presents an opening of some value to oversea electric industries. Among new schemes at the moment is the electric railway from Isa Paz to Yungas, officially sanctioned in 1915. The estimated cost of the line is 12,000,000 fr., met by the issue of departmental bonds guaranteed by the Government; the Board of Public Works is carrying out the construction.—*La Revue Generale de l' Electricite.*

Canada.—According to the *Canadian Engineer*, the Mount Royal tunnel of the Canadian Northern Railway is now practically completed, and permanent track is being laid; it is expected that trains will be running into Montreal by next June. Two 80-ton electric locomotives are now in use, and four more will be purchased for the regular service.

Lancashire.—War Bonus.—Following upon the exclusion by the Committee of Production of females from the war bonus granted to tramway workers recently, an effort is being made to secure the concession for them. The general secretary of the Tramway Workers' Association has sent to all the Corporations and companies included in the previous arbitration an application for a bonus of 6s. 6d. per week, less any war bonus granted since the outbreak of the war to male workers. The girls employed on Bolton tramways are included in the application, though it is understood that they are not members of the Association.

Both the permanent-way men and the females employed as conductors on the Preston Corporation Tramways have applied for the war bonus of 6s. 6d. per week recently awarded to certain tramway employés by the Committee on Production, but the Tramways Committee states that it is not able to depart from the terms of the award.

London.—L.C.C.—The Highways Committee reports that the additional financial burdens placed upon the Council's tramway undertaking from the outbreak of the war to March 31st, 1917, in respect of wages, &c., to employés are as follows:—War bonus and war wages, £172,150; increases in rates of pay, £8,300; war service allowance, £250,950; a total of £431,400.

On the basis of the present establishment, the additional annual cost under these three heads is £268,400, which is equivalent to a charge of 1·288d. per car-mile run. The cost of the salaries and wages in the tramway department increased from 4·70d. per car-mile in 1911 to 5·60d. per car-mile in 1915-16.

The Highways Committee has submitted a scheme for the reorganisation of the Council's tramway department. It is proposed to divide the work into five branches—traffic, electrical, rolling stock, permanent way, and general; the position of deputy chief officer is to be done away with, the heads of branches to be directly under the chief officer.

The traffic branch is to be subdivided into two sections—a development and publicity section, and an operation section.

The Committee points out that the Council's tramways have to compete for traffic with other means of transit, and the development of the undertaking on successful lines must, to a considerable extent, depend on constant and well-directed effort to adjust the services to public need.

Equal importance is also attached to publicity work ; the chief officer is of opinion that an expenditure of from £15,000 to £20,000 would be necessary to advertise adequately the Council's tramways. The Committee considers that greater use should be made of the Press to convey to the public the advantages peculiar to the tramway service.

Under the reorganisation scheme, the Committee recommends the following appointments :—Traffic manager at a salary of £1,200, rising to £1,500 a year ; the position of electrical assistant to be abolished and an electrical engineer appointed at £1,200, rising to £1,500 a year ; a rolling stock engineer, £1,000 to £1,200, the position not to be filled at present ; permanent-way engineer, £800 to £1,000 ; a chief clerk, and in the traffic branch a development superintendent, at £500, rising to £700 ; an operation superintendent, £500 to £700 ; and a publicity assistant at £300 to £400. Minor appointments and rearrangements of certain offices are also recommended for the position of electrical engineer, development superintendent, and operation superintendent ; it is proposed to arrange for advertisements to be issued.

At its meeting, on Tuesday, the Council approved the above scheme of reorganisation ; Mr. J. K. Bruce (deputy chief officer) was appointed traffic manager at £1,250 per annum. It was mentioned that Mr. A. L. C. Fell, chief officer, had returned to duty after six months' absence on sick leave.

Southend-on-Sea.—Owing to the difficulty of obtaining male drivers, inquiries are being made to ascertain from other towns, which have engaged women drivers, their experience of the adoption of this experiment. Arrangements are to be made for the conversion of one of the large bogey cars into a double-decked car, as an experiment, at an approximate cost of £75.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—March 7th. Powell-Duffryn Steam Coal Co. Electrical goods for 12 months. Stores Manager, Aberaman Offices, Aberdare.

March 8th. U.D.C. Annual tenders for cable, meters, joint boxes, electric lamps, &c., for the Electricity and Tramways Department. See "Official Notices" to-day.

Australia.—Sydney.—March 5th. Council. One 7,500-k.v.a. turbo-alternator. See "Official Notices" January 5th.

Adelaide.—March 28th. P.M.G.'s Department. Telephones, telephone parts, line and battery material, &c. Schedules 444 to 453. See "Official Notices" February 2nd.

Melbourne.—March 7th. Council. 1,048 electricity recording meters. See "Official Notices" February 9th.

March 21st. Victorian Railways. 200 half-watt lamps and 100 lanterns ; also 100 contact couplings.* April 4th. Terminal blocks (complete) for electrical connections.

Brisbane.—February 28th. P.M.G.'s Department. Telephone apparatus, Schedule 385 ; ear-pieces, &c., Schedule 386 ; heat coils, protectors, &c., Schedule 391. See "Official Notices" to-day.

March 28th. P.M.G.'s Department. Cable (switchboard), Schedule 394.

Argentina. — Buenos Aires. — March 30th. Electric carbons during 1917, for the municipality. Local representation. Conditions from Oficina de Licitaciones, Intendencia Municipal de la Capital, Avenida de Mayo 525, Buenos Aires.—*B. of T. Journal.*

Barrow.—March 5th. Corporation. Electrical stores for 12 months. Borough Electrical Engineer.

Bedwas (Mon.). — March 8th. Bedwas Navigation Colliery Co., Ltd. Twelve months' supply of electrical goods, &c. Mr. G. Morgan, Secretary.

Belfast.—March 3rd. Electricity and Tramways Committee. Tramway stores, including electrical accessories, cables, lamps, &c. See "Official Notices" to-day.

March 14th. Electricity and Tramways Committee. Six or twelve months' supply of stores, including several electrical items, for the Electricity Department. See "Official Notices" to-day.

Bolton.—March 7th. Electricity Committee. Materials and stores. See "Official Notices" February 16th.

Brighton.—March 9th. T.C. Five-ton steam motor-wagon and 3½-ton electric motor-wagon. Particulars from Mr. H. Talbot, Town Clerk.

Canada.—March 28th. Toronto Electric Commissioners. Synchronous condensers, 5,000, 7,500 or 10,000 k.v.a. capacity. See "Official Notices" February 9th.

Glasgow. — The general manager of the Corporation Tramways Department is to obtain offers for the supply of an electrically-propelled vehicle for the use of the department.

Grenada.—March 31st. The time for tendering for the Government electric light and power concession, already announced, has been extended to March 31st.

Harrogate. — March 5th. Corporation. By-product steam boiler plant. See "Official Notices" February 2nd.

Kilmallock.—March 5th. Kilmallock (Co. Limerick) E.L. & P. Co., Ltd. Hydraulic turbine, dynamo and motor booster, battery and switchboard. See "Official Notices" February 16th.

London.—Hammersmith.—February 28th. B.C. Electricity stores for 12 months. See "Official Notices" February 16th.

Metropolitan Water Board.—March 8th. Twelve months' supply of electric lamps. Chief Engineer, Savoy Court, Strand, W.C.

L.C.C.—The Highways Committee recommends that tenders be invited for alterations to the switchboard gallery and for the laying of additional condenser water pipes at the Greenwich generating station.

Londonderry.—March 17th. Corporation. Engine-room stores, carbons, electricity meters, cables, &c., for the Electricity Department. Town Clerk.

Macclesfield.—March 14th. Cheshire County Asylum. Electrical goods for one year. Mr. W. G. F. Tingay, Clerk to the Asylum, Parkside.

Manchester.—March 7th. Electricity Committee. Coal-conveying plant and suction ash plant. See "Official Notices" February 9th.

March 14th. Corporation. Nine 40-h.p., three-phase, slip-ring motors. See "Official Notices" to-day.

Stockton-on-Tees.—March 12th. Stores for the T.C. Electricity Department. See "Official Notices" to-day.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Bedford.—The Education Committee has accepted the tender of Mr. F. Nash for electrical work until June 30th.

The T.C. has accepted the following tenders :—

Siemens Bros. & Co., Ltd.—Cables, £3,273, and laying and jointing, £2,631.

British Electric Transformer Co., Ltd.—Six transformers, £1,136.

Stirling Boiler Co., Ltd.—Two boilers and mechanical stokers, £6,610.

British Thomson-Houston Co., Ltd.—Turbo generator and condensing plant, £8,674.

Government Contracts.—List of new contracts placed during January, 1917 :—

War Office.

Electric cable and wire.—B.I. & Helsby Cables, Ltd. ; Callender's Cable and Construction Co., Ltd. ; Craigpark Electric Cable Co., Ltd. ; Fuller's Wire & Cable Co., Ltd. ; W. Geipel & Co. ; General Electric Co. ; W. T. Glover & Co., Ltd. ; A. Green, Ltd. ; Hooper's Telegraph and India-Rubber Works, Ltd. ; Liverpool Electric Cable Co., Ltd. ; Midland Electric Wire Co., Ltd. ; St. Helens Cable & Rubber Co., Ltd. ; Siemens Bros. & Co., Ltd. ; I.R., G.P. & Telegraph Works Co., Ltd.

Electric cells.—Siemens Bros. & Co., Ltd.

Ebonite rod and sheet.—I.R., G.P. & Telegraph Works Co., Ltd. ; Peel-Conner Telephone Works, Ltd.

Electric lighting sets.—Aster Engineering Co., Ltd.

Generating sets.—Austin Motor Co. (1914), Ltd. ; Coventry Simplex Engines, Ltd. ; W. H. Dorman & Co., Ltd. ; Heatley-Gresham Engineering Co. Ltd. ; A. Lyon & Wrench, Ltd. ; Record Engineering Co., Ltd.

Generating plant.—Austin Motor Co., Ltd.

Wood telegraph-poles.—Davey & Armitage.

Switchboards.—Dorman & Smith.

Iron and steel wire.—Dorman, Long & Co. ; R. Johnson & Nephew, Ltd., Rylands Bros., Ltd. ; Shropshire Iron Co., Ltd. ; Whitecross Co., Ltd.

India Office Store Department.

Accumulators.—Pritchett & Gold, &c., Co.

Crucibles.—Morgan Crucible Co. ; J. C. Waterhouse, Ltd.

Telephones.—Siemens Bros. & Co. ; Peel-Conner Telephone Works.

H.M. Office of Works.

Engineering works.—Electric wiring, Admiralty Transport Building : Alpha Manufacturing Co.

Post Office.

Protective apparatus.—British L. M. Ericsson Mfg. Co., Ltd.

Telegraph apparatus.—Creed & Co., Ltd.

Telephone apparatus.—British L. M. Ericsson Mfg. Co., Ltd.

Telegraph cable.—Craigpark Electric Cable Co., Ltd. ; Siemens Bros. and Co., Ltd.

Telephone cable.—W. Geipel & Co. ; W. T. Henley's Telegraph Works Co., Ltd. ; Siemens Bros. & Co., Ltd. ; Union Cable Co., Ltd. ; Western Electric Co., Ltd.

Cable drums.—B.I. & Helsby Cables, Ltd. ; Western Electric Co., Ltd.

Flameproof wire.—London Electric Wire Co. & Smiths, Ltd. ; C. Macintosh and Co., Ltd.

Plates for stay-rods.—Walls, Ltd.

Iron poles.—Siemens Bros. & Co., Ltd.

Ironwork, steel poles and fittings.—Bullers, Ltd.

Galvanised-iron wire.—Dorman, Long & Co., Ltd. ; R. Johnson & Nephew, Ltd. ; Rylands Bros., Ltd. ; F. Smith & Co., Wire Manufacturers, Ltd., Whitecross Co., Ltd.

Vulcanised I.R. wire.—Union Cable Co., Ltd.

Weymouth.—T.C. Accepted tender :—

Johnson & Phillips, Ltd.—Booster and switchgear, £980, cables and laying, £5,520.

FORTHCOMING EVENTS.

Junior Institution of Engineers, London.—Friday, February 23rd. At 7.30 p.m. "Random Notes on Structural Design," by Mr. C. G. D. Burdett. Friday, March 2nd. At 7.30 p.m. "Tool-Store Management," by Mr. S. A. Roberts.

Association of Supervising Electricians.—Tuesday, February 27th. At 7.15 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Modern Power Cables," by Mr. H. Savage.

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, February 27th. At 7 p.m. At the Engineers' Club. Paper on "Some Points in connection with Engineering Specifications," by Mr. J. Shepherd.

Royal Institution of Great Britain. Tuesday, February 27th. At 3 p.m. At Albemarle Street, Piccadilly, W. Lecture on "The Strength and Structure of Metals," by Prof. W. E. Dalby, F.R.S.

Chemical Society. Thursday, March 1st. At 8 p.m. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

SUBSTITUTION IN ELECTRICITY WORKS.

Mr. H. Faraday Proctor, honorary secretary of the Incorporated Municipal Electrical Association, has, by request of the Reserved Occupations Committee (St. Ermin's Hotel), fowarded to members a copy of a letter and memorandum addressed to the Association by the Committee, under date February 5th. The Committee draws attention to the revised list of certified occupations which came into force on February 1st, and adds :—"You will see that the reservation for electrical generating stations remains unchanged for the present', and that no age limit has been imposed. This exceptionally favourable treatment cannot, however, be continued without modification, and the enclosed memorandum has accordingly been prepared for the guidance of electrical undertakings in effecting substitution and thus releasing men for the Army."

Mr. Faraday Proctor, in forwarding the memorandum, which we print below, to members, makes the following observations :

"The Committee particularly desire that all electrical undertakers should take action in this matter as speedily as possible, and that disabled soldiers and sailors should be used as far as possible at electric generating stations, but that if a sufficiency of such disabled men is not forthcoming, there may be no delay in introducing women for occupations where their services are capable of being used.

"You will probably be aware of what is being done in the matter of training disabled soldiers and sailors at the Northampton Institute and elsewhere, in which matter the Institution of Electrical Engineers is taking a prominent part.

"The question of data as to the sufficiency of men for the various positions, as also the question of technical advice in the matter of retaining a sufficiency of skilled operators in electricity works, is receiving attention at the present time."

[*Copy of Memorandum issued by the Reserved Occupations Committee for the Guidance of Electrical Undertakings in effecting substitution of and releasing Men for the Army.*]

ELECTRICAL GENERATING STATIONS.

It is known that many electrical generating stations have lost a considerable number of men through enlistment, while, at the same time, especially in towns with a large number of munition works, the demands for current are much greater than ever. In small towns, staffs in normal times are often so small as to leave but little margin for reduction. Moreover, many of the occupations inside the stations, and some of those outside, in connection with the mains and with installation, require skilled engineers, mechanics, or trained workers of long experience.

It is for these reasons that the reservation for electrical generating stations in the List of Certified Occupations has hitherto been so wide, all classes of workmen being covered, and no age limit imposed. It is felt, however, that this exceptionally favourable reservation cannot be continued without modification after the end of February, and managers of electrical undertakings should make every effort to release men for the Army by substituting women, disabled men, or men of inferior medical categories for men of military age and fitness. The following memorandum has been prepared with a view to assisting managers in this purpose :—

I.—Substitution by Disabled Soldiers or by Men of Inferior Medical Categories.

It is suggested that inexperienced unskilled men would be suitable for immediate employment, without training, in some of the jobs in an electrical station. Nevertheless, disabled soldiers could be utilised in some occupations, *e.g.*, as assistant switchboard attendants, with a moderate amount of training, or even, in some of the smaller stations as switchboard attendants to release men of military age and fitness.

In the same way, men of inferior medical categories can often perform efficiently work upon which men of Category A or B 1 are are at present employed, thus releasing the latter. Under certain conditions the Army Council are even prepared to exchange trained men of the lower medical categories who have already joined the Colours for men of Category A or B 1, returning them *to their former employers*, where their services are likely to be of greater service than elsewhere, and where they can live at their own homes. Firms desirous of taking advantage of this arrangement should communicate with the Secretary (D.R. 4), War Office Annexe, Whitehall Place, London, S.W.

II.—Substitution by Women.

Substitution of women for men is possible for some jobs, and has already been successfully started in certain stations in the processes indicated below. In connection with one large station 21 women are now employed.

Switchboard Attendants and Attendants at Sub-Stations.

This applies both in the main generating stations and in those larger sub-stations which require the constant presence of such workers. For these posts a superior type of woman should be engaged if available, preferably one who has had some scientific training. In large stations where two or three attendants, or more, are engaged on each shift, it would doubtless be necessary to have, as charge hand on each shift, a skilled male attendant ; but junior switchboard attendants can readily be replaced by suitable women. Normally junior switchboard attendants are youths who undertake such work for a time, in order to gain practical switchboard experience, as a stepping-stone to the position of electrical engineer.

In some of the less important sub-stations women can also be employed ; but in those which ordinarily require the presence of one man only it is recommended that two women should be substituted, when these have been trained, in view of the possibility that a woman working alone may, in case of emergency, lose her presence of mind. The work of sub-station attendants being eminently suitable for disabled soldiers and sailors, provided they are carefully selected, it is desirable that they should be obtained where possible for training and employment in preference to women.

Meter Testing. This work also would call for women of a superior type, and although it would require a long preliminary training before they could undertake it unaided, women could perform useful work as assistants whilst being trained. Other jobs which ordinary working women can successfully undertake are :—

Cleaning of Station and Machinery.—In the modern stations, fitted with high-speed turbo-generators, cleaning operations are much simpler and can be done with but little risk of accident, compared with the older stations, where the machinery is not enclosed, and the various parts which require cleaning are difficult to get at. Even in the latter case, cleaning of machinery—*e.g.*, engines and dynamos, *whilst at rest*—can very well be done by women, if suitably clothed and if proper appliances—*e.g.*, step ladders, movable wood platforms, &c.—are provided to give safe access to the various parts. For such work as cleaning floors, &c., women are of course very suitable.

Labourers in Boiler Houses and Refuse Destructors.—There is not much scope for women in the modern type of boiler house, where the coal and ash handling and stoking is done mechanically, but in the smaller stations they can be employed in such jobs as ash wheeling and cleaning up. Much can be done in this and in other occupations, to facilitate the employment of women by providing smaller barrows, suitable overalls or other clothing, and the like.

Meter Reading.—This outdoor work can well be done by women.

General.—In all cases where women or girls are employed separate sanitary and washing conveniences should of course be provided, and provision should, if possible, be made for the supply of meals apart from the men.

In certain shift work a modification of the Factory Acts would be required to permit of the employment of women at night and on Sundays ; but the Home Office are at all times ready to consider applications for permits for the employment of women in this manner, under suitable safeguards.

NOTES.

Electrically-Welded Tool Tips.—An article in a recent issue of the *Railway Review* refers to the practice of the Westinghouse Electric and Manufacturing Co., of East Pittsburg, which is at the present time utilising the electric arc process for welding high-speed steel tips to machine-steel shanks for cutting tools fo many of its planers and lathes. Old, worn-out high-speed stee tools can be cut to proper size and utilised for tips, with resulting economy in costly material.

The arc welding process has been found much cheaper than the oxy-acetylene and forging methods. For best results, a current o 100 amperes at 60 to 70 volts is employed, using a $\frac{5}{32}$ in. Norway iron electrode. A good operator will make 25 to 30 welds o $1\frac{1}{2}$ sq. in. cross-section tools in $9\frac{1}{2}$ hours.

Electric Light Switching.—The following is the resul of Messrs. Lundberg's Third Batch Exam. (names in order o merit) :—

Advanced Grade.—John Moran (Bury, Lancs.), E. Emery (Old Hill, Staffs.), C. R. Gunn (Liverpool).

Intermediate Grade.—R. G. Stripp (London, N.W.), H. S. Edwin (Dartford), J. Hamer (Dewsbury), J. T. Watkin (Newark), F. Townshend (Cap Town, S.A.) *Another paper :* R. P. Gilbert (London, N.) *Anothe paper :* Sapper A. J. Tourle, R.E. (Dunstable).

Preliminary Grade.—Reginald A. Paxton (Manchester), R. F. Nailo (London, W.), G. D. Hamavala (Bombay), E. Briggs (Barnsley), F Ellis (Port Talbot), "Spark" (Paisley), C. McLindon (Delgany, Co Wicklow). *Another paper :* F. White (Grantham), J. Hesson (Work ington, Cumberland), A. Collins (Eastbourne), A. Pizzuto (Malta), Pioneer V. T. Rawlins (B.E.F.), W. P. Stockdale (Leadgate, Co Durham). *Another paper :* C. H. Dutton (London, W.), H. Parkinso (Stoke-on-Trent).

Candidates whose names do not appear above, and who have no received intimation of failure, are informed that their paper will be included in the next batch. Full particulars regardin these periodical Exams. may be had on application to Messrs. A. Lundberg & Sons, 477-489, Liverpool Road, London, N.

Institution and Lecture Notes. — Institution of Engineers and Shipbuilders in Scotland.—On Tuesday, two papers were down for reading at Glasgow: "Economic Recuperation After the War," by Prof. W. R. Scott; "Influence of Retarders on the Transmission of Heat Through Boiler Tubes." by Mr. R. Royds.

Institution of Gas Engineers.—The annual meeting will take place in London, on Tuesday, June 5th. There will be a presidential address, but no papers. On June 6th, there will be a visit to the works of the Tottenham District Light, Heat and Power Co., to view the new section of the works now approaching completion. The company's electric generating station at Wood Green will also be inspected.

Institution of Mechanical Engineers.—The report of the Council for 1916 shows a total membership of 6,247, a reduction of 72 during the year. The total revenue was £22,444 and the expenditure £12,629, leaving a surplus of £9,815. The total investments and other assets amounted to £137,588, and the net capital to £75,692. Over 900 members were on active service during the year. A sum of £500 has been granted in aid of the translation of the specifications of the British Engineering Standards Committee into French, Spanish, and Russian, with metric equivalents of English measures, and to enable them to be sold at lower prices, the Council regarding this work as of vital importance to British engineering firms.

Institution of Electrical Engineers.—Mr. Joseph Taylor, hon. secretary of the SCOTTISH LOCAL SECTION, intimates that the next Edinburgh meeting will be held on March 20th, when Mr. S. A. Juhlin will read a paper on "Voltage Regulation of Rotary Converters."

Dr. Alex. Russell delivered his Kelvin lecture—"Some Aspects of Lord Kelvin's Life and Work"—at the monthly meeting of the SCOTTISH LOCAL SECTION, in Glasgow, on February 16th. He gave some interesting reminiscences of his own boyhood and youth in Glasgow, and recalled the names and characteristics of several of his teachers and professors at Glasgow University. After the lecture—which has already been abstracted in our pages Dr. Russell, in proposing a vote of thanks to Prof. Gray for the assistance given him in providing apparatus for the experiments in connection with the lecture, said that Prof. Gray had been an able successor to Lord Kelvin, and his work was well known to experts all the world over. Early in the proceedings, the chairman (Mr. J. K. Stothert) announced the following nominations by the Committee for the office bearers for the session 1917-18:—Chairman: Mr. Archibald Page; vice-chairmen: Messrs. E. T. Goslin and A. S. Hampton; hon. secretary: Mr. Joseph Taylor; assistant hon. secretary: Mr. Wm. F. Mitchell; Committee: Messrs. F. H. Whysall, W. W. Lackie, and W. B. Hird, Prof. Maclean, Messrs. Alexander Lindsay, A. S. McWhirter, D. M. Macleod, Archibald Wilson, J. E. Sayers, Sam Mavor, and J. F. Neilson. The three last named are new members, the others being already in office.

The next ordinary general meeting of the STUDENTS' SECTION will be held at the City and Guilds' Technical College, Finsbury, on Wednesday, February 28th, at 7.45 p.m., when Mr. R. P. Howgrave-Graham will read a paper on "Some Experiments with High Voltages." Dr. C. V. Drysdale will preside. The paper should prove interesting and educational, it being almost entirely experimental.

At a meeting of the NEWCASTLE LOCAL SECTION on February 12th, a discussion on the decimal system of coinage and weights and measures was introduced by Mr. Gerald Stoney, who urged the adoption of such a system as an imperative necessity. Several speakers took part in the discussion, almost without exception supporting the proposal. At the same meeting the chairman, Mr. H. W. Clothier, said the Committee had received from London proposals in regard to arranging a local scheme for the training of disabled sailors and soldiers. The Committee had made fairly full inquiries, and found that already there had been a good deal of progress made in the Newcastle district. Classes were being held in connection with a local power company, and the Cowen Training Home had already organised a class for training men, more particularly with the object of making them fit to take charge of the running of private installations, &c. The present accommodation at the Cowen Home was greater than the demand.

On February 16th, under the auspices of the DUBLIN LOCAL SECTION Mr. L. J. Kettle delivered a lecture on the Dublin Electricity Works, in the course of which he drew attention to the existence of the Rathmines and Pembroke electricity works, as well as the tramway power station, in close proximity to the city, and argued that the two first-named could be economically supplied from the Dublin works without increasing the plant installed there, and that the saving in cost of supply would probably amount to some £6,000 a year.

Correspondence.—We have received the following letter:—

"With reference to the action between the Rugby Urban Council and myself, reported in your issue of the 2nd inst., I notice the report has been worded as if I had pleaded guilty to the whole of the Council's *suspicions*, whereas I pleaded guilty only to the technical charge of using current from the power mains for lighting. Also no mention is made of the extenuating circumstances—viz., that the meter was registering 33 per cent. too high, as admitted by the prosecution, and that I was paying a flat rate of 2d. per unit, no current being used for power purposes.

"With reference to the three terminals in the hall, the report reads as if the meter had been actually short-circuited, whereas these connections were never made, and witness for the prosecution admitted that they had no evidence that this had been done, the terminals having been used for quite another purpose.

"With reference to the 300-C.P. lamp mentioned in the report, this was only the size estimated by the Council's official, the real size being 150 C.P., and the lamp having never been used for lighting.

"The above corrections to the report will oblige.

"Rugby, *February 20th*, 1917." "H. L. SMITH.

Imperial Preference.—The resolutions which were adopted by Lord Balfour of Burleigh's Committee have been issued as a White Paper. They are stated in this form in view of the approaching Imperial Conference

"1. In the light of experience gained during the war we consider that special steps must be taken to stimulate the production of foodstuffs, raw materials, and manufactured articles within the Empire wherever the expansion of production is possible and economically desirable for the safety and welfare of the Empire as a whole.

"2. We therefore recommend that His Majesty's Government should now declare their adherence to the principle that preference should be accorded to the products and manufactures of the British Overseas Dominions in respect of any Customs duties now or hereafter to be imposed on imports into the United Kingdom.

"3. Further, it will, in our opinion, be necessary to take into early consideration, as one of the methods of achieving the above objects, the desirability of establishing a wider range of Customs duties which would be remitted or reduced on the products and manufactures of the Empire, and which would form the basis of commercial treaties with Allied and Neutral Powers."

The Berne correspondent of the *Morning Post* quotes the *Vorwärts'* remarks in regard to the report of the Balfour Commission proposing preferential tariffs for the British Empire. The *Vorwärts* observes that preferential duties for the British Dominions will hit Germany's export trade "as they are intended to do," and concludes with the mournful reflection that "the British world Empire was our best customer; it bought one-fifth of our exports."

Appointment Vacant.—Shift engineer (42s.), for the Queen Mary's Military Hospital (County Asylum), Whalley. For particulars see "Official Notices" to-day.

National Service. — The Important Trades. — The Director-General of National Service has issued, for the guidance of volunteers, a detailed list of trades and occupations of primary importance for which men are urgently required. In the "Shipbuilding and Engineering, including Repairing," Section, special mention is made of electrical engineering, the manufacture of internal combustion engines, and "other engineering works engaged in repairing machinery or plant for use in industry." In the "Miscellaneous Metal Trades" mention is made of electrical accumulator manufacture and repairing, scientific instrument making, and steel and copper wire-drawing. The "Public Utility Services" named include electrical generating stations and tramways (in connection with munition works).

Fatalities.—An inquest was held at Newcastle-on-Tyne, on Tuesday, respecting the death of an electrician named James Fairen, employed by Messrs. Armstrong, Whitworth & Co., Ltd., at Scotswood. Bert Clements, a work-mate, stated that they were repairing an electric crane on Saturday night. Fairen was lying stretched out on a plank 9 ft. long by 7 in. wide and 1½ in. thick. It was inclined at a steep angle between the higher and lower girders of the crane. When his back was turned witness heard a shout, "Bert, I'm falling," and he saw deceased fall to the ground, a distance of 49 ft. The jury returned a verdict of "Accidental death," and it was stated that the firm had now arranged with H.M. Factory Inspector to alter the method of cleaning the electric cranes.

George Scott (59), chargeman at the Mexboro' electric power station, was found, last week, lying dead at his work, bleeding slightly from the nose. He had suffered from bronchial trouble for several years, but had left home in apparently his normal health. Death was declared to be due to heart failure, following bronchitis. An inquest was not considered necessary.

According to the *Times*, Alfred Harrison, a labourer at the Derby Corporation electricity works, was fatally scalded on Wednesday by the bursting of a tube.

British Industries Fair.—This Fair opens on Monday next, February 26th, at the Victoria and Albert Museum and the Imperial Institute, and will remain open until March 9th.

Parliamentary.—The Lancashire Power Construction Co. is applying for an Act to re-arrange, convert, increase and reduce the capital, and to confer other powers.

Magneto Manufacturers' Association.—A recent issue of the *Motor* announces the formation of the British Ignition Apparatus Association, which embodies practically all the magneto manufacturers in the country. At the present time over a dozen British firms are making magnetos, and their output to date reaches 165,000 magnetos for war purposes.

Damaging Insulators.—At Thorne Police Court, near Doncaster, last week, two youths were fined £1 10s. each for damaging telegraphs by shooting at the insulators with catapults. The police stated that during last year over 100 insulators were broken on that particular part of the line, and this year, up to the present, 56 had been broken. It was a very serious matter, particularly at the present time, for telegraph lines to be damaged.

Volunteer Notes.—First London Engineer Volunteers.—Headquarters: Balderton Street, Oxford Street, W. Orders for the week, by Lieut.-Col. C. B. Clay, V.D., Commanding:

Monday, February 26th. Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30—8.

Wednesday, February 28th. Instructional Class, 6.15. Platoon Drill, Platoon No. 2.

Thursday, March 1st. Platoon Drill, Platoon Nos. 5 and 6. Ambulance Class by M.O., 6.30.

Friday, March 2nd. Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.25—8.25.

Saturday, March 3rd. Commanding Officer's Parade. Uniform, 2.45 p.m.

Sunday, March 4th. Entrenching at Otford. Parade Victoria (S.E. & C. Railway Booking Office), 8.45 a.m.

Easter Camp.—At Esher, where a course has been arranged under Royal Engineer Instructors. Names must be sent in to Orderly Room not later than February 28th.

Telephone Number. The Telephone at Headquarters is now *Mayfair 1969.*

(By order), Macleod Yearsley, *Adjutant.*

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Mr. C. C. Atchison, who recently resigned the post of electrical engineer to the Rochdale Corporation, owing to continued ill-health, has been presented with a silver cigarette case by the Rochdale Municipal Officers' Association, of which he has been president for the past two years, in addition to a pair of binoculars from the chief officials, and a pocket aneroid barometer from over 40 pre-war members of the staff at the electricity works.

The Rochdale Corporation Electricity Committee has recommended that Mr. F. H. Rudd, the station superintendent, be appointed acting engineer for a period of three months. Mr. Rudd has been at the works 16 years. During the engineer's recent absence, owing to ill-health, and since his resignation, Mr. Rudd has been in charge of the works.

A sub-committee of the Hull Electricity Committee has recommended an increase of £50 in the salary of the acting engineer, Mr. McGoris, whose services are highly appreciated. He has had entire charge of the undertaking whilst the engineer, Mr. Bell, has been on military duty since the outbreak of the war. The Electricity Committee recommends that the increase be £75, instead of £50.

Mr. J. W. S. Clunas, who was recently appointed city electrical engineer at Cape Town, in succession to Mr Walter F. Long, has resigned the position in order to take up an appointment with Messrs. Reunert & Lenz, of Johannesburg. Mr. Clunas's salary as city electrical engineer was £900 per annum, and allowance for motor-car.

Mr. Stephen Kirkland, switchboard attendant at the Rawtenstall electricity works, was presented with a timepiece by the staff on the occasion of his marriage.

The L.C.C. Highways Committee recommends that Mr. J. K. Bruce, deputy chief officer of tramways, be appointed traffic manager under the L.C.C. Tramways reorganisation scheme, at a salary of £1,250, rising to £1,500 a year, as from April 1st, and that the position of deputy chief officer be abolished. The special sub-committee appointed to inquire and report upon the organisation and working of the L.C.C. tramways undertaking has expressed its appreciation, which the Highways Committee fully endorses, of the valuable assistance given to it in the consideration of questions arising in connection with the electrical work of the department by Mr. J. H. Rider, formerly electrical engineer in the department, whose advice in many important matters greatly facilitated its work.

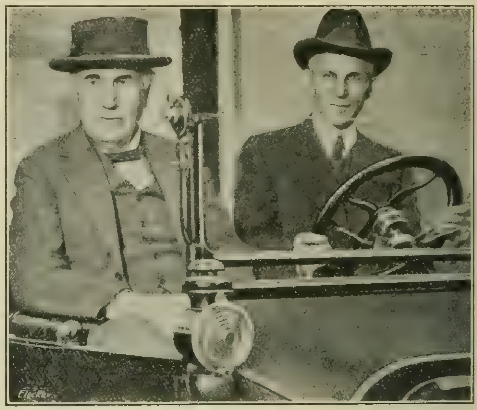
The Luton Electricity Committee has decided to increase salaries as follows:—Chief clerk (Mr. R. Harding), from £143 to £156 per annum; general clerk (Mr. F. M. Gregory), from £91 to £104 per annum.

General.—Mr. A. W. Tait, C.A., has joined the boards of Callender's Cable & Construction Co., Ltd., and of the Anchor Cable Co., Ltd.

The salary of Prof. Miles Walker, Professor of Electrical Engineering at the Municipal School of Technology, Manchester, has been raised from £600 to £1,200. It was stated that Prof. Walker had been offered an industrial appointment at £1,800 a year, but preferred to remain in the teaching profession; he was at the head of his branch of electrical engineering in this country, and such men in future would have to be paid salaries of £1,000 to £1,500 a year.

Mr. Hugh Rose, foreman electrician at the Inverurie Locomotive Works, who has received an appointment with Messrs. Claud Hamilton, Ltd., Aberdeen, has been presented by the employés in the electrical department with a case of pipes and a tobacco pouch.

The accompanying illustration, for which we are indebted to the *Ford Times*, is a recent photograph of Mr. Thos. A. Edison, in company with Mr. Henry Ford, of the Ford Motor Co. These two well-known personages have long been friendly, and a year or so ago it was reported that they were collaborating on the production of a popular-priced electric motor car. So far, however, there is no further news of the new vehicle, and, as Edison is now devoting a good deal of time to the new American Board of Naval Inventions, of which he is the chairman, it is more than probable that the idea has been dropped, or at least postponed until after the war.



Roll of Honour.—Sapper P. F. Groves, R.E., the only son of Mr. W. E. Groves, Birmingham electric supply department, died in France on the 21st ult., aged 19. He was attached to the Army Docks Department as interpreter.

A commission as second-lieutenant in the R.E. has been granted to Mr. E. B. Preston, electrical engineer, of Newcastle-on-Tyne, who enlisted soon after the outbreak of war in the Newcastle Territorial Engineers.

Lance-Corporal A. H. Morgan, Devonshire Regiment, who was for some years on the Exeter staff of the National Telephone Co., and later with the Post Office, has fallen in action in Mesopotamia, at the age of 34 years.

Captain G. C. Milnes, King's Own Royal Lancaster Regiment, who is the electrical engineer for Lancaster, but has been on service since the outbreak of war with the Machine Gun Section of his battalion, has been promoted to the rank of Major. He has been mentioned in dispatches.

The Military Medal for bravery in action has been awarded to Sergeant A. H. Cornwall, R.E., who was trained as an electrician at the works of the Bromley (Kent) Electric Light and Power Co.

First-Class P.O. Chas. R. Allwright, R.N., who joined the service whilst with Messrs. Callender's Co., has been awarded the D.S.M. for gallantry in the Jutland battle, on H.M.S. *Chester.*

Sergeant Jack May, formerly with Messrs. Fraser & Chalmers, of Erith, has been killed in action.

Sergeant James Wright, R.E., has been awarded the Military Medal. He was mentioned in a dispatch from Sir Douglas Haig a few months ago. Before joining the Army he was for 14 years at the Blackburn Corporation electricity works.

Private Harold Fullalove, of the Loyal North Lancashire Regiment, who has died of wounds, was an electrician with the L. & Y. Rly. Co.

Obituary.—Mr. John Rennie.—We regret to announce the death of Mr. John Rennie, the electrician of the Board of Trade Laboratory, and assistant to the Electrical Adviser to the Board of Trade, at the age of 66. At the age of 65 he would, under ordinary circumstances, have retired under superannuation rules, but as he was in full possession of his powers, and had a complete grasp of his work, he was invited to continue his services. About a month ago he was attacked by asthma, and succumbed to heart failure on Monday morning last.

Mr. Rennie was born at Ayr in 1850. During some years at the shipbuilding yards of Messrs. Barclay, Curle & Co., of Glasgow, he worked in the shops, and received practical training as an engineer. At the age of 26, feeling no doubt that the scientific side of engineering attracted him more than the heavy work of a shipyard, he entered the University of Glasgow, and went through the courses in arts and engineering under Lord Kelvin, then Sir William Thomson. The physical laboratory naturally attracted him, and he held for three years a Thomson Experimental Scholarship. In 1881 he became secretary and private assistant to Sir William Thomson, and witnessed the development of the Kelvin electrical measuring instruments, as well as many other inventions, such as the compass, and assisted also in the scientific researches which were being conducted at that time.

When the Board of Trade Electrical Standards Laboratory was to be founded, Sir William Thomson recommended Mr. Rennie as electrician under Major Cardew, and in thus depriving himself of not only his scientific assistant, but the secretary in charge of his heavy correspondence, he felt that he was placing him in a position of scientific as well as of public importance. Seeing that the legal standards of electrical measurements consisted of Thomson balances and electrostatic voltmeters, Mr. Rennie was obviously the man for the place, and during the 27 years in which the Laboratory was under his charge he proved that these instruments were not only worthy of and suitable for the requirements of those days, but that they were capable of those much higher degrees of precision which are necessary at the present day. If anybody, who did not grasp the difference between a standard apparatus in a standards laboratory and a commercial instrument, ventured to criticise a Kelvin instrument, Mr. Rennie would stoutly defend it, and explain what the "Old Man" was aiming at, and how perfectly those aims were realised. He was proud to point out how many details which had been invented by his master, apparently on the spur of the moment, and perhaps as temporary expedients, had proved to be unsurpassable. When, in 1908, the ampere standard was compared with the amperé balance of the National Physical Laboratory through the intermediary of the Cadmium cell and resistance, an optical appliance was fitted to the Kelvin balance which is used for measuring one ampere, and Mr. Rennie was proud to show that a difference of three or four millionths of an ampere could be easily indicated.

In the early years of the Board of Trade Electrical Standards Laboratory, Mr. Rennie, working under Major Cardew, was actively engaged in the intercomparison of the various standards and sub-standards, and in minute investigation of the instrumental errors; and he arranged a system of records in which the complete history of the important instruments, with details of their corrections from time to time, was entered. Almost every instrument in the Laboratory was known to him, and was alluded to by him, sometimes to the bewilderment of other members of the staff, by its number. After three or four years everything was ready for work. The mere fact that the Laboratory was founded is an indication that there was a demand, and a fairly strong demand, for it among electrical engineers, and it seemed obvious that the work for which it was intended should be started. It was anticipated when he left Glasgow to take up this post that work of commercial value would be done, and that Mr. Rennie's position would become one of importance, but for seven years the Treasury (that is to say, probably some minor official in that department) absolutely vetoed a scale of fees proposed to be charged for the services of the Laboratory to engineers. It is needless to say that the Laboratory did not stand idle and comparisons were made gratuitously, chiefly for instrument makers. One result of this was that Mr. Rennie received no more than his commencing salary for a long time.

The Laboratory was established to take charge, as it were, of the ampere, the ohm, and the volt, and standards of self-induction and capacity were considered to be outside its scope; but, with the development of electrical engineering, three-phase working opened a ground which the original Kelvin instruments did not directly cover. Mr. Rennie not only kept himself well abreast of the principles of three-phase measurement, but he was also well aware of the practical requirements of engineers as distinguished from those which certain theorists imagined that engineers should employ.

When it became necessary to add suitable wattmeters to the plant in the Laboratory, Mr. Rennie was very exacting in his requirements, and expected more from the instruments than was easily provided, and in several cases the makers had reason to be thankful for suggestions which Mr. Rennie not only made, but insisted upon.

Perhaps the most important work of Mr. Rennie's life was that which he expended upon electric supply meters. The list of meters which the Electrical Adviser recommended to the Board of Trade for official approval, after test by Mr. Rennie and himself, is very far from a complete record of the meters which Mr. Rennie examined. Many strange inventions were submitted to the Laboratory before October, 1891, when the Shallenberger meter was sealed. The fact that, notwithstanding the inadequacy of legislation with regard to meters, so little trouble has been experienced, such excellent meters are in use, and that so few are ever disputed, is the outcome of Mr. Rennie's incessant work on the subject. With his intimate and unique knowledge of the construction of electric meters, he was able to point out to those who submitted types for approval, defects which would only show themselves after prolonged tests. For many years it was his practice to encourage the use of meters by station engineers before the type was approved, in order that practical experience might be obtained in addition to the Laboratory tests. The complete set of tests of a meter could seldom be put through in less than about six months, but one meter, or, rather, one type of meter, remained for ten years under scrutiny, and when at last the approval was given, it is difficult to say how much of the invention was due to Mr. Rennie and Major Cardew.

Mr. Rennie was one of those retiring men personally unknown to many engineers, but well appreciated by those who had to deal with him officially, or on the Engineering Standards Committee, or at the lectures which he gave at Faraday House. He could seldom be induced to take part in discussions at scientific societies, and it is to be regretted that he has published very little. He had very high ideals in human affairs, as well as in engineering and in science. When some verification or comparison had been made with six-figure accuracy, he used to say, "The 'Old Man' would have liked that."

He leaves a widow, two daughters, and two sons. His eldest son, Donald, a graduate of Cambridge, and B.Sc. (London), was a Second-Lieutenant in the 1st Royal Fusiliers, attached to the Royal Warwickshire Regiment, and was killed in action in November, 1914; his second son takes up a commission in the Royal Flying Corps next week, and his youngest is abroad in the Royal Naval Division.

Mr. J. H. Tucker.—We regret to learn that Mr. J. H. Tucker, of the well-known firm of Messrs. J. H. Tucker & Co., electrical accessories manufacturers, Birmingham, died at his home at Solihull on Sunday last, in his 55th year. We understand that Mr. Tucker has not been really well since the summer, but he was taken seriously ill in December, and had since then been unable to attend to business. Mr. Tucker's loss will be very keenly felt by all who have been personally associated with him, but his death will not involve any change in the business or in the firm's policy.

Ald. J. Brodie.—We deeply regret to announce the death of Mr. Ald. Joseph Brodie, J.P., who had been chairman of the Blackpool Electricity and Tramways Committee uninterruptedly for the past 20 years. He passed away on Monday last, after a long period of illness, at the age of 57. The news will, we are sure, come with sorrow to the very wide circle of friends with whom it was such a pleasure for him to meet at the annual conventions of the Municipal Tramways Association and the Incorporated Municipal Electrical Association. The deceased gentleman, who was always popular, generous, and full of fun, will be remembered as a shrewd, far-seeing, and large-hearted man who played the straight game. From the first day we met him, at one of the early M.E.A. conventions, we struck up a friendship which the passing of years only served to strengthen. In connection with the affairs of Blackpool, his loss will be greatly felt, for he did so much to secure the able administration (under Mr. Chas. Furness) of the tramways and electricity undertakings. The capital of these undertakings when he was first identified with them, in 1896, was only £105,100, and the revenue for that year was a mere £17,720. For 1916, however, the revenue had risen to £124,412, and the capital expenditure stood at £568,000. We extend our heartfelt sympathy to his widow.

Mr. E. C. Churchward.—We regret to learn that Mr. E. C. Churchward, general manager and engineer of the Scottish Central Electric Power Co., Falkirk, died on Tuesday night. The deceased gentleman was appointed to his position at the inception of the company in 1905. He was previously in the office of Messrs. Bramwell & Harris, consulting engineers, who promoted the Scottish Central Co., which operates in the counties of Stirlingshire, Clackmannanshire, and Linlithgowshire.

Mr. C. G. Major.—Mr. Charles George Major, chairman of Messrs. Smith, Major & Stevens, lift manufacturers, Northampton, died suddenly on February 15th, from shock after the demise of his wife on the previous day. He resided at Balham, S.W., and had taken an active part in the management of the firm since the establishment of the headquarters at Northampton in 1910.

NEW COMPANIES REGISTERED.

Rotax Motor Accessories Co., Ltd. (145,967).—Private company. This company was registered on February 9th, 1916, with a capital of £175,000 in £1 shares, to take over the business carried on at Rotax Works, Chandos Road, Willesden, as the Rotax Motor Accessories Co., also to carry on business as manufacturers of lighting equipment for railways, tramways, motor cars, and vehicles, &c. The subscribers (each with one share) are: Eugen Aron, Rotax Works, Willesden Junction, N.W., manufacturer; Hermann Aron, Rotax Works, Willesden Junction, N.W., manufacturer; Rowland W. Cox, Rotax Works, Willesden Junction, N.W., general manager; Carl T. F. Benson, Rotax Works, Willesden Junction, N.W., works manager; Arthur Bell, Rotax Works, Willesden Junction, N.W., secretary; Arthur G. Benstead, Rotax Works, Willesden Junction, N.W., electrical engineer. The first directors (to number not less than two or more than seven) are Eugen Aron and Hermann Aron (both permanent managing directors). Solicitor: A. S. Joseph, 61, Fore Street, E.C. Registered office: Rotax Works, Chandos Road, Willesden Junction, N.W.

Deptford Steel & Ironworks, Ltd. (146,087).—Private company. This company was registered on February 15th, with a capital of £20,000 in £1 shares (10,000 pref. ord.), to take over the business of an electrometallurgist, sherardiser, galvaniser, detinner, &c., carried on by N. C. Mackin as the Deptford Steel and Iron Works and the Homogeneous Lead Coating Co. The subscribers (each with one share) are: S. Cole, Sardinia House, W.C., chartered accountant; H. H. Marriott, 10, Victoria Street, S.W., solicitor. The first directors are to be appointed by the subscribers. Solicitors: Kenneth Brown & Co., Lennox House, Norfolk Street, W.C.

Driver, Drennan & Cooper, Ltd. (145,955).—Private company. This company was registered on February 9th, with a capital of £50,000 in £1 shares, to take over the business of cable manufacturers, wire drawers, and electrical engineers and metallurgists, carried on by J. Drennan and J. K. Cooper at Gaythorn Mills, Gaythorn, Manchester, as Drennan and Cooper, and the North-Western Cable Co., and also certain assets in England belonging to the Driver-Harris Wire Co., of Newark, New Jersey, U.S.A., and to enter into an agreement with W. B. Driver and J. Drennan and J. K. Cooper. The subscribers (each with one share) are: F. L. Driver, 70, Aston Street, Newark, New Jersey, U.S.A., president of Driver-Harris Wire Co.; J. Drennan, Kalmhill, Mellor Road, Cheadle Hulme, Ches., electrical engineer. The first directors (to number not less than three or more than five) are: F. L. Driver (chairman); W. B. Driver, A. Bensel, J. Drennan (managing director), and J. K. Cooper. The two last mentioned may retain office for six years. Qualification, £25. Remuneration as fixed by the company. No board or general meeting may be held except for ordinary routine business without the presence of the nominee of the Driver-Harris Wire Co. or his proxy or attorney. Solicitors: Pearson, Prior & Co., 438, Corn Exchange, Manchester. Secretary: J. Drennan.

Chas. W. Cook, Ltd. (145,981).—Private company. This company was registered on February 13th, with a capital of £5,000 in £1 shares, to take over the business of an engineer and scientific apparatus manufacturer carried on by C. W. Cook at Manchester; also to carry on the business of electrical engineers, munition makers, chemical manufacturers, &c. The subscribers (each with one share) are: C. W. Cook, 535, Stretford Road, Old Trafford, Manchester, engineer; C. E. Cook, 535, Stretford Road, Old Trafford, Manchester, engineer. The first directors (to number not less than three or more than seven) are: C. W. Cook (governing director), C. E. Cook, and A. W. Cook. Qualification, £20. Solicitors: Jackson & Newton, 1, Chancery Place, Manchester. Registered office: University Works, Bridge Street, Manchester.

Borra Magneto Repairing Co., Ltd. (146,030).—Private company. This company was registered on February 16th, with a capital of £1,000 in £1 shares (300 pref.), to take over the business carried on by D. Borra, at 72, Dean Street, Soho, W., and to carry on the business of electricians, repairers of magnetos, dynamos, and motor accessories, &c. The subscribers (each with one share) are: D. Borra, 24, Westmead Road, Sutton, Surrey, magneto expert; W. H. M. Burgess, 49, Glasshouse Street, W., merchant; H. J. Prockter, The Gables, Lingfield, Surrey, architect; G. H. Smith & Co. (London), Ltd., 12, Mortimer Street, W., motor accessories manufacturers. The first directors (to number not less than two or more than seven) are: D. Borra, W. H. M. Burgess, H. J. Prockter, and G. H. Smith. Qualification, £1. Remuneration, £52 each per annum. Solicitors: Edmonds & Co., 13, Clifford's Inn, E.C. Secretary: C. G. Larrette. Registered office: 72, Dean Street, Soho, W.

Associated British Machine Tool Makers, Ltd. (145,999).—Private company. This company was registered on February 14th, with a capital of £100,000 in £1 shares, to carry on the business of machinery and engineering tool manufacturers, mechanical, electrical, and general engineers, makers of sand blast machinery, air compressors, metal cleaning apparatus, oxygen and hydrogen gas plant, textile and wood working machinery, appliances used in the manufacture of machine and other guns, motor cars, cycles, and aircraft, &c. The subscribers (each with one share) are: W. B. Lang, The Grange, Johnstone, near Glasgow, engineer; G. W. Gregory, 9, Birch Lane, Manchester, engineer; S. A. Smith, New Holme, Harboro' Road, Ashton-on-Mersey, manufacturer; G. Thompson, Shepperton, Selly Wick Road, Birmingham, manufacturer; W. F. Clark, Bartley Cottage, Northfield, Birmingham, engineer; W. G. Shanks, Melfort House, Milliken Park, near Glasgow, engineer; S. H. March, Redclyffe, Chorlton-cum-Hardy, engineer; H. Butler, Fern Bank, Halifax, engineer. The first directors (to number not less than five or more than 15) are: W. F. Clark, J. W. S. Asquith, S. H. March, A. H. Baldwin, W. B. Lang, A. E. Matthewson, W. G. Shanks, W. D. Ford-Smith, E. Williams, and H. Butler. No person may be a director or a member of any committee appointed by the board unless he is a member of the company, or is a partner in a shareholder firm, or is a director or official of a company which is a shareholder in this company. Remuneration (if any) to be fixed by the company. Solicitors: W. A. Crump & Son, 17, Leadenhall Street, E.C. Registered office: 34, Victoria Street, S.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Perfect Burglar Alarm, Ltd. (112,522) (originally known as Lichtenfeld Burglar Alarm Co., Ltd. Renamed January 13th, 1915.) Capital, £4,000 in £1 shares (1,000 pref.). Return dated December 29th, 1916. 230 pref. and 1,710 ord. shares taken up; £1 per share called up on 1,210 shares and 15s. per share on 230; £1,380 paid, leaving £2 10s. in arrears; £500 considered as paid on 500 shares. Mortgages and charges: Nil.

Porous Accumulator Co., Ltd. (57,526).—Capital, £3,000 in £1 shares. Return dated December 30th, 1916. All shares taken up; £1,007 paid; £1,993 considered as paid. Mortgages and charges: Nil.

CITY NOTES.

London Electric Railway Companies. The reports of the Central London Railway, the London Electric Railway, the Metropolitan District Railway, the City and South London Railway, and the London General Omnibus Companies for 1916 have been issued. The aggregate gross receipts of the five companies from all sources were £6,038,529. The companies retained for revenue liabilities, as per agreement, £5,531,562, and the balance of £506,968 was credited to the common fund. Of this amount, the Central London Railway takes 20 per cent., the London Electric Railway 30 per cent. (as against 26 per cent. for 1915), the Metropolitan District 12 per cent., and the City & South London 6 per cent. (as against 2 per cent. for 1915). The total number of passengers carried by the companies and the average fare per passenger cannot be given, as the District is still under Government control, and its figures are not available.

Central London Railway.—Total net income £184,492, plus £15,686 brought forward; interest, rentals, and other fixed charges absorb £41,499; reserve takes £20,000; dividend on preference stock £21,600. For the year the ordinary dividend is 3½ per cent., and that on the preferred ordinary 4 per cent., and on the deferred ordinary stock 3 per cent., leaving £12,079 to carry forward. The increased appropriation to reserve (£10,000 more than for 1915) is due to the uncertain outlook, the high price of materials and labour, and the impossibility of securing all the materials required for the compete maintenance of the property during the year. Capital expenditure during the year, £12,295. The construction of the extension railway between Wood Lane and Ealing Broadway is making slow progress owing to the war. An administrative staff superannuation fund has been established jointly with the other companies. The company is actively interested in the "Safety First" campaign. Sir Albert H. Stanley having been appointed president of the Board of Trade, resigned his position with the company, and Mr. W. C. Burton, a new director, becomes managing director. Meeting: To-day.

London Electric Railway Co.—Total net income £590,190, plus £12,303 brought forward. Interest, rentals, and other fixed charges require £276,153; there is put to reserve £35,000; dividend on preference stock absorbs £126,947. Dividend on the ordinary shares 1½ per cent. for the year, carrying forward £24,474. The reserve appropriation is £15,000 higher than last year, for reasons stated above. Capital expenditure during 1916, £39,257. The manufacture of the joint rolling stock for the through running of trains from the Bakerloo section of the railway to Watford having been delayed by the war, arrangements have been made with the L. & N.-W. Rly. whereby the London Electric Railway will, for the present, provide the necessary rolling stock and operate the train service. It is hoped to commence through running at an early date. The references above to superannuation, safety first, and to the managing directorship all apply to this company as well. Meeting: To-day.

Metropolitan District Railway Co.—Total net income £565,765, plus £13,952 brought forward. Interest, rentals, and other fixed charges require £344,999. There is appropriated to reserve £45,000 (as compared with £35,000 in 1915); dividends on guaranteed and first preference stock absorb £124,930; 3 per cent. is paid on the second preference stock, and £20,688 is to be carried forward. Capital expenditure during the year, £2,475. The above remarks respecting the safety first campaign and the managing directorship both apply in the case of this company. Meeting: To-day.

City & South London Rly. Co.—Total net income £124,488, plus £9,027 brought forward. Interest, rentals, and other fixed charges absorb £31,570; there is put to reserve £20,000 (increase £10,000); preference dividend £42,500. Dividend, 1½ per cent. on consolidated ordinary stock, carrying forward £17,245. Capital expended during 1916, £24,850. The above references to superannuation, safety first, and the managing directorship also apply to this company. Meeting held on Tuesday.

Smithfield Markets Electric Supply Co., Ltd. The gross profit for 1916 was £3,797, against £4,250 for 1915; the net profit was £2,467, compared with £2,816. £400 has again been placed to debenture stock redemption fund, and £1,250 to depreciation account. The balance remaining, including £1,296 brought forward, is £2,113. A dividend of 1 per cent. on the ordinary shares requires £600, £500 is written off cost of change of pressure, and £1,013 is to be carried forward. The profits have been adversely affected by the fire at the station in October. The service to the markets was interrupted for some days pending arrangements for a temporary supply, and it was then decided, in order to provide against similar interruption in the future, to retain that supply as a permanent stand-by, and to alter the pressure of the company's own system to conform thereto. The cost of the change so far incurred appears in the accounts (£938, plus amount written off), and will be gradually liquidated out of revenue spread over a period of three years. The damage caused by the fire was fully covered by insurance. For the first nine months of 1916 the sale of current increased satisfactorily. Higher costs of production were met to some extent by increasing the charges; a further rise in prices of the principal commodities is expected. The Diesel plant installed in the spring has proved entirely satisfactory.

South Metropolitan Electric Light & Power Co., Ltd. For the year 1916, the revenue account shows a credit balance of £50,510, which with £6,605 brought forward and £1,102 dividend of 10 per cent. on the holding in the West Kent Electric Co., Ltd., makes £58,116. After deducting £12,589 for interest on debenture stock, paying 7 per cent. on the first preference and 6 per cent. on the second preference shares, £17,600 is put to depreciation, 4 per cent., less income-tax, is paid on the ordinary shares, leaving £7,249 to be carried forward. The comparative figures for two years are:—

	1915.	1916.
H.P. connected	19,389	21,411
Number of consumers	6,781	6,985
Gross revenue	£80,576	£95,883
Expenditure	£31,386	£45,373
Net revenue	£49,190	£50,510

The gross revenue shows a further substantial improvement, but owing to the high price of coal nearly the whole of the increase has been absorbed in extra expenditure. The new 5,000-KW. turbo-generator has been put to work, and in order to deal with the growth of the business another of 5,000 KW. has been placed on order. With the sanction of the Treasury, £29,140 4½ per cent. first debenture stock and

5,440 6 per cent. cumulative second preference shares were issued during 1916. The West Kent Electric Co., Ltd., more than doubled its gross receipts, and the net revenue increased from £3,051 to £5,432. Annual meeting: February 28th.

Westminster Electric Supply Corpn., Ltd. During 1916 the connections to the mains increased from 42,355 KW. to 43,969 KW. Lieut.-Col. J. F. Remnant, M.P., has been elected to fill the vacancy caused by the retirement of the Rt. Hon. W. Hayes Fisher, M.P. After allowing for depreciation, sinking fund and other charges, and preference interest, the total dividend for the year on the ordinary shares is 7 per cent., carrying forward £2,952. Units sold to consumers, 23,498,812 (including A.C. supply of 1,230,332, used on works 320,911, total 23,819,723). The revenue from sale of current was £228,817, as against £213,416 in 1915. The total revenue was £262,624, against £247,060 in 1915. The expenses on revenue account totalled £196,331, against £185,969. Coal, &c., cost £21,495, against £17,462. Annual meeting: February 28th.

St. James' and Pall Mall Electric Light Co., Ltd. During 1916 the connections increased from 16,305 KW. to 16,631 KW., and 11,272,368 units were supplied to consumers. The Central Electric Supply Co. has determined to pay no dividend on its shares for 1916. The net profits of the St. James' Co. were £22,842, plus £2,752 brought forward. After paying 7 per cent. for the year on the preference shares, and a total of 8 per cent. on the ordinary for the year, £2,595 is to be carried forward. The sale of electricity produced £136,448, and the total revenue was £143,072; the expenses on revenue account were £115,077, leaving £27,995 to carry to net revenue. The deaths of Messrs. Bennett Fitch and S. T. Dobson are recorded with regret. Units generated by steam plant 664,076, purchased 13,817,632, = 14,481,708. Units sold, &c.: Private supply 11,272,368, works 263,757, batteries 250,072, transmission and transformation 2,107,260, distribution, &c., 588,251. Annual meeting: February 27th.

National Electric Supply Co., Ltd.—The annual meeting was held at Preston last week. Mr. JOHN BOOTH, the chairman, said that the company had been disappointed in regard to the new turbine plant which had been delayed in delivery, and this had handicapped them in dealing with a growing output under very trying conditions. Notwithstanding daylight saving and lighting restrictions, the total output had increased by 22.8 per cent., due to the increased demand for power purposes, and the total income had increased by £2,250. The sale of current for lighting was £1,310 less than in the previous year. Coal cost £2,675 more, wages increased by £249, and rates and taxes by £463. The capital account had been increased by £7,000, chiefly in payment for the new turbine set. It was proposed to put £4,000 to reserve for depreciation. The company started the new year with promising prospects, for they had a record load and were in a better position as regards machinery than for many years. Dividends at the rate of 4 per cent. on the preference and 3s. 6d. on the ordinary shares, making 6s. for the latter for the year, were declared.

The War Loan.—The following applications for War Loan were announced after we went to press last week:—

	New money. £	Total. £
Endolithic Manufacturing Co.	(12,200)	12,200
Monte Video Telephone Co.	(41,500)	50,000
Staff and Employés, G.E.C., additional	(13,500)	40,000
Fraser & Chalmers' Employés	(5,000)	5,000
C. A. Vandervell & Co.		64,800
British Westinghouse E. & M. Co.	(50,000)	60,000
National Gas Engine Co.	(75,000)	200,000
Falk, Stadelmann & Co., Ltd., and Directors	(26,100)	54,000
Mrs. Salomon Falk (widow of the late Mr. S. Falk, and founder of Falk, Stadelmann & Co.)	(5,000)	12,200
Miss Audrey Falk (daughter of the late Mr. S. Falk and Mrs. Falk)	(250)	1,426
Mawdsleys, Ltd. (Directors and Staff)		58,000

Tyneside Tramways & Tramroads Co.—For the half-year ended December, the surplus of receipts over expenses was £6,223, plus £700 brought forward. A dividend on the ordinary shares at the rate of 4¼ per cent. per annum (less income-tax), makes with the dividend paid in September 3 per cent. for the year. There is put to reserve for renewals, depreciation, and other contingencies £1,400, to special reserve £400, leaving to be carried forward £665. The traffic receipts increased by £1,705, and for the whole year there is an increase of £687.

Kaministiquia Power Co., Ltd.—The gross revenue last year was 366,800 dols.; operation and maintenance, 48,378 dols.; depreciation and renewal reserve, 29,000 dols. (in addition to 6,000 dols. appropriated on monthly basis during the year); net revenue, 289,422 dols.; fixed charges, 96,125 dols.; net income, 193,297 dols. The rate of dividend on the stock was increased during the year from 6 per cent. to 7 per cent. Surplus earnings of 50,557 dols. have been transferred to general surplus, which now stands at 336,697 dols.—*Financier.*

Central Electric Supply Co., Ltd.—During 1916 the company supplied 30,059,660 units to the Westminster, St. James', and Chelsea Companies. The deaths are regretted of Mr. Bennett Fitch and Mr. S. T. Dobson. The Rt. Hon. G. W. Balfour has been appointed a director. The financial result has been already announced here.

Lancashire United Tramways, Ltd.—The report for 1916 states that the net profit is £33,105. The receipts increased £12,979. The increase in expenditure was £8,775, due to the additional output of electrical energy and to increased charges for materials and labour. The interest and dividends received from the operating companies, together with sundry receipts, amounted to £16,782. After deducting interest on the prior lien debenture stock and expenses, there remains £3,024. Out of this interest will be paid on the second mortgage debenture stock for 1916 at the rate of 1 per cent., which will absorb £2,965, and £59 is carried to depreciation account. There is also a balance on the year's working of the operating companies, after payment of the interest and dividends, of £17,580. —*Financial Times.*

Para Electric Railway & Lighting Co., Ltd.—For the year ended November 30th the gross receipts increased from £243,483 in 1915 to £271,691. The operating expenses increased from £115,309 to £123,403, the net revenue earned in Para being, therefore, £148,288, as compared with £128,174, the revenue of the previous year. As the accounts are based upon the legal exchange rate of 16d. per milreis, there must be deducted £42,803, being the actual loss incurred on remittances. After providing for this loss on exchange and London expenses, the balance of operating revenue is £100,675, compared with £90,759 of the previous year. The net revenue in milreis during the past year was the largest yet obtained by the company. After paying debenture charges and preference dividend, a dividend of 6 per cent. on the ordinary shares, less income-tax, £25,572 is to be carried forward.—*Financial Times.*

Newcastle & District Electric Lighting Co., Ltd.—The profit for 1916 was £39,364, plus £27,823 brought forward. Interest on debentures and loans absorbs £18,548, £2,395 is put to second mortgage debenture redemption fund, £10,000 is put to reserve, 2½ per cent. per annum, less income-tax, is to be paid on the shares, and £29,979 carried forward. The profit would have enabled a larger dividend to be paid, but coal costs and war conditions render it wise to restrict it to 2½ per cent. The year's capital expenditure was £9,793. A further £2,500 of the 6 per cent. second mortgage debentures have been redeemed.

Fife Tramway, Light & Power Co.—The profits for the year, after paying loan interest, &c., are £23,771. The half-year's 6 per cent. dividend on preference shares (£4,817) was paid, and after paying the balance due on these, setting aside £3,289 in paying 4½ per cent., less tax, on the ordinary shares, and carrying £3,000 to the reserve account, £8,164 will be carried forward. The revenue from shares and management fee from Dunfermline & District Tramways Co. was £15,000, and from the Fife Electric Power Co.'s electric lighting undertaking £14,671.

Electrical Distribution of Yorkshire, Ltd.—The net profit for 1916 was £3,495, against £3,638 for 1915 and £2,964 for 1914. The amount brought forward was £905. A dividend of 6 per cent. (free of income-tax) on the ordinary shares absorbs £2,532, £1,000 is put to reserve, and £869 is carried forward subject to directors' remuneration. Having regard to lighting restrictions, increased expenditure, and other difficulties, the results are satisfactory. In February, 1916, 8,134 £1 shares were allotted. Applications have been made for electric lighting orders for supply in other districts in the West Riding.

London Electric Supply Corporation, Ltd.—It is stated that the directors have declared 1 per cent. on preference shares for the past half-year, making 4 per cent. for year; £7,068 forward. Last year, 3 per cent. on ordinary shares for year, £5,000 to contingencies account, £9,050 forward.

Blackpool & Fleetwood Tramroad Co.—Final dividend of 4½ per cent. (making 6½ per cent. for the year) absorbs £6,750. There is put to general reserve £1,000, to depreciation reserve £5,000, writing down value of investments in railway stock £3,005. £15,755 is carried forward, subject to excess profit duty £3,750.

Bournemouth & Poole Electricity Supply Co., Ltd.—Subject to audit, final dividend on the ordinary shares 7 per cent. per annum, less income-tax, for the last half-year, making 6 per cent for the year.

Mersey Railway Co.—The available revenue for 1916 was £21,299, as against £21,442 for 1915. This is being distributed as follows:—4 per cent. on 1866 debenture stock, 3 per cent. on 1871 ditto, 3 per cent. on 1882/3/5 ditto, 1 per cent. on the "B" debenture stock; carry-forward £21.

Oxford Electric Co., Ltd.—Dividend at the rate of 2½ per cent., less income-tax, on the ordinary shares for the half-year ending December 31st last, being a distribution for the year at the rate of 5 per cent.

South London Electric Supply Corporation, Ltd.—Subject to final audit, dividend on ordinary shares at the rate of 5 per cent. per annum for the year 1916, placing £7,550 to depreciation fund, and carrying forward £3,053.

Mather & Platt, Ltd.—Dividend on the ordinary shares at the rate of 17½ per cent. per annum, less income-tax, and less the interim dividend of 5 per cent. already paid for the year.

Vulcan Boiler & General Insurance Co., Ltd.—For 1916, the net profit was £62,689, including £8,338 brought forward. The dividend and bonus is 25 per cent., less tax.

South Staffordshire Tramways Co., Ltd.—The directors recommend a dividend of 4 per cent. on preference shares, carrying forward £844.

STOCKS AND SHARES.

Tuesday Evening.

The success of the War Loan has had a marked influence upon the Stock Exchange. Before the figures were announced, there was a general tendency throughout the markets which showed that they were relieved at the closing of the subscription lists, and looked for better business, which, of course, means better prices. Mr. Bonar Law's announcement on Monday night was regarded as eminently satisfactory; and a smart improvement in the price of Consols had a sympathetic effect all round the House. The liveliest interest of the moment is centred upon sweepstake tickets, in which an active market has sprung up on the basis of 20s. premium for the 20s. tickets.

The only unpleasant spot in the markets with which we deal is the passing of the dividend on the ordinary shares by the London Electric Supply Corporation. Not only so, but the company has also reduced the dividend on its preference from 6 per cent. to 4 per cent. The reason, of course, is the unforeseen event of last autumn, but this at the time was understood, at any rate by a good many people, to be of moderate dimensions, and not likely to imperil the maintenance of the full dividend on the preference shares. The price of the latter has fallen 10s. to 3¾, and that of the ordinary shares 5s. to £1, both of these, however, being decidedly nominal—that is to say, sellers find it difficult to place shares when they want to realise.

On the other hand, the West End reports continue good. The St. James' & Pall Mall repeats its previous distribution of 8 per cent. for the year, and this time is not obliged to cut into the contingency fund as it had to do in 1915. The net profit of £23,000 is about £3,000 higher than that of the preceding twelvemonth. The Westminster Electric has issued its report, showing progress which, considering all the circumstances, is decidedly satisfactory. The Central Electric Supply Co. passed its dividend, as it did in 1915. Quotations are steady, but there is not a great deal of business going on. More is doing, however, in the shares of the manufacturing companies; and in such issues as British Aluminium a fair volume of trade is being transacted.

The various Tube reports are now available, but, as usual, the form in which they are presented does not enable much information to be gathered as to the real earnings of the different companies. The London General Omnibus Co. is the basis upon which the others practically rest; and in this case, as we mentioned last week, the dividend was reduced from 12 per cent. to 8 per cent. for the year. All the five companies in the pool—*i.e.*, the District, City & South London, Central London, London Electric, and London General Omnibus Companies—report the aggregate traffic earnings at £5,279,000, which was swollen by other receipts to just over £6,000,000, both marking substantial advances over the earnings of the corresponding period. It is interesting to note the sums which the various companies take out of the pool; and in comparing them with those of 1915, we get the following table :—

	1916. £	1915. £
London General	162,200	180,500
London Electric	152,100	117,400
Central London	101,400	90,300
Metropolitan District	60,900	54,200
City & South London	30,400	9,000

The City & South London increase is mainly due to the fact that the company gets 6 per cent. out of the pool now, as against 2 per cent. previously, while the London Electric Co. draws 30 per cent. instead of 26 per cent., the 8 per cent. being taken from the proportion paid to the London General Omnibus Co., so accounting largely for the reduction in the dividend on the latter. The market in the various stocks and shares has improved with that for other railway stocks; and Underground Electric incomes, after being down to 83, now stand at 85, while the £10 shares moved up 5s. to 1⅞. Steam-electric stocks are also harder. It cannot be said that there has been much increase of business to fortify this week's improvements.

The Treasury has now published its list of securities of which it demands delivery in accordance with a recent order under the Defence of the Realm Act. Amongst these securities figure the 4½ per cent. bonds of the New York Telephone Co. The remainder of the list is principally made up of bonds of various American railways, and the only surprise felt with the list is that it should be necessary for the Treasury to take steps which would not have been called for had the bondholders supported the previous Scheme B put forward by the Treasury with a view to assisting the exchange problems.

Telegraph and cable stocks are better on the whole, in company with other industrial securities. The Eastern group is harder, and in various other parts of the market the recent weakness brought about by realisation of their stocks by holders who wanted to utilise their money in the War Loan, has given way to a more robust tone as the bargain-hunters came to pick up what was cheap. The principal excitement, however, has shifted again to Marconi shares, the price rising to £3 under the stimulus of buying produced by further vague optimisms as to the profits which the company is now earning and the amount which the Government may be expected to hand over in payment for services since the outbreak of war. The shares of the subsidiaries are also better, Americans improving to 16s. 9d., and Canadians to 8s. 9d.

British Aluminiums are a lively spot, with an advance of 1s. on the week to 28s. Dividend anticipations are responsible for the buying. The shares on the outbreak of war stood at their par value of £1. Edison Swan have also come into demand as a result of the meeting at which the scheme for reorganisation of the capital was approved; the shares rose to 10s., and the other issues are also better.

Babcock & Wilcox, in the engineering group, have gained half-a-crown; and the fresh attention paid to chemical shares has brought about a rise of 3s. 9d. in Castner-Kellners. There is a noticeable increase of interest paid by the public to industrial shares of all kinds, and the rubber market has fully participated, business improving and prices rising in steady fashion day by day. Vickers and Armstrongs are also harder; while the high-priced shares of the industrial groups are becoming difficult to obtain. Henley's, however, are dull on the offer of a mere handful of shares. A fall of 5s. occurred in General Electric preference.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1914.	Dividend 1915.	Price Feb. 20, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary ..	5	5	9¾	—	7 8 2
do. do. do. 4½ Pref..	4½	4½	8 5/16	—	6 15 10
Chelsea	5	4	3	—	6 18 4
City of London	9	8	11	—	7 5 5
do. do. 6 per cent. Pref.	6	6	9¾	—	6 8 1
County of London	7	7	10	—	7 0 0
do. 6 per cent. Pref.	6	6	9½	—	6 6 4
Kensington Ordinary	9	7	6⅜	—	6 10 3
London Electric	4	8	1	— ¼	Nil
do. do. 6 per cent. Pref.	6	6	8¾	— ½	5 6 8
Metropolitan	8½	8	2¼	—	6 13 4
do. 4½ per cent. Pref.	4½	4½	8⅛	—	7 4 0
St. James' and Pall Mall ..	10	8	6	—	6 13 4
South London	5	5	2⅞	—	6 19 0
South Metropolitan Pref. ..	7	7	1 3/32	—	6 7 8
Westminster Ordinary	9	7	6⅝	—	6 4 5

Telegraphs and Telephones.

	Dividend 1914.	Dividend 1915.	Price Feb. 20, 1917.	Rise or fall this week.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	94	— ½	6 7 8
do. Def.	80/-	89/6	22	—	6 16 4
Chile Telephone	8	8	6 15/16	— 1/16	5 15 3
Cuba Sub. Ord.	5	5	8¼	—	6 8 6
Eastern Extension	7	8	13¾	—	*5 16 4
Eastern Tel. Ord.	7	8	137	+2	*5 16 10
Globe Tel. and T. Ord.	6	7	11⅛	— ¼	*5 19 2
do. Pref. ..	6	6	9¾	—	6 3 1
Great Northern Tel.	22	22	34	—	6 9 5
Indo-European	13	13	46½	—	6 19 9
Marconi	10	10	3	+ ⅛	8 6 8
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord. ..	10	10	2 1/16	+ 1/16	4 16 10
United R. Plate Tel.	8	8	6⅜	—	*6 5 6
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13¾	—	*5 16 4

Home Rails.

	Dividend 1914.	Dividend 1915.	Price Feb. 20, 1917.	Rise or fall this week.	Yield p.c.
Central London, Ord. Assented	4	4	62½	—	6 8 0
Metropolitan	1¼	1	24	+1	4 3 4
do. District	Nil	Nil	16	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅞	+ ¼	Nil
do. do. "A" ..	Nil	Nil	5/6	+6d.	Nil
do. do. Income	6	6	85	+1	*5 17 8

Foreign Trams, &c.

	Dividend 1914.	Dividend 1915.	Price Feb. 20, 1917.	Rise or fall this week.	Yield p.c.
Adelaide Sup. 6 per cent. Pref.	6	6	4 15/16	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	2 15/16	— 1/16	9 7 2
do. 2nd Pref. ..	5½	5½	2¾	—	—
do. 5 Deb. ..	5	5	64½	—	7 15 0
Brazil Tractions	4	4	48½	+1	8 5 0
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	61	—	8 4 0
do. do. Preferred	—	Nil	43	—	Nil
do. do. Deferred	—	Nil	37½	—	Nil
do. do. Deb.	4½	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	25	—	Nil
do. 6 per cent. Bonds	—	Nil	22½	—	Nil
Mexican Light Common ..	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	14½	—	Nil
do. 1st Bonds ..	Nil	Nil	27½	—	—

Manufacturing Companies.

	Dividend 1914.	Dividend 1915.	Price Feb. 20, 1917.	Rise or fall this week.	Yield p.c.
Babcock & Wilcox	14	15	2¾	+ ⅛	5 9 1
British Aluminium Ord. ..	5	7	28/-	+ 1/-	5 7 2
British Insulated Ord.	15	17½	11⅞	—	7 7 4
British Westinghouse Pref. ..	7½	7½	2 9/32	+ 1/32	6 11 3
Callenders	15	20	12¼	—	8 4 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	8⅜	+ 3/16	6 10 9
Edison & Swan, £3 paid ..	Nil	—	½	+ 1/16	Nil
do. do. fully paid ..	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	61½	—	6 10 1
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9¼	— ¼	6 9 9
do. Ord.	10	10	18¾	—	7 5 6
Henley	20	25	15¾	— ¼	8 4 0
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11¾	— ½	*8 10 2
Telegraph Con.	20	20	37	— 1	*6 15 2

* Dividends paid free of income-tax.

FREQUENCY CHANGERS.

By R. TOWNEND, A.M.I.E.E

(*Abstract of paper read before the* Institution of Electrical Engineers.)

Frequency changers may be divided broadly into three classes:—

1. Where the electrical energy is converted electro-magnetically from one frequency to the other (by transformer action).

2. Where part of the energy is converted electro-magnetically and the remainder converted into mechanical energy, and then, in some cases, back again into electrical energy.

3. Where the energy is converted into mechanical energy, and then again into electrical energy.

The first of these types has been described in a paper read before the Institution, but, as the only ratio of frequency conversion obtainable is 1 to 3 (or multiples of this value) its scope is limited.

The second type usually takes the form of an induction motor mechanically coupled to some form of driving motor. If an electromotive force having a certain frequency is applied to the stator terminals of a slip-ring induction motor, the rotor of which is fixed so that it cannot rotate, the motor operates as a transformer, the slip-ring voltage being determined by the ratio of the number of turns in the stator and rotor windings, and its frequency being the same as that of the stator supply. If the rotor is allowed to rotate, its speed being held constant at any desired value, either by a friction brake or by coupling it to a generator, the rotor frequency is reduced.

If the rotor is rotated by means of a driving motor in the opposite direction to that in which it normally tends to rotate, the rotor frequency is increased.

If the rotor were allowed to rotate at half synchronous speed in its normal direction, and neglecting the losses in the machine, of the power supplied to the stator 50 per cent. would be given out of the rotor at half the stator frequency, and 50 per cent. would be given out mechanically to the direct-coupled machine which now operates as a generator.

With this arrangement it is therefore possible, by using a variable-speed driving motor, to obtain any frequency from zero to a value limited by the maximum safe running speed of the induction motor.

Its bad inherent voltage regulation has prevented this type of machine from being used commercially to any extent, but it is certainly a very useful form of frequency changer for experimental or testing purposes where high-frequency power is occasionally required, and the question of voltage regulation is of little importance.

The third type of frequency changer consists of an alternating-current motor driving a synchronous alternating-current generator. The motor may be either of the induction or of the synchronous type, the former giving what we will call the induction frequency changer, and the latter the synchronous frequency changer. The generator may be of the induction type, but this is very seldom adopted owing to the well-known disadvantages of generators of this type.

As the motor and generator are not electrically connected together, each machine can be designed for any desired voltage and number of phases, so effecting a change in both voltage and number of phases, in addition to the change in frequency, if this should be required. It is thus possible to obtain single-phase power at a low frequency for traction work from a polyphase high-frequency supply without unbalancing the latter. Also by controlling the generator voltage by means of an automatic regulator, its pressure can be maintained constant independent of variations in either the voltage or frequency of the supply.

The number of poles on the motor and the generator must have the same ratio as the motor and generator frequencies (neglecting the slip in the case of the induction frequency changer), and this, of course, determines the maximum speed for which the set can be designed. Thus a set converting from 25 to 50 periods may have a 2-pole motor and a 4-pole generator, giving an operating speed of 1,500 r.p.m., whereas a set converting from 25 to 60 periods has a maximum speed of 300 r.p.m., corresponding to a 10-pole motor and a 24-pole generator. If, however, it is permissible to lower the 25-period supply to 24½ periods, and raise the 60-period supply to 61¼ periods, a speed of 735 r.p.m. could be adopted corresponding to a 4-pole motor and a 10-pole generator.

In the case of the induction frequency changer, the ratio of the two frequencies varies to a small extent with the load, due to the varying slip of the induction motor, and with the number of poles just mentioned an exact conversion ratio of 25 to 60 periods would be obtained at a load corresponding to a motor slip of 4 per cent.

The question whether to adopt induction or synchronous motors depends upon the conditions governing each case. If it is essential that the ratios of the frequencies should be constant at all loads, that the power factor of the motor should be under the control of the operator, or that the set should be perfectly reversible (by perfectly reversible is meant that the motor will operate as a generator without requiring synchronous machines in parallel with it), it is necessary to adopt synchronous frequency changers. Where these requirements do not apply, the induction set has advantages, particularly from the point of view of the operator, as the paralleling of, and load distribution between, induction frequency changers are usually simpler than is the case with synchronous sets

Where two stations have to be coupled by means of frequency changers, it may be preferable under certain conditions to use induction sets, as they form a connecting link having the nature of a slipping clutch, whereas synchronous sets have the characteristic of a rigid coupling.

Induction Frequency Changers.

Starting is effected in the manner ordinarily adopted for induction motors; if of the squirrel-cage type, a low voltage is switched on to the stator terminals, and when full speed is reached, the starting switch is thrown over to the full-voltage position; with this arrangement the starting current in the line will be approximately 100 to 150 per cent. of normal full-load current. In the case of the slip-ring motor, normal voltage is applied to the stator terminals, and the resistance connected across the rotor slip-rings is gradually cut out as the motor speeds up. With this type of motor, the starting current will be approximately 30 to 50 per cent. of normal full-load current.

Where induction frequency changers have to operate in parallel, the slip-ring type of motor is preferable, as it enables the generator to be synchronised more easily.

Considering the case where a frequency changer running on no load has to be paralleled with a similar set carrying full load, owing to the slip of the induction motor varying directly with the load, the incoming set will be running at a higher speed than the loaded set, and in order that the generators may be safely paralleled it becomes necessary to increase the no-load slip of the incoming set to a value approximately the same as that of the loaded set. If the fully-loaded machine has a slip of 3 per cent., the incoming machine will have a slip approximately 0.2 per cent. (assuming the resistance of the rotor circuits to be the same in each case), and if the generators have a frequency of 50, a synchroscope connected to the two generators will make a complete revolution in 0.71 sec., under which condition safe paralleling is an impossibility. It is, therefore, necessary to increase the slip of the incoming machine before the paralleling can be effected.

This increased slip may be obtained either by artificially loading the incoming set, or by increasing the resistance of the rotor circuits of the motor. If the motor is of the squirrel-cage type, its rotor resistance is fixed, and it is therefore necessary to adopt the first method in order to obtain the desired slip.

In the case of the slip-ring motor, the second method can be adopted, and is obviously more desirable than having artificially to load the machine. It should be noted, however that as the motor is running on practically no load, the resistance required in the rotor circuit is considerably higher than is usually supplied for starting the set.

An alternative method which is frequently adopted when paralleling induction frequency changers is to allow the incoming machine to run up to full speed, and when the generator is giving its correct voltage, power is cut off from the motor, and the generators paralleled at the instant the frequency of the incoming generator falls to that of the loaded machine.

When two or more sets are operating in parallel, the load taken by each will depend upon the full-load slip of the different motors, and if a distribution proportional to their relative capacities is desired, each motor must have the same percentage slip at full load.

With slip-ring motors this can be obtained by means of the external resistance in the rotor circuit, but as this precludes the use of brush-lifting and short-circuiting gear, it is desirable that the motors should be designed to have the correct slip with the slip-rings short-circuited.

With slip-ring motors, the load can be distributed as desired between the different sets, but with squirrel-cage motors this cannot be achieved, as each set must carry a definite proportion of the total load, dependent upon its slip at full load.

The induction frequency changer can transmit power in the reverse direction, *i.e.*, with the induction machine running as a generator, provided there are synchronous machines running in parallel with it, having a capacity large enough to supply not only the wattless current required to magnetise the induction machine, but also the wattless component of the total load on both the induction and synchronous machines.

When operating as a generator, the induction machine must run above the synchronous speed, and as in the case when motoring, the slip varies with the load, equal slips above and below the synchronous speed corresponding to equal outputs as generator and motor respectively.

In order to obtain the advantages of the induction frequency changer, and at the same time to obtain perfect reversibility, two induction sets may be used; one set having a low-frequency induction machine coupled to a high-frequency synchronous machine, and the other a high-frequency induction machine coupled to a low-frequency synchronous machine. A pair of frequency changers of this type has been installed in South Wales to link up two stations generating at frequencies of 40 and 50 periods. The stations were of a capacity sufficiently large to make the adoption of synchronous sets undesirable, but it was necessary that the frequency changers should be able to operate in the case of either station being unable to supply power. One set consists of a 10-pole synchronous machine coupled to an 8-pole induction machine, and the other set of a 10-pole induction machine coupled to an 8-pole synchronous machine. The combined output of the two sets is 1,000 KW., the K.V.A. output being limited by the K.V.A. capacity of the synchronous machines, owing to the synchronous generator having to supply the magnetising current of the induction generator in parallel with it, and also the wattless component of the combined output of the two machines.

The induction machines were adjusted by means of rotor resistances to have the same slip at equal loads, and the two sets then worked perfectly well in parallel, automatically supplying load to either system as occasion demanded.

Synchronous Frequency Changers.

If a synchronous generator is running on no load, its generated E.M.F. is in phase with the terminal E.M.F., but when loaded, these two electromotive forces may no longer be in phase, due to the resistance and inductive drop in the windings. This displacement is shown vectorially in fig. 1 for a load having a power factor of 100 per cent:—

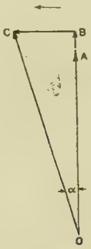


Fig. 1.

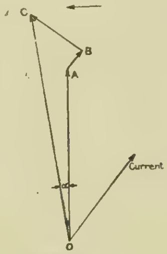


Fig. 2.

O A is the terminal E.M.F., and as the load has a power factor of 100 per cent., the current is also in phase with O A.

A B is the resistance drop in the windings (in phase with the current).

B C is the inductive E.M.F. (leading 90° with respect to the current).

O C then gives the phase direction of the generated E.M.F., leading with respect to O A by the angle α.

Fig. 2 shows a similar diagram for a load having a power factor of 80 per cent. lagging.

Similarly in the case of a loaded synchronous motor, the back E.M.F. will lag with respect to the terminal E.M.F. by an angle which we will call β. We see, therefore, that when the frequency changer is loaded, its generator terminal E.M.F. will lag behind its no-load position by an angle of $\alpha + (\beta - \beta_1) f_G / f_M$, where β_1 is the no-load value of β, and f_G and f_M are the respective frequencies of the generator and motor.

In figs. 1 and 2 the value of A B is small compared with O A, and has therefore very little influence on the angle α. B C is approximately proportional to the armature current, and therefore where α is small it is approximately proportional to the output of the machine, if the voltage remains constant.

In the case of a frequency changer converting from 25 to 50 periods, assuming that at full load α = 20° and β = 25°, if one set is operating at full load and a similar set has to be paralleled with it, the terminal E.M.F. of the incoming machine will be 65 deg. ahead of that of the loaded machine when the generators should be synchronised, and when this is done the sets will divide the load equally.

If the 50-period machines are synchronised before the 25-period machines, the latter will be 34 deg. out of phase when they should be synchronised.

The paralleling of machines when out of phase causes a heavy momentary rush of current and severe mechanical stresses in the stator windings and other parts of the machines, the value of these stresses increasing with the amount by which the voltages are out of phase. If two similar machines are paralleled with their voltages 180 deg. out of phase, the rush of current and mechanical shock will be the same as if each machine had been short-circuited across its terminals.

It is, of course, desirable to keep these stresses as low as possible, and it is therefore an advantage to synchronise the high-frequency machines before those of the lower frequency. A still more satisfactory arrangement is to build the frequency changers with either the motor or the generator stators rotatable through a small angle, either by means of a hand-wheel (similar to the brush-rocking gear of a continuous-current generator), or by a small motor suitably geared to the stator. The stator of the incoming machine can then be rocked round until the generator voltages are in phase, and then rocked in the opposite direction until the set takes the desired load.

If two exactly similar frequency changers are operating in parallel, the total load will be divided equally between them, and any change in the excitation of one generator will only alter the power factor at which each generator is operating, the kilowatt output of each machine remaining practically the same as before.

In order to make one generator take more load than the other, it is necessary to make the generated E.M.F. of the former lead with respect to the E.M.F. of the latter, and this is accomplished by turning the stator of the former generator through a small angle in a direction against the rotation, by means of the rocking gear already referred to. A division of the load proportional to the normal output of the different sets generally gives the highest overall efficiency.

When designing frequency changers which have to operate in parallel, care should be taken that all the sets have as nearly as possible the same phase displacement between the motor and generator electromotive forces at full load, otherwise the load distribution between the different sets will vary with different total loads.

It is also necessary that frequency changers which have to operate in parallel should be so built that when the motor voltages are in phase the generator voltages are also in phase. This is easily achieved if either the motor or the generator stator be made rotatable. If fixed stators are adopted the sets can be made exact mechanical duplicates, but to do this involves considerable difficulties. It is therefore advisable to make the sets approximately similar and to provide some means for final adjustment.

In order to ascertain if the generator voltages of two frequency changers are in phase when the motor voltages are in phase, a simple method is to run the motors in parallel, and connect terminal A of one generator to the corresponding terminal A_1 of the other generator. Both generators are then excited to give exactly equal voltages, and the voltage measured between terminals B and B_1, or C and C_1, will indicate the amount by which the generators are out of phase. These voltages can be plotted graphically to obtain the angle through which one generator stator should be rotated to bring the voltage exactly into phase.

An alternative method is to run the two sets with both the motors and generators in parallel, an ammeter being connected in one phase of the generators. Both generators are then excited with approximately normal field current, the excitation of one being then adjusted so that the alternating current flowing between the two generators is a minimum. If the generated voltages are exactly in phase, this minimum will be zero.

The starting of synchronous frequency changers can be effected either by means of a mechanically-coupled starting motor or by making the synchronous motor (or if desired the generator) self-starting and self-synchronising.

If a separate starting motor is adopted it is usually of the induction type, and may have either a squirrel-cage or a slip-ring rotor, the latter being desirable for large units owing to the smaller momentary starting current required. The starting motor is usually built with one pair of poles less than the synchronous motor, and the rotor resistance is adjusted so that the set runs slightly above synchronous speed when the synchronous motor is excited to give normal voltage; the speed is finally adjusted to the correct value by exciting the generator.

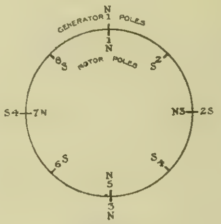


Fig. 3.

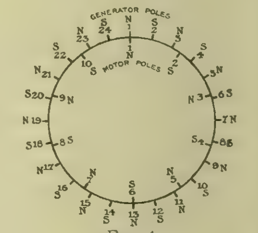


Fig. 4.

If the separate starting motor be dispensed with, and the synchronous motor be made self-starting, the starting current will be increased, but as the machine is self-synchronising this operation is considerably simplified. During the starting period the synchronous motor operates as an induction motor, the field system being usually fitted with a number of copper or brass bars embedded in the pole faces, the bars being short-circuited at each end by metal rings, forming a complete squirrel cage. If solid steel poles are used, this squirrel cage may be dispensed with, the currents induced in the pole faces giving sufficient torque to run the machine up to speed.

Starting is effected by means of an auto-transformer, a voltage of 30 to 50 per cent. of the normal being usually sufficient to give satisfactory starting; the initial line current at starting is about 75 to 150 per cent. of full-load current. The slip-rings of the motor should be short-circuited through a resistance during the starting period, in order to prevent a high voltage being induced in the field coils. When full speed is reached, the field is excited and the machine pulls into step, the starting switch being then thrown over to the full-voltage position.

When the motors of two identical synchronous frequency changers are running in parallel, the generator voltages will not necessarily be in synchronism, even assuming both sets to be running light.

We will consider the case of two identical frequency changers A and B converting from 50 to 25 periods, the motors having 8 poles and the generators 4 poles. A is running on no load, and it is required to connect B in parallel with A on both the 50-period and 25-period ends.

Fig. 3 shows diagrammatically the positions of the poles on the motor and generator, the radial lines inside the circle representing the centres of the motor poles and the radial lines outside the circle representing the centres of the generator poles.

When the two motors are in synchronism, the N pole 1 of motor B can occupy four positions with respect to the N pole 1 of motor A, viz., positions 1, 3, 5, and 7, but in only two of these positions, 1 and 5, will a N pole of generator B occupy the same relative position as a N pole of generator A. That is to say, with the motor pole 1 in positions 1 and 5, the generator voltages will be in phase, but with positions 3 and 7 the generator voltages will be 180 deg. out of phase. It is therefore seen that with the ratio of frequency conversion under consideration (2 : 1) the probability of obtaining synchronism between the generators when the motors are in phase is 1 to 2.

If it is found that the generator voltages are 180 deg. out of phase when the motors are in synchronism, this can be corrected by reversing the excitation of one generator. If the excitation of one motor be reversed, it will be impossible to synchronise the generators, as their voltages will be 90 deg. or 270 deg. out of phase.

If the 25-period machines are synchronised first, it will be seen that the 50-period machine voltages must be in phase every time.

If we consider the case of some other ratio of frequency transformation, say, 25 to 60 periods, the probability of obtaining correct synchronism of both motors and generators is considerably reduced. With this case the minimum numbers of poles on the motor and generator are 10 and 24, and fig. 4 shows the relative position of the centre lines of the poles of the two machines. When the motors are in phase, pole 1 of motor B can occupy positions 1, 3, 5, 7, or 9 with respect to pole 1 of motor A, but only in the case of position 1 will the generator voltages be in phase. We thus obtain one chance in five of obtaining correct synchronism of the generators.

If the 60-period machines be paralleled first, the chance of obtaining correct synchronism is 1 in 12, which may be increased to 1 in 6 if the 25-period machines are fitted with a field-reversing switch.

It will be found that the chance of obtaining correct synchronism is always greater if the low-frequency machines are synchronised before the high-frequency machines, but, as already pointed out, when a set has to be paralleled with one already on load it is an advantage to synchronise the high-frequency machines first, in order to reduce the angle by which the loaded and unloaded machines are out of phase, so reducing the rush of current at the moment of switching in.

In order to obtain correct synchronism of both motors and generators, one of two methods may be adopted :—

(1) Where the motors and generators are synchronised simultaneously.

(2) Where the motors and generators are synchronised separately.

(1) This method is usually only possible when a separate starting motor is used, because a self-starting synchronous motor will usually pull into step without field excitation, and therefore there is no control over the instant at which it will pull into synchronism.

The most satisfactory arrangement is to have a synchroscope fitted with two pointers, one controlled by the high-frequency and the other by the low-frequency machine. As the machines approach synchronism, the two pointers will rotate at different speeds proportional to the respective slips of the incoming machines controlling them, and the motors should be paralleled when the two pointers simultaneously indicate synchronism.

(2) The motor is first paralleled and the synchroscope connected to the generator; the pointer of the synchroscope will, of course, remain stationary at a position on the dial indicating the phase difference between the bus-bar and the generator voltages. The motor excitation is then reversed, so causing the motor to "slip a pole," when the synchroscope pointer immediately takes up a new position. This operation of reversing the motor field current is repeated until the synchroscope indicates synchronism, when the generator can be switched on to the bus-bars.

If the motor is of the self-starting type, it is advisable to perform this operation of pole-slipping when the motor is running at the reduced starting voltage, as this causes a smaller kick in the line current, and less shock to the motor.

It is important to note that when synchronising the generators in the way just described, the position taken up by the synchroscope pointer will vary with the output of the loaded machine, due to the angular displacement (due to the load) between the motor and generator bus-bar voltages as previously explained. This can be taken care of by fitting the synchroscope with a zero mark, which can be moved over a scale graduated in kilowatts output of the running machine. Before synchronising the incoming machine, the zero mark is moved to the mark on the scale corresponding to the output of the loaded machine, and when the pointer is opposite the zero mark the incoming machine is in the correct phase for paralleling.

In the case of a frequency changer, where neither machine has a rotatable stator, if it is impossible to synchronise the generator correctly, due to faulty machining, &c., the amount by which the voltages are out of phase may be reduced by changing the connections between the stator terminals and the bus-bars.

Considering the case of a 10-pole three-phase motor driving a 24-pole three-phase generator, with the maximum possible error in machining or winding, it is possible to obtain an out-of-phase angle between the generator and bus-bar voltages which will not be greater than 6 deg.

Comparison between Induction and Synchronous Sets.

From the point of view of cost, efficiency, overload capacity reliability, maintenance, and floor space, both types are practically on an equality (assuming the same synchronous speed with each type). The type to be adopted must, therefore, be determined by the other characteristics of the machines. The difficulty and troubles experienced in connection with the operation of synchronous frequency changers are not as real in practice as one would at first expect. If either the motors or the generators are fitted with rotatable stators, the synchronising and load distribution is as simple, or even simpler, than with induction frequency changers. If the machines have non-rotatable stators, the difficulty of synchronising depends to a great extent on the ratio of frequency conversion.

In any case, the operation of "slipping poles" by reversing the motor excitation is easily carried out, and will quickly bring the generators into the correct phase relation for paralleling.

Taking all the points into consideration, the advantages of the synchronous frequency changer are sufficient to justify its adoption in the majority of cases.

Mr. Partridge, in opening the discussion, said the subject was of great importance in connection with the linking-up proposals. He was sorry the author had not referred to phase changers, and went on to suggest the use of automatic regulating transformers instead of rotating the stators. All his company's motor-generators were now switched in through water resistances, and he thought it would be dangerous to switch-in as suggested by the author. It was not easy to move a large stator, but it might be possible to use some form of magnetic clutch between the two sets. He could not tell whether the author really advocated induction or synchronous frequency changers; personally, he thought the induction type would be simpler to work, and it was a most important feature. There was less danger of the induction type falling out of step, and it was mechanically stronger. For the last six years he had been using a 1,500-kw. machine, running at 365 r.p.m., consisting of a three-phase induction motor with 8 poles coupled to a single-phase 28-pole synchronous motor; damper windings were provided, and the overall efficiency was 86 per cent.; the machine had been satisfactory, and fulfilled all its guarantees. Either side was used to generate current, and it was synchronised by running up on the induction motor; normally it supplied single-phase current; a voltage regulator was fitted, and kept all the single-phase voltage steady.

Mr. J. S. Highfield said it was surprising that frequency had never been standardised; in quite a small area he knew of half a dozen different frequencies. The problem was not so simple, for, as a rule, it was desirable that the link between two undertakings should allow reciprocal supplies to be given, so that a station could be shut down if desired. He thought that linking-up was a temporary expedient, but a very important one, and doubted whether the induction machine would be satisfactory, as probably two synchronous sets would be required. It was questionable whether it would be possible to work a number of frequency changers at different stations, all tied together, and the probable solution was to do away with the odd frequencies.

The Author, in his reply, referred to the design of phase changers, pointing out that some rotating machine was essential in the apparatus. Stators which could be rotated were quite satisfactory in frequency changers, and in some cases a small motor was installed to turn them. He believed that a machine had been built in which the stator was arranged to rotate continuously in case the load exceeded the safe limit. He thought there was no need for an electromagnetic coupling. The frequency changer must be big enough to take care of rapid variations of load without losing step. The solution of all difficulties in paralleling was to use a rotatable stator; the difficult thing to decide was how big a frequency changer should be.

Prices Advanced.—Owing to the continually increasing cost of raw materials, the Herbert Frood Co., Ltd., of Chapel-en-le-Frith, has advanced the prices of Ferodo fabrics 15 per cent.

IMPROVED METHODS OF POWER MEASUREMENT.

[Communicated.]

(*Concluded from page* 192.)

Apart from the more important consumers thus provided for, there still remains the medium and small consumer, who may possibly require both lighting and power; the consumer situated in remote districts; and the consumer who may suddenly wish to increase his demand considerably for a short period. To these classes the schemes already described do not apply very satisfactorily.

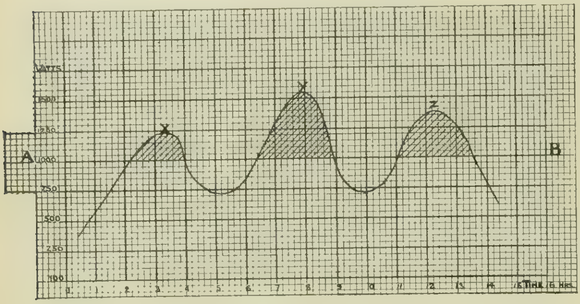


Fig. 8.—Differential Meter—Load Curve.

What is required is a meter permitting the supply of power up to a certain predetermined amount without registration, and for demands or peaks above this amount registration of the excess units. Fig. 8 shows a simple load curve. The horizontal line A B shows the maximum rate at which energy may be consumed, and which in this case is 1,000 watts. Whilst the demand does not exceed this line, registration must not occur, whilst when "peaks" such as X Y Z occur, the units, as shown by the shaded area, must be recorded by the meter. With such an instrument it is at once seen that:—

1. Supply is unrestricted.
2. Peak periods are penalised, and therefore discouraged, a heavy charge being made for units registered
3. A fixed revenue per month, quarter, &c., as the case may be, is assured, and the excess units need only be read and charged, say, twice a year, making this scheme particularly suitable for remote consumers.

As the name "differential" implies, the registration is the difference between the maximum allowable load and that demanded in excess.

Several ingenious devices have been evolved, usually costly in construction, and not entirely satisfactory in principle; these are known under various names, such as: Differential meter; subtraction meter; excess meter; peak meter, &c.

Obviously, a retarding torque must be applied to the meter movement equal to the torque developed by the meter at the maximum allowable load without registration. This has been attained in a variety of ways, as follows:—

1. *Shaded Pole Magnet.*—A small electromagnet provided with a shaded pole and excited from the voltage, acts on the disk so as to oppose rotation in the normal direction. A ratchet and pawl prevent backward rotation, and until the torque of the meter can overcome that of the shaded-pole magnet, rotation does not occur. This suffers from the defect that the retarding torque of the shaded-pole magnet varies as the square of the voltage, and a 10 per cent. error is possible with only a 5 per cent. variation of voltage.

2. *Demagnetisation of Driving Fluxes.*—A small transformer is connected with the primary winding across the voltage. The secondary winding is of low voltage and greater current, and this current is passed through an additional coil on the ordinary series winding, so arranged as to oppose the magnetising effort of the series coil in the meter. When the load is sufficiently great the ordinary series winding overcomes the demagnetising winding, and the meter begins to register. Assuming the voltage to be constant, the demagnetising effect is constant, and by suitably arranging the number of turns, can be made such as to permit of a certain load before registration occurs. However, as the voltage is never constant, and as the variation may be as great as 5 per cent., the error introduced will be in proportion to the variation of voltage. This principle is applied in various ways, but is always subject to the above defect.

3. *Differential Gears.*—Two dials are utilised, one being engaged with the meter and the other with a constant-speed device, operated from either a mechanical hand-wound clock mechanism or a small Ferraris motor, the latter avoiding the periodical visits necessary in the case of hand-wound instruments.

The two dials are connected together by a differential gearing, and when the speed of the gear wheels driven from the meter movement exceeds the speed of those driven by the constant-speed device, registration of the excess units occurs.

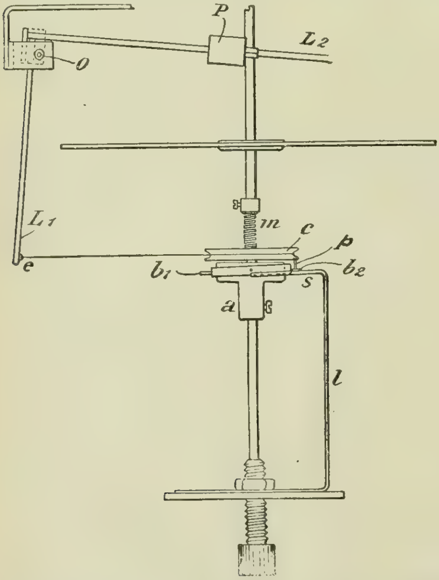


Fig. 9.—Diagram of Westinghouse Differential Meter Gear, as Applied to Induction Watt-hour Meter.

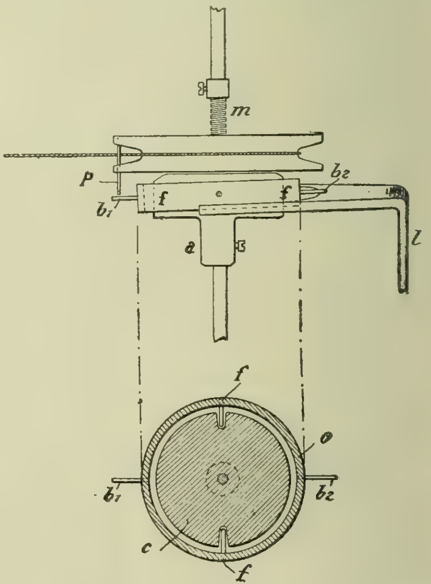


Fig. 10.—Differential Gear Applied to Watt-hour Meter.

Suitable means are adopted to prevent negative registration when the speed of the meter dial train is less than that of the constant-speed dial train. There are many disadvantages to this method, for it necessitates delicate and expensive mechanism, periodical visits in the case of hand-wound instruments, and in the case of the Ferraris motor the constant-speed dial must be driven by some kind of clock escapement to ensure this constant speed, for otherwise it will vary as the frequency.

The foregoing are probably the most satisfactorily developed instruments up to now, but they all fail in that they require special design. Further, the elaborate mechanism makes them expensive, while with only a limited range of adjustment, once calibrated, very little alteration, if any at all, is possible.

The British Westinghouse differential device not only has the advantage of being absolutely independent of the conditions of supply (voltage, frequency, wave form, &c.), but has also that of great simplicity, permitting it to be fitted to standard designs; it is, therefore, a decided advance on its predecessors.

The retarding torque is obtained by means of a weight at a fixed radius from the centre of the spindle. The meter movement operates against this torque continuously, and when sufficient current is passing, registration occurs. Figs. 9 and 10 are diagrammatic sketches of the gear as applied to an induction watt-hour meter. The weight P is carried on a bell-crank lever L_2 O L_1, pivoted at O.

A grooved pulley c is loose on the shaft, being held in position by means of the spring m, pressing it against the disk a, which is rigidly attached to the shaft. A silken cord connects the lower end L_1 of the bell-crank to the grooved pulley C. The fixed disk a carries an oscillating collar ff (fig. 10), pivoted at ff, this collar in its turn carrying pins b_1, b_2. These pins engage with the vertical pin p on the grooved pulley.

When the torque of the meter is sufficiently big to overcome that due to the weight P, the movement rotates, winding up this weight by means of the grooved pulley C. As rotation continues, one side of the oscillating collar rides on the fixed spring $s\,l$. This spring $s\,l$ is so arranged as to tilt gradually the oscillating collar until finally the engaging pin p on the pulley is released from the pin b_1 on the collar. The weight P is then released, and in falling turns the grooved pulley a half revolution in the opposite direction to rotation, when re-engagement between the pin p and the pin b_2 occurs, for pin b_2 is then at its highest position. Rotation continuing, the side of the collar with pin b_1 gradually rides upon spring $s\,l$ until the grooved pulley is released again, the weight falls, and pins b_1 and p re-engage.

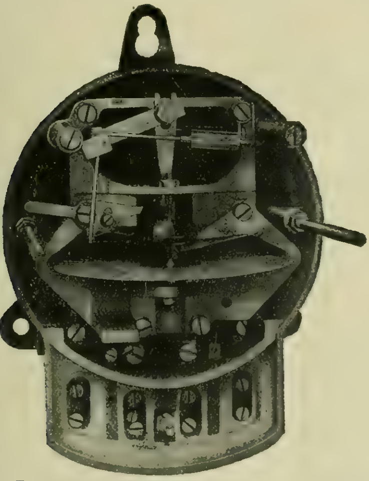


Fig. 11.—Differential Mechanism applied to Westinghouse Type N Single-phase Meter.

The weight is so arranged that when it has fallen to its lowest position it is still exerting the same retarding torque as when in its top position. This is obtained by suitably proportioning the arms of the bell-crank lever to overcome the slight angular error of the falling weight. Further, for the short time the weight P is falling, the meter would tend to accelerate, but this time is extremely short, and is off-set by the shock in a negative direction when re-engagement occurs.

Without further discussion of possible errors, it is enough to say that the instrument may be calibrated extremely accurately.

Fig. 11 shows a view of the mechanism as applied to a type N single-phase meter, and the extreme simplicity of construction is at once seen. This simplicity has the additional advantage that very little trouble is likely to be experienced, while if trouble has developed it can easily be rectified.

Further, by altering the position of the weight P, the retarding torque is altered and a very wide range is permissible.

A scale whereby the distance from centre O is equivalent to a maximum permissible load is easily obtainable, and alterations can be carried out on site with perfectly accurate results. For example, if the distance of the weight from centre O is two centimetres, and the maximum permissible load without registration is 1,000 watts (10 amp. at 100 volts), moving the weight to a distance of four cm. would increase the limit to 2,000 watts.

The weight is so arranged as to permit of easy and quick readjustment, and, as the arm O L_2 is approximately five cm. long, a very wide range is possible.

Very little additional friction is introduced, and in any case it is amply compensated for. This device practically fulfils all the conditions specified previously, and enumerating the various advantages we have :—

1. No interference with supply.
2. Peak periods penalised.
3. Frequent periodic visits unnecessary, readings every six months being amply suitable for remote customers.
4. Definite revenue each month based on maximum allowable load.
5. Retarding torque absolutely constant, independent of voltage, frequency, wave form, &c.
6. Wide range of adjustment possible, easily and quickly carried out on site if necessary.
7. No elaborate mechanism, therefore friction a minimum; low cost makes it suitable for the medium and small consumer.
8. Accurate calibration.
9. No auxiliary shunt circuits, contacts, &c.

This device, as developed by the British Westinghouse Co., is a very satisfactory appliance, and will enable supply companies to deal suitably with the medium and small consumer.

THE GREAT NEED OF PROMOTING RESEARCH IN AMERICA.

In the New Year issue of the *Electrical World*, Dr. W. R. Whitney, director of the Research Laboratory, General Electric Co., had a special article on this subject. In a rapid review of the history of the American nation, he indicated how the resources of the country had been successively drawn upon with feverish haste and little thought for the future, and proceeded to rebuke his fellow-countrymen for their devotion to mere commercialism without regard to the higher aims of civilisation.

The special significance of his remarks lies in the fact that he is at the head of the great laboratory from which some of the most striking and important discoveries have emanated during recent years in connection with industrial research; yet he lays stress on the necessity of research in pure science, which has hitherto received but little attention in the United States. We reproduce the bulk of the article below :—

Coincident with our history, other countries, somewhat differing from our own, have been increasing the world's store of knowledge by a certain system. It is by utilising this store that we have made most of our advances. From it we have made our engines, healed our wounds and cured our sick, talked through wires, and heard through infinite space. We inventors and engineers, using, generally, the scientific products of foreign lands, have turned knowledge into utility. But we have taken no time to contribute to the world's needed supply of new facts. We owe a debt we hope our descendants will pay. We might as well defy them to pay it.

Compared with other countries, we have been exceedingly short-sighted. We are much more active as users than as producers of knowledge. We make no provision for repairing the rapid exhaustion of our soils, replacing our disappearing coal and oil, or providing the new knowledge on which future life or happiness must be based. Inventors and engineers are being rapidly grown, but searchers to unearth the knowledge on which engineering is based are not being produced. Other countries have provided for the education, support, and encouragement of men who practically devoted their lives to pure or scientific research. Their investigations seemed more or less academic. These were careful physical analyses of natural phenomena which, at the time, had no visible utilitarian value. It is not surprising to find that most of the foundations of engineering have come to us through professors of science in European universities or institutions.

As we review the history of scores of such cases, it is evident that most foreign universities have held teaching to be secondary to research, and have, for several decades, at least, employed and given great facilities to men who made experiments their life work and taught science for the purpose of preparing similar investigators. It is we Americans who have prostituted teaching for the use of the industries.

In a volume on German culture, edited by a group of English writers, there are comparative lists of great contributors to engineering science. There are listed 12 leaders in chemistry and 12 in physics from England, France, Germany, and the rest of the world, making 96 in all. They were the producers of new science in the nineteenth century. Of these 96, only 5 were from the United States; 48 mathematicians are also compared, and no American is among them.

Another and different criterion occurs in the recipients of the Nobel Prizes. These are annually awarded, without regard to country, to the individual who is most deserving in the particular fields of physics, chemistry, physiology or medicine, literature.

and peace. Here, again, we do not shine very brightly. In physiology or medicine, among the 15 awards down to 1914, America had received one. Also in physics, the United States had received one out of 13, and in chemistry none. That is, in new and constructive scientific work of this kind during these recent years, America had been recognised only twice out of 39 chances.

While we may be doing our share in the applications of science, we have failed in laying foundations. Until we can learn to do still better, let us follow the example of the German Universities or of the British Institutions. There the teaching of science is not confined to the preparation of men to earn a living as engineers. In practically every one of scores of Universities, particularly in Germany, there are professors whose main object seems to be to advance knowledge, to discover new facts, and to teach by precept the acquirement, instead of the storage of information. They work with their own hands. The very great value of these professors is seldom realised, and so I want to call to mind a few of them. The point I wish to make is that apparently most of our advances may be traced back to one of these professors, who, trained to be an observer, matured in a laboratory supported by the State, has had time and facilities to follow the lead of some natural observation.

Consider electric lighting, for example. The earliest impetus was given to it by experiments using the cells of Grove and Bunsen. They were famous for their research and teaching as well. One was a professor in England, the other in Germany. The publications on these batteries at the time show the men to have made careful and interested studies of novel phenomena. Of course, they had no thought of electric lights, and even when these were produced by battery currents, much as in pocket lamps to-day, there was no commercial development until the current-generating machines were produced. But even with the cells of Grove, Sir Humphry Davy produced the first electric arc between carbon electrodes. Davy was for many years the chief chemist and lecturer of the Royal Institution. If we go back of Grove or Bunsen, we come to the professors of Boulogna and Pavia, who made the first researches on current generation. Galvani investigated the frog's legs and Volta the metal pile. They published their observations. Fundamental observations and the necessary experiments are always more certain to be performed by such trained observers than by others. Faraday, the life-long investigator of the Royal Institution, had disclosed the principles of the generation of electric current by using permanent magnets, and further research then became rapid. Apparently Prof. Wheatstone made the first machine for producing current by mechanical means without permanent magnets, though Siemens presented his paper to the Royal Society first, and both were read before the Society the same evening. In either case the product came from the kind of mind and the type of study which I am showing contributes to our knowledge. The contributions of pure research are seldom in response to recognised needs, but the needs themselves are developed or disclosed through the research.

The more recent history of lighting is filled with the studies of engineers and students, and greatest of these is Edison, but even here one cannot help noting the radical or unexpected steps whose foundations are laid in the professor's laboratory. An entirely new type of electric illuminant was disclosed by Prof. Nernst by his studies of oxide conduction. Dr. Welsbach, in rare oxide investigations, not only found the gas mantle, but produced the osmium incandescent lamp as well. Von Bolton, student of Ostwald, and highly trained in experiments, worked out tantalum and produced a new lamp, and even the recent tungsten gas lamps depend on the purely scientific researches of the able English professors Rayleigh and Ramsay for the argon used in them.

Readers of *Popular Mechanics* some time ago selected by vote the seven wonders of the modern world. The highest votes were received by wireless, the telephone, aeroplane, radium, antiseptics, antitoxins, spectrum analysis, and X-rays. How were these originated? All of them were produced by the identical formula. In the first place, they were not the result of a direct attempt to accomplish what was really attained. The end was not visible when the foundations were laid. The real work was done by thoroughly well-trained observers—not by laymen. They were professors in every case. They followed up a lead opened by an observation which was too insignificant to attract the attention of less trained men.

It would be impracticable to give the histories of these so-called wonders. Anyone who reads may learn how Prof. Helmholtz, an expert German investigator, was the instigator of the work of Hertz, which in turn was based on the principle of Maxwell that variation in electric displacement is electric current. This, Maxwell had derived from work on Faraday's researches. And thus, in the foundations of the single wonder of wireless, we find the co-operating efforts of at least four experimenting professors of science. They were all working for the public, and supported by a university or public institution.

Radium and X-rays are of such recent disclosure, that it is hardly necessary to recall that the work was done by English, German, and French professors.

One might well conclude from the history of the British Royal Institution alone that pure research was a good governmental investment if the environment was capable of developing such products as Davy, Faraday, Tyndall, and Rayleigh. Surely we may hope to awaken ourselves to the importance of constructive action for the advancement of science. If we count only on such private bequests as have already helped so much in studies of disease, we are evidently not awake. Federal appropriations to assist American colleges in research seem a fair way to discover and produce good men, and to economically supply them with apparatus and atmosphere.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, Londno, W.C., and at Liverpool and Bradford.

1,796. "Electric fuses." J. F. Avila, Simplex Conduits, Ltd., & L. M. Waterhouse. February 5th.

1,802. "Manufacture of carbons for electric arc lamps." H. B. Grylls and W. Heape. February 5th.

1,851. "Electromagnetic switches." British Thomson-Houston Co. (General Electric Co., U.S.A.). February 6th.

1,867. "Electro magnets." Cutler-Hammer Manufacturing Co. & Igranic Electric Co. February 6th.

1,880. "Spark plugs." C. F. Arnold. February 7th. (U.S.A., February 7th, 1916.)

1,921. "Automatic trolley alarm or signal for electric tramcars." Horstmann Gear Co. & R. Dodd. February 8th.

1,930. "Art of metering electricity." E. O. Schweitzer. February 8th.

1,948. "Electrical heating apparatus." H. de Stefano. February 8th.

1,953. "Electromagnetic switches." British Thomson-Houston Co. and General Electric Co. February 8th.

1,962. "Electric ovens." J Bradley. February 8th.

1,971. "Trolley-wire locator." F. J. Davis. February 8th.

1,978. "A fault-finder for testing cylinders, sparking plugs, and magnetos of internal-combustion engines ignited by electricity." A. Veitch. February 9th.

1,985. "Electric lamp locks." J. H. Collie. February 9th.

2,011. "Safety spark gaps for magneto-electric machines." British Thomson-Houston Co. & A. P. Young. February 9th.

2,022. "Ignition devices for internal-combustion engines." J. J. Murray. February 9th.

2,026. "Trolley heads for electric traction." W. Pickersgill & J. H. Pitt. February 10th

2,040. "Polyphase electromagnetic brakes, clutches, &c." F. H. Kershaw. February 10th.

PUBLISHED SPECIFICATIONS.

1915.

16,808. Alternating-current Motor Starters. Electric Control, Ltd., and O. Ellefsen. December 1st.

1916.

The numbers in brackets are those under which the specification will be printed and abridged and all subsequent proceedings will be taken.

665. Machines for making Electric Cables or the like. Macintosh Cable Co. & P. W. Sankey. January 15th, 1916. (Cognate application, 9,738/16) [103,316]

681. Alternating-current Dynamo-electric Machines, Induction Regulators, and other Electrical Apparatus. British Thomson-Houston Co. and F. P. Whitaker. January 15th, 1916. [103,317.]

1,076. Vibrating Diaphragms for Telephones, Transmitters, Gramophones, and the like. T. Chalmers. January 24th, 1916. [103,335.]

1,189. Telephonic Receiving Apparatus for Aviators or others working under similar conditions. Western Electric Co. & G. H. Nash. January 25th, 1916. [103 341.]

1,255. Regulation of Electric Induction Motors. British Thomson-Houston Co. & N. Shuttleworth. January 26th, 1916. (Cognate application. 2,261/16.) [103,344.]

1,282. Arrangements for Transmitting Impulses, particularly applicable in Telephone Systems. Relay Automatic Telephone Co. & L. C. Bygrave. January 26th, 1916. [103,345.]

1,384. Incandescent Gas-filled Electric Lamps. A. J. West. January 28th, 1916. [103,351.]

1,481. Switches for use with Electric Generators. E. Girardeau January 29th, 1915. [100,042.]

3,535. Electric Relays. National Safety Appliance Co. May 5th, 1915. [100,389]

4,334. Electric Locomotives. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 23rd, 1916. [103,387.]

6,326. Electrical Apparatus for Indicating the Depth of Liquids in Tanks or other Vessels. J. Plummer & G. B. Burrows. May 3rd, 1916. [103,403.]

7,014. Electric Furnaces. M. M. Kohn. May 17th, 1916. [103,062.]

7,186. Insulation of Electrical Machinery and other apparatus. C. H. Klyne & C. J. Baker. May 19th, 1916. [103,413.]

7,518. Electric Ship Propulsion Systems. R. V. Morse. May 26th, 1916. [103,065.]

7,607. Relay Selectors, especially suitable for use in Automatic and Semi-automatic Telephone Systems. Relay Automatic Telephone Co. & H. J. Herink. December 11th, 1915. [102,330.] (Divided application on 17,386/15.)

8,216. Sparking Plugs for Internal-combustion Engines. F. A. L. Johnson. June 10th, 1916. [103,420.]

8,858. Method of and means for Varying the Resistance of an Electric Circuit. Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.). June 23rd, 1916. [103,254.]

9,349. Automatic Switching Devices for Wireless Telephone Systems. L. de Forest. July 7th, 1915. [100,841.]

10,070. Electric Cable Junction or Terminal Boxes or Apparatus. C. Vernier and British Insulated & Helsby Cables, Ltd. July 18th, 1916. [103,435.]

10,116. Electric Motor Controllers. Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.). July 18th, 1916. [103,436.]

10,122. Electric Vacuum Devices with Incandescent Cathodes. L. de Forest. July 22nd, 1915. [100,959.]

10,611. Automatic Telephone Call Distributing Systems. Western Electric Co. December 19th, 1914. [101,033.] (Divided application on 17,581/15.)

11,327. Alternating-current Dynamo-electric Machines of the Compensated Commutator Type. British Westinghouse Electric & Manufacturing Co (Westinghouse Electric & Manufacturing Co., U.S.A.). August 10th, 1916 [103,265.]

10,640. Controllers for Electric Motor Circuits. Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.). July 27th, 1916. [103,441.]

11,691. Magneto-ignition Systems. Soc. de Paris et du Rhone. Decembe- 6th 1915. [102,606.]

11,736. Construction of Pocket or Portable Electric Lamp. W. King (I. Chkliar & B. Theodor). August 18th, 1916. [103,268.]

13,727. Electric Heating and Cooking Apparatus. G. Pate & A. R. Wood. September 27th, 1916. [103,279.]

14,946. Magnets for Magneto-electric Machines. G. F. Cooke. October 20th, 1916. [103,461.]

17,321. Electrical Contacts. British Westinghouse Electric & Manufacturing Co. January 21st, 1916. [103,464.]

THE

ELECTRICAL REVIEW.

VOL. LXXX. MARCH 2, 1917. No. 2,049.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: March 2, 1917. [No. 2,049.

Page

British Canals 225
Liquidation of German Electrical Companies in Russia ... 226
The Wire-Drawing Industries 226
The Electrical Installation at the British Industries Fair ... 227
Radiators, by "Experiment" 227
Phantom Circuit System for Controlling Street Lights, by A. H. Davis (*illus.*) 228
American Report on German Electrical Organisation... ... 229
Economic Recuperation after War, by Prof. W. R. Scott ... 229
Preference for American Cables in Australia 231
Correspondence—
  The Inspection of Munitions 231
  Boiler House Operation and Maintenance (*illus.*)... ... 232
  Fuse Failures 232
  Curious Trouble with Lead-Sheathed Cables 232
  The Homogenous Lead Coating Co.... 232
  British *v.* German Turbines 232
  Meirowsky Insulating Tubes 233
New Electrical Devices, Fittings and Plant (*illus.*) 233
Legal 233
War Items 235
Business Notes 236
Notes... 239
Powdered Coal Boiler Furnace (*illus.*) 242
City Notes 243
Stocks and Shares 245
Market Quotations 246
Exports and Imports of Electrical Goods during January, 1917 247
Some Points in Connection with Engineering Specifications, by J. Shepherd 248
Reviews 250
Foreign and Colonial Tariffs on Electrical Goods 252
New Patents Applied for, 1917 252
Abstracts of Published Specifications 252
Contractors' Column ... ... Advertisement page xx

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The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain £1 1s. -d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

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NEW YORK: D. Van Nostrand, 25, Park Place.

PARIS: Boyveau & Chevillet, 22, Rue de la Banque.

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ROME: Loescher & Co., Corso Umberto 1° 307.

SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.

TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE "ELECTRICAL REVIEW'S"

ELECTRICAL & ALLIED TRADES DIRECTORY

(THE RED BOOK),

1917 EDITION,

IN PREPARATION.

H. ALABASTER, GATEHOUSE & KEMPE,

4, Ludgate Hill, London, E.C.

BRITISH CANALS.

IN our last issue we drew attention to the announcement that the Government had decided to take control of the internal waterways of this country, together with all buildings and plant connected therewith, and to appoint a committee to take charge of this means of transportation. The Government, having already assumed control of all the railways and shipping of the United Kingdom, thus becomes the sole authority for the carriage of munitions and merchandise by land or water, the only remaining alternative being transport by road, which is practically unorganised, and too costly at the present time to play an important part in the matter. The fact that the Government control applies only "for the period of the war" constitutes an element of uncertainty which is to be regretted. Whatever the merits or demerits of State control or ownership—for which in normal times we have no liking—the conditions obtaining in connection with our internal navigations are so deplorably chaotic that, we must confess, the only possible avenue for escape from the present lamentable waste of traffic facilities appears to be centralisation of control, the way to which has been unexpectedly thrown open by the war. It will be remembered that the Royal Commission on Canals and Waterways, which sat from 1906 to 1909, recommended in the latter year that a central "Waterway Board" should be constituted for Great Britain, and that the four main arteries, known as the "Cross," should be put under its control without delay and unified. Those waterways would have been "improved to the 100-ton standard" as a minimum, though some parts of them could be traversed by very much heavier vessels, and would have given excellent communication by water between the great Midland cities and the Thames, Humber, Mersey, and Severn rivers.

The system under existing conditions in 1905 conveyed a traffic (including the Birmingham Canal) of 16.6 million tons, possessed a mileage of 1,084 miles, and earned a net revenue of £228,691. The total cost of the necessary improvements on this system, with its branches, was estimated at 17.5 millions sterling, and the annual expenditure at 1.1 millions, which could have been covered with about double the traffic actually recorded. The carrying capacity of the 100-ton portions of the routes would have been about five times as great as that of the existing barge canals, and ten times that of the narrow sections, which impede traffic even on these routes, while great economies in time and labour would have been effected. With the adoption of electric haulage, trains of barges carrying 300 tons could have been conveyed, with further saving in cost per ton, but the Commission made no direct recommendation on this subject. While it was impossible to make an accurate forecast as to the traffic eventually obtainable, when the total lack of organisation which existed gave way to a proper system, the Commission pointed out that the Manchester Ship Canal, though then unable to show a working profit, had conferred "remarkable and unquestionable benefit" upon Manchester and the surrounding district, which had abundantly justified the great outlay incurred. (Incidentally, we may remark that the traffic on that canal has since developed to such an enormous extent that it is now paying dividends on the ordinary shares.)

But what was the result of the Commission's three years' labours? Its final report, a mine of information regarding the waterways of the country from every aspect of the question, was absolutely ignored by the Government of the day, whose time was too much occupied with party politics to permit of its taking into consideration schemes for the assistance and development of industry and commerce, and the subject has been kept alive only by a small but devoted band of believers in the great possibilities of our waterways, of whom Mr. Neville Chamberlain was one of the leaders. So long as the canals are in the hands of private owners, it is impossible to look for any material reform. It will be remembered that, in giving evidence before the Advisory Committee of the Board of Trade with regard to British trade after the war, the B.E.A.M.A. ascribed the cheaper rates for carriage prevailing in Germany, so detrimental to our export trade, partly to the throttling of our canals by railway companies, and to the great development of water transport in recent years in Germany, Holland, and France.

It is true that in certain cases, such as the Aire and Calder, the Weaver, and the North Stafford Navigations, excellent results have been obtained, but these are isolated examples, and the reorganisation and improvement of our waterways in general cannot be dealt with except by one central body charged with their unification and administration on a comprehensive scale. The opportunity now presents itself—such an opportunity as can never be expected to recur—of handling the whole question in a statesmanlike manner, and placing water carriage on an entirely new plane of service to the community. But for this purpose, the limiting proviso "for the period of the war" must be abandoned, as the work will take years to accomplish, and, indeed, it cannot be put in hand at all during the war owing to the more pressing demands for labour in other directions.

How should the scheme be carried out? With animal haulage, electric or steam traction from the banks, or the use of steam tugs? These appear to be the main alternatives, and of these we may at once condemn the first as too slow, and too costly. For an answer to the remaining questions we may look abroad and see what has been done on the Continent, where water carriage has sustained a vastly greater development than in this country, thanks to the intervention of the State. In Northern France, long stretches of the Canal d'Aire et de la Deule have been electrically equipped in comparatively recent years, with satisfactory results, in the neighbourhood of Douai; in Germany, the Teltow canal, some 37 km. in length, was equipped with electric haulage from the commencement of its existence, and has been in operation for ten years. Full information regarding these installations will be found in several numbers of Vol. 60 of the Electrical Review, and numerous articles have appeared in our pages from time to time in which we have advocated the improvement and electrification of our extensive system of waterways, which comprises some 4,670 miles. The Douai canal system includes some 52 miles of route electrically equipped; this region is now in German occupation, being situated between Arras and Lille.

From the experience gained on these and other electrical systems, and the many experiments that have been carried out with haulage by tug-boats (steam, oil, and electric), road, rail, and elevated tractors, &c., there is little room for question that the best method of haulage yet devised is that of electric traction on rails; this has been proved thoroughly successful in France and Germany. The cost of installation, apart from the power transmission lines, is approximately £1,000 a mile, which cannot be regarded as prohibitive, and where the traffic exceeds two million tons a year its adoption is considered to be justified. Now, it can hardly be doubted that this figure would be far exceeded on the main arteries of traffic in this country, under an energetic and enlightened board of control, and the supply of power would present no difficulties, in view of the numerous power stations which are already in existence on such routes. By far the greater cost would be that of improving the canals themselves, as mentioned above, to make them capable of carrying throughout barges of 100 tons' capacity as a minimum. Private investors cannot be expected to provide the funds, in view of the existing conditions of canal traffic, and the fact that many of the canals are owned or controlled by the railway companies, with which they ought to compete, is a further argument in favour of the establishment of a Board of Waterways to deal with the whole matter, with the assistance of the State. We trust that this unique opportunity will be seized and turned to account. We do not suggest that the whole of the British canals should be rejuvenated at once; many of them are useless, or lie in such unfavourable country that it would not be wise to spend money on them. It must not be forgotten that the conditions on the Continent, as regards profile, water supply, &c., are far more favourable than here. But we do think that the reorganisation and improvement of the four great waterways recommended by the Commission should be taken in hand as soon as possible, to be followed in due course by such other canals as are shown to be worth the labour and expenditure.

Liquidation of German Electrical Companies in Russia.

The question of removing German influence from the large electrical and electrotechnical concerns in Russia was considered at a recent meeting of the Special Committee for Struggling with the German Hegemony. The cases particularly considered were those of Siemens & Schuckert, Siemens & Halske, the General Electricity Co., the Electro-Peredatch, and the 1886 Co. The representative of the Ministry of Trade submitted three ways for dealing with these companies. First, liquidation; secondly, purchase by the Treasury; and last, Government participation in these companies in order to establish proper control over each of them. The Committee decided in favour of the first proposition being adopted by the Trade Department, namely, the liquidation of all five electrical concerns. The working out of the details of the project was confided to the temporary board directing these companies, and the Committee indicated in general terms the main principles governing, and the manner in which to effect, the liquidation. It was proposed by the Committee that bearer shares in all five companies should be suppressed and exchanged for nominal shares. The present holders of shares will have the option of declaring for exchanging their shares for nominal shares of the company to be formed to take the place of the one liquidated. The exchange of shares will be permitted only in respect to those of the holders who remove all doubt from the point of view of their relations to German capital. As to the remaining shares, these will be bought by the Government at a nominal price, or will be deposited in the Treasury, which will thus take part in some of the concerns, or they will be sold by the Treasury at current quotations as registered shares. It is proposed that the liquidation of all five electrical companies should be concluded by July 1st this year.

THE ELECTRICAL INSTALLATION AT THE BRITISH INDUSTRIES FAIR.

Through the courtesy of Messrs. Tackley & Co., Ltd., of West Kensington, the contractors to the Board of Trade for the electric supply to the British Industries Fair, which is being held at the present time at the Victoria and Albert Museum and Imperial Institute, we are able to briefly describe the system of wiring which has been adopted to meet the very special conditions of this temporary installation.

Direct current is supplied from the Office of Works plant in the building at 220 volts pressure through 250-ampere main switches and fuses, to a five-way double-pole switch and fuse distribution board, which forms the starting point of Messrs. Tackley's installation in the Victoria and Albert Museum. This is a slate panel board, with front connections and glass-protected fuses, and is carried on battens clear of the wall; it, together with a supplementary cable, with ironclad main switch and fuses, which was added owing to the heavy demand, supplies six sub-distribution boards in various parts of the exhibition, *i.e.*, the North Court, South Court, L Section, H Section, Smoking Room, and Fancy Goods Section.

The main distribution cables—all braided v.r. 800-meg. grade—which supply the sub-distribution boards, are all run overhead, well above the stands and clear of gangways, being strung from 7/18 galvanised straining wire by means of leather suspenders, and were installed before the stands were erected. Aerial distribution, well above all obstructions, obviously facilitates work of this kind, and in some cases the cables are carried through windows and across courts between buildings, the straining wire being attached to trees.

The sub-distribution boards, usually 8 and 10-way, are all arranged for 10 amperes per way, and are of the protected-fuse type, in glass-fronted boxes.

A feature of the work is the method of attachment adopted, as no interference with the structure of the building is permitted.

To overcome this difficulty, the straining wires are attached to special clamps round pillars, &c., felt pads being inserted to prevent abrasion, &c.; the sub-distribution boards similarly are attached to battens on pillars, &c., and held in place by straining wires passing round the latter. Each sub-circuit feeds to a main switch and fuses on particular stands, through 7/20 v.r. cable, which in turn feeds a 3-ampere circuit carrying, roughly, 20 30-watt metal lamps, distributed over one or more stands as required. In some cases such sub-circuits are continued to several points, the 7/20 cable being looped-in from board to board, but in no case does a local lamp circuit carry more than 3 amperes, this being the limit prescribed by the London Fire Brigade authorities. The current densities prescribed by the I.E.E. wiring rules are adhered to; a limit of 1,000 amperes per sq. in. is adopted for 3/22 and all small cables.

Turning to the stands, which are, of course, temporary wooden structures, the whole of the casing, &c., carrying wiring is visible, being on the surface to comply with Fire Brigade regulations. The sub-circuit wires are led down from the aerial runs to protected type fuses and switches mounted on a base board which is fixed on to a uralite slab, space being left for ventilation between board and slab, and the latter is fixed to the face of the finished stand—that is, over any drapery, &c. In every case electrical switchgear, fuses, &c., are backed by a sheet of uralite as a protection against fire. Most of the fittings are plain pendants with opal shades, but on a number of stands where decorative effects are desired, very elaborate fittings, with cut glass and alabaster bowls, and fancy shades, are employed.

Although the controlling switch and fuse boards on stands, for the lamp circuits are in all cases limited to 3 amperes, these fittings are of large size, and could, if necessary, carry 15 amperes.

In the case of one or two stands it was not advisable to run the wiring on the surface, and in such cases it is run in screwed steel tubing, which is efficiently earthed.

In a few cases the wiring was erected before the stands were completed, and the flexible lamp suspensions have to pass down through draped ceilings; in such cases a 4-in. diameter asbestos washer is attached above and below the draping, the flexible passing through a 2-in. diameter hole in the centre. The flexible employed is 35/40 v.r., or larger; the ceiling roses are all of the loop-in type, with the terminals screwed from the back; and the lampholders are all of the one-part type (in which the terminals draw out of a china socket).

Zenith metal-filament lamps are used throughout; these were made specially robust, and carefully tested at the makers' works (at Harlesden) in view of the 3-ampere lamp circuits serving several stalls.

The installation at the section of the Fair held in the Imperial Institute has been similarly carried out: it is devoted to toys, games, &c.; a number of electric kettles, urns, and small motors for working models are installed, and where plugs are provided for heating equipment of any kind, a ruby lamp is fitted in parallel with the plug to show when the circuit is in use.

Altogether, between 400 and 500 stands are supplied. 2,000 to 3,000 lamps being used, including a few half-watt fittings on large stands.

It is interesting to note the quantity of material which is absorbed in a temporary installation of this kind; we understand that some 10½ miles of 3/22, 3¼ miles of 3/20, 7½ miles of 7 20, ¼ mile of 7/14, and ⅛ mile each of 19/16 and 19/12 cable have been used, together with 16,000 ft. of 2 in. capping and casing, 27 gross yards of flexible, 1,600 insulated eyelets for suspensions, and over a 1,000 fancy glass shades.

Messrs. Tackley are responsible to the Office of Works for the whole of the energy consumed on the installation, as measured by meters in the two buildings, and the tariff to stall-holders—as approved by the Board of Trade, under whose auspices the Fair is being held—is in the form of an inclusive fee for unlimited supply of energy during the Fair per lamp installed, Messrs. Tackley providing and maintaining the installation.

In conclusion, we must congratulate the contractors on having undertaken such a large installation despite difficulties in the matter of labour and material; especially so as they are at the same time maintaining electrical installations in five camps, and naturally have a greatly reduced staff available.

The work as a whole has been personally supervised by Mr. W. C. Tackley and Mr. H. G. Hoad, the latter of whom was, we understand, for many years in charge of installation work carried out by the London County Council.

RADIATORS.

By "EXPERIMENT."

An electrical friend, some years ago, spoke rather bitterly of his firm because the principal had asked him to test various types of radiators. Said he, "It is evident that all the heat which goes into the radiator must come out of it, and therefore the efficiency of every radiator must be 100 per cent." This appears sensible enough; but the fact remains that the modern real red-heat radiator, to borrow Mr. Bastian's slogan, is far better than the old lamp type for communicating heat to the user. Let us then admit that, while they all give out the whole of the heat put into them, some radiators practically are more efficient than others.

Most people, however, think that one hot-wire heater is as good as another, and in choosing patterns they are guided by price and general appearance, and, just now, by the chance of getting delivery. That certainly was my own position a short while ago. Then I happened to sell a radiator of a well-known pattern to a consumer, and while it was on the railway, I lent him one made by another firm. To my surprise, he complained that the new one gave nothing like the heat of the lent one, and demanded that it be changed. I thought that the difference lay in the imagination of the user, but when other people said the same thing, I began to look into the two types, to see if there really was a difference between them.

A careful examination showed that they were not quite the same. In the favourite pattern, the heating spirals are fixed close to the fireclay bar, which soon becomes very hot, while in the other radiator the spirals are kept well away from the bar, which keeps much cooler. In running, the fireclay bar of the first one radiates heat freely, while in the second one this part of the heat is carried away by air which circulates freely round the hot wires. Now, hot air is of very little use, whether from a radiator or a politician. It streams up to the ceiling, and very likely runs away through the ventilator. The man who is warming himself at the heater usually stands or sits in front of it, and naturally he judges the effect by the amount of radiant heat coming towards him.

Now we see why the old lamp radiator was a failure. Glass is opaque to radiant heat, which, therefore, cannot get to the man who wants warmth. The heat sticks at the glass, and is wiped off it by the air which streams over its surface. I once supplied a hot-wire heater to a man who had been using the lamp type. Standing with his back to the radiator, he remarked that it gave out no more heat than the old one. At that moment his trousers began to smoke, and as he skipped away, he agreed that there was a difference.

These facts point to the principles which should prevail in electric heater design. As far as possible all heat should be radiant. One way to achieve this would be to arrange the spiral heaters horizontally in deep grooves in the fireclay bars. The container should further be arranged to prevent air from passing over the bars. This would mean that the bars should be of larger section to get rid of their heat without rising to too high a temperature, but that would greatly increase the useful heat emitted. As both bars and wires would be radiating heat, it is probable that a radiator on these designs would give even up to 50 per cent. more warmth to anyone standing in front of it. It is worthy of note that few radiators on the market are made on these lines. Most of them have more or less vertical spirals, doubtless arranged for the air to pass over them, so that the heat may be absorbed as quickly as possible. But if the improved design will give as much, or more, useful heat with 1,500 watts as the ordinary type will give with 2,000 watts, the design will be worth the extra cost.

On coming to this conclusion, I wrote the makers of one radiator, pointing out that their pattern gave too much hot air and not enough radiant heat, and my reasons for that conclusion. The fact was obvious enough; indeed, the designer had probably had air heating in mind when he got out the pattern. Yet, instead of weighing up the pros and cons, the makers wrote back that their radiator gave great satisfaction to other people, and even suggested that I might be prejudiced against it. One can only regret an attitude of that kind. Of course, no one expects makers to alter their designs to suit everyone, but the wise maker will welcome criticism, and will not be unwilling to face facts. He knows quite well that he must please the buyer, for if that important person is not pleased it is of little use the designer being satisfied. Our British manufacturers must learn to follow in the footsteps of our American friends, and to look out for opportunities for improvement. Consider how beautiful a piece of mechanism is the modern typewriter. Here one might think that makers might justifiably be content to rest on their oars, and to throw criticism back in the teeth of the critics. And yet how far otherwise is their way. Year by year one little point after another is added, or modified, and the five-year-old design, perfect though it seemed, looks quite old-fashioned by the side of the new arrival. The same methods which gave the Yankees the typewriter monopoly are giving, or have given, them the monopoly of cash registers, electrical vacuum cleaners, fountain pens, adding machines, shaving soap, and chewing gum. All this has not happened by chance, but by the open mind that is ever looking for improvement, and that is willing to change its designs whenever change seems worth while. We must either wake up or get left behind; but when our manufacturers condescend to use the immense stores of unutilised talent in this country, we won't need to fear the "getting-left" proposition.

But our manufacturers must learn to accept friendly criticism. There was once a man who took over a weary single-phase station. He decided to try to make it pay by increasing the output, and called for tenders for a new single-phase generator. The representative of one firm asked him why he didn't fill up the slots of the generator, and make it into a three-phaser. The engineer might have answered to this, "Sir, am I running this station, or you?" But he didn't. He appropriated the idea, and soon the undertaking was out of the hands of the undertaker who had been waiting for the demise. The moral of this story is: don't be afraid of the criticism of the man who is trying to be friendly. He may have an idea which you can palm off as your own, and in that there is a mighty good chance of getting something for nothing.

PHANTOM CIRCUIT SYSTEM FOR CONTROLLING STREET LIGHTS.*

By A. H. Davis.

In the suburban districts of cities using a multiple system of street lighting, it frequently happens that there is not sufficient load to warrant the running of feeders exclusively for street lighting; consequently, these lights are connected to the service or house-lighting feeder. Since house-lighting service must be continuous, the problem of turning the street lights on and off immediately presents itself.

To secure the desired control, an inexpensive and reliable apparatus has been developed by means of which the street lights can be turned on or off at will from the power station. This apparatus can be used on any alternating-current lighting system where the 2,300-volt feeders are not earthed. If the system has an earthed neutral on the 2,300-volt lines, the apparatus can still be used, if it is allowable to disconnect the earth wire momentarily while turning the street lights on or off. An earth on the 110-volt lines does not interfere with the switching operation.

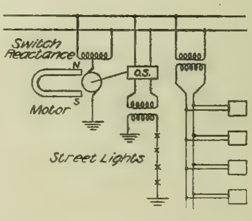

Fig. 1.—Connections of Automatic Oil Switch.

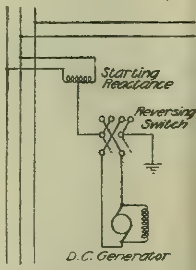

Fig. 2.—Connections of Station Mechanism for Operating Oil Switch.

The oil switch O S, fig. 1, used to control the street lights is usually connected in the primary circuit of the transformer from which these lights are run. This switch is operated by a small direct-current motor that has a permanent magnet field, and the switch mechanism is so arranged that a reversal in the direction of the motor's rotation operates the switch in the opposite direction. One terminal of the motor is connected to the middle point of a reactance coil and the other terminal is earthed. The ends of the reactance are connected to the two wires of the 2,300-volt feeder. The function of the reactance is to allow a direct current to flow from the 2,300-volt mains through the motor to earth, and at the same time to hold back the 2,300-volt alternating current. The magnetising current of the reactance is only a few milliamperes, and therefore the coil does not earth the 2,300-volt system.

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* From the *General Electric Review*. Abstract. A somewhat similar system, devised by Messrs. Duddell and Handcock and Dykes, was described in the Electrical Review of Feb. 21st, 1913.

The direct current is not left on continuously, but is only applied to produce the switching operation. The switch is so arranged that after being operated in one direction by an application of direct current, a subsequent application without reversed polarity will cause the motor in the switch to run idle, thus not affecting the position of the switch. However, when the polarity of the direct current is changed, the switch operates in the opposite direction, and as soon as the limit of motion of the switch is reached the motor will again run idle until the direct current is removed.

The station apparatus, fig. 2, is exceedingly simple, consisting only of a second reactance, which allows direct current to be put on the alternating-current system without affecting the alternating-current potential between wires, and of a reversing switch for conveniently changing the polarity of the direct current. By closing the reversing switch for about two seconds the oil switch on the street lights is operated, even though miles away.

Any source of direct current can be used, provided it is allowable momentarily to earth either side of the circuit. If there is no direct current available, a small generator or rectifier can be installed and run from the alternating-current lines.

Any number of switches can be operated simultaneously. In case it is desired to operate switches independently, a few parts can easily be added to the switch, so that its mechanism will be inoperative the first time the direct current is put on the system with polarity such that it tends to operate the switch, but will operate the second time the direct current is put on with the same polarity. If this special switch is used in conjunction with a standard switch, the standard switch will operate the first time the direct current is thrown on and the special switch the second time. Of course, the switches will always operate in the same sequence.

AMERICAN REPORT ON GERMAN ELECTRICAL ORGANISATION.

The *Electrical World* recently published an abstract of an account of the conditions prevailing in the electrical industries of Germany and England, which was given before the Federal Trade Commission. Some of the evidence given before this Commission has already appeared in our pages. This Commission is in favour of co-operation in foreign trade, the principle embodied in the Webb Bill, which was referred to in our issue of February 16th. Our contemporary in its abstract includes the following :—

The A.E.G. and the Siemens-Schuckert have succeeded in concentrating about 80 per cent. of the entire electrical business of Germany into their own hands. Of this about 45 per cent. is controlled by the A.E.G. and about 35 per cent. by Siemens. One of the distinctive features of the German electrical industry is the extent to which it is supported by banks. Through members of its board and executives, the A.E.G. is related to banks and banking groups representing $533,234,000. [These relationships are graphically shown on a chart prepared from data submitted by William J. Clark, of the General Electric Co., and arranged according to a design suggested by O. C. Merrill of that company, and published in the report.]

This close connection with great banking groups has assisted the A.E.G. in the promotion of foreign trade. These banks have assisted in financing many foreign undertakings in which electrical equipment was required. They have also assisted in the organisation of special banks and trust companies for electrical enterprises, preferably abroad. These banking connections also account for the credit extended in foreign trade by the A.E.G. and the Siemens-Schuckert concern. The chart also shows the extensive connections of the A.E.G. with other important German business enterprises. Some of these, such as insurance companies, add to its financial strength. Others are companies manufacturing chemicals, glass, fabrics of various kinds, iron and steel products, &c. Others are mining companies, metal buying and refining concerns. These all facilitate its purchase of materials and supplies. Still others are transportation, light, power, and public-utility companies. The A.E.G. maintains a most extensive organisation throughout Germany and many foreign countries by means of subsidiary companies. Some of these are banks for the financing of electrical enterprises; others are operating, managing, and selling companies. All in all they represent a capital investment of approximately $500,000,000.

In 1903 the A.E.G. entered, it is said, into an agreement with the General Electric Co. of America by which certain territories are respected. The A.E.G. was given the exclusive trade in Germany, Luxemburg, Austria-Hungary, European and Asiatic Russia, Finland, Holland, Belgium, Sweden, Norway, Denmark, Switzerland, Turkey, and the Balkan States, while the United States and Canada were apportioned to the General Electric Co. In addition, the A.E.G. was given the right to use the Curtis patents for steam turbines, and the General Electric Co. that of the Riedler-Stumpf patents. This agreement, however, binds only the General Electric Co., and other American concerns were not parties to it. The neutral districts, which are open to both, are said to be Mexico, Central America, South America, and Japan.

As in the case of the A.E.G., the Siemens-Schuckert group is closely connected with powerful banking groups which aid in promoting its business. Considering the Siemens-Schuckertwerke and the Siemens-Halske A.G. as an entity—the Siemens-Schuckert concern—and eliminating duplication of connection with the Deutsche Bank, the Essener Kredit-Anstalt, the Elektro-Treuhand A.G., and the Reichsbank, it appears that German banking interests aggregating $300,000,000 support the organisation.

By some authorities it is said that the A.E.G. and Siemens-Schuckert concerns are in sharp competition throughout Germany and in many other parts of the world. On the other hand, various Americans who are well informed as to the conditions of the electrical industry of the world state that in foreign trade at least there seems to be little or no competition between them, but that frequenly they operate jointly. It has also been said in Germany that there is more or less agreement between the two, and that for several years they have not been unlimited competitors, but that the chief staple products of the two groups have been sold on the basis of a fixed schedule, all larger products, oversea as well as domestic, being handled according to mutual agreement, frequently on common account.

The abstract proceeds to refer to British investments abroad, the effective co-operative organisation of the B.E.A.M.A., and the need for co-operation among American manufacturers. It concludes :—

A special report by Julius G. Lay, United States Consul General at Berlin, dated November 2nd to 16th, 1915, is included among the various reports which were received by the Commission in connection with its investigation. In part this report refers to the electrical industry as follows :—

In certain lines there are occasionally absolute monopolies. For instance, the Vereinigung deutscher Starkstrom Kabelfabrikanten is a cartel for high-tension cables. The contract runs until 1917. This cartel is composed of Bergmann, Siemens-Schuckert, Felten & Guilleaume, A.E.G., and Süddeutsche Kabelwerke, and is an absolute monopoly. Also Akkumulatorenfabrik Berlin u. Hagen is a monopoly of the storage-battery manufactories. Siemens & Halske, and A.E.G. have bought up about 30 different storage-battery manufactories, leaving only one outsider, the Accumulatoren und Elektricitäts Werke A.G., formerly W. A. Böse. The monopoly pays 25 per cent. dividends.

The lamp business, which is of great importance, is the main field for sharp competition between the firms A.E.G., Siemens-Schuckert, Bergmann, and the Auer Gesellschaft (which makes only lamps, both gas and electric). However, patent conventions exist between these companies, and between each one of them and the General Electric in America. Altogether, there are 11 competitors making metal-filament lamps.

The German electrical concerns in European countries have their own foreign company; in South America they have their own company in the principal cities, but in some cases they have agents to whom salaried engineers from the home office are accredited and paid by the home office. The A.E.G. alone has 100 offices in continental Europe outside of Germany, and 60 offices outside of Europe.

ECONOMIC RECUPERATION AFTER WAR.

By PROF. W. R. SCOTT, D.Phil., Litt.D., LL.D., F.B.A.

When one endeavours to pierce the veil that hides from us at present those future years which will be brightened by the return of peace, it seems as if popular opinion hovers between two opposite poles of thought. The one type thinks of peace as meaning a resumption of social and economic life just as it was when its normal development was interrupted by the outbreak of war. The other type is quite the opposite—it seems to regard the early days of peace as an economic *tabula rasa* upon which a new economic history may be written. Yes, a *tabula rasa* perhaps—but only in the sense that economic movements, both of the past and of the present, have left invisible traces upon it in a species of secret writing which will gradually come to light when the war is over. As differentiated from these one-sided views, there must be divined something of the future based as much as possible upon economic knowledge and the resources of past experience in so far as these are applicable. Indeed, such an inquiry, apart from its practical value, is a test of the efficiency of modern political economy, which, to the extent to which it is a science, should be able to predict. Yet prediction, as regards the present war, has been largely falsified by events to a degree which has been remarkable. Thus it is certainly safer, if less enterprising, for the economist to wait upon events, contenting himself with classifying, investigating, and pronouncing upon these after they have happened. This is useful work, but the time for much of it is not yet; rather may we not try to see, however imperfectly, something of the reaction of the present war upon the future of industry, thereby attempting to forecast the material destiny of Europe during a part of the next generation.

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* Read at the Institution of Engineers and Shipbuilders in Scotland, February 20th, 1917.

Moralists, poets, philosophers, economists, and statesmen have written much of the evils of war. To each nation, whose temperament is essentially pacific, there is given a clear vision of the losses involved in a state of hostilities. On its material side war involves immense destruction and waste; and it is this which has to be repaired in the subsequent years of peace —if that be possible. Accordingly, the first step will be to estimate the volume of the loss of wealth occasioned by warfare. There is, first, the loss of human productive power in so far as productive workers are killed or suffer in industrial efficiency by reason of wounds or disease due to war. Here is a war loss which is obvious, and which is irreplaceable till a new generation fills the vacant places, or, alternatively, till a new supply of labour can be drawn from elsewhere. Secondly, during the progress of hostilities highly skilled labour is diverted from productive to destructive employments. In the third place, the consequences of this are visible in the devastation to which tracts of country have been subjected which have been fought over by contending armies. Again, naval operations have involved losses of shipping. In the fifth place, the general supply services of armies in the field inevitably occasion a certain waste of stores. Then, in the sixth place, the high cost of modern war is likely to impose a certain strain upon the credit and finance of the combatant countries. In most cases immense additions to the funded debt are already necessary, and these will grow with the duration of the war. In addition, there are unfunded borrowings, whether in the form of bank credits to a Government or in largely increased issues of paper money. Sooner or later these debts must be faced, and the interest on a funded debt will impose a heavy burden on future industry for many years to come, while unfunded debts or excessive issues of paper money will probably be dealt with by the flotation of a loan when the time is judged opportune. Here, again, there will be a further charge for interest. It may be that where the credit and financial systems have become highly artificial, the position cannot be adjusted without a commercial crisis; and, if so, the losses through a temporary collapse of credit, caused indirectly through the war, must be added to the more immediate war losses. Even yet the melancholy catalogue is not complete. There remain minor factors to be reckoned. There is a certain dislocation of production which arises upon mobilisation, and again upon demobilisation. If the industries of a country were organised efficiently before the war, the diversion of demand and contraction of production usually, if not, indeed, inevitably, involve producing at a less advantage than before. Again, the closing of trade routes forces recourse to substitutes for some commodities previously used, and the substitutes are frequently either inferior, or else more costly. War, in fact, removes many of the advantages which previously accrued from territorial division of labour.

Changes of territory, too, as a result of peace terms, have to be reckoned. Here, in the aggregate, the loss to production in general is to be measured by the extent to which the new owners of such conquered or ceded districts are less efficient producers than its former owners; while, conversely, if the ultimate settlement follows the broad lines of racial divisions, a gain rather than a loss may be anticipated in the greater contentment and more congenial political affinities of the population affected by the change. Again, there is the question of indemnities, which, in principle, is closely connected with that of loans to be raised for purposes of war, adding to the debt of the country which pays the indemnity and lessening *pro tanto* that of the country which receives it. In the aggregate it would seem that this process involved a mere transfer of a claim to wealth from one country to another, but it may be questioned whether under the conditions which are likely to govern the final settlement, and where the indemnity is paid by one great power to another great power, the sacrifice of the former may not be larger than the benefit accruing to the latter. Also, there is the element, at present largely indeterminate, of the position of tariffs after the war. Clearly a state of international relations in which, after a political peace, a war of tariffs was waged, would be yet another element to be added to the long list of war losses, in so far as trade was diverted into artificial channels beyond such a degree as its course was facilitated by lesser customs duties amongst friendly nations. So much depends upon the course of the various campaigns, and the state of feeling between the present time and the declaration of peace that, while the possibilities offer a fascinating field for conjecture, the elements of the problem are too uncertain and too fluctuating to afford any firm basis for calculation. At the moment of writing it would appear that this is a phenomenon of which account must be taken.

The foregoing factors, while not exhaustive, appear to be the chief that have to be considered. It is needless to say that the list is already long, and it is a distressing one. But the mere enumeration of these conditions only opens up the really difficult problem of the degree of importance which is to be assigned to each. And that difficulty becomes intensified by the fact that all these causes will continue to operate in varying degrees during the unknown period which must elapse until peace is declared and industry can return to its normal course. Therefore, all that is possible is to attempt to signalise those causes which are likely to be most powerful in determining the *post bellum* conditions. Two of these stand out pre-eminently. These are the loss of labour power and the accumulation of debt, whether funded or unfunded. It would seem that for many years to come the great powers of Europe will be weary Titans toiling painfully under the crushing load of their public obligations. And the diminution in the supply of labour seems to make the process of recovery slower than it would have been had the slaughter been less. Moreover, the efficiency of credit has made it possible to mortgage future production to an extent previously unknown. No doubt, ultimately, the modern system of credit will enable the burden to be diffused over the production of a long period, but it can scarcely be anticipated that the transition from credit on a war basis to credit on a peace basis can be effected without a serious crisis in some of the belligerent countries, perhaps not immediately after the war, but not very long after peace has been made. Such a crisis, should it come, would delay recovery in the countries where it occurred, and it would react upon the renaissance of industry in other nations whose credit had stood the strain with less disturbance.

In confronting a situation so unparalleled, both imagination and courage are required—imagination to divine the economic conditions of the new Europe which will arise out of suffering of the old; and courage, too, in order to recover as quickly as may be and upon a secure basis, from the enormous losses which are accumulating daily. It appears to me that, when one faces the future in this spirit, the degree of *resilience* in industry may easily be under-estimated. To a very considerable extent the disorders which war is inflicting upon industry are generating antidotes. The swollen war costs are forcing economy upon the belligerent peoples. Observers of pre-war social conditions cannot fail to have noted the rapidly rising standard of living over a very great part of Europe. In the closing years of last century, and during the early years of the present one, the peoples were garnering the fruits of more than 50 years of remarkable economic progress. Thus, habits of comfortable, and even luxurious living had been formed. The present generation had become accustomed to that form of free spending which Aristotle described as the characteristic of those who, having inherited wealth, had never known privation.* War is enforcing a return to a more Spartan régime. Gradually habits of economy are perforce replacing those of profusion. But as these habits become established, their influence will persist when the war is over. Hence resources will be derived from this source, partly to pay interest on war debts, partly further to supply the new capital which will be required in large amounts to replenish working capitals and to replace buildings, plants, and means of transport which have been destroyed during hostilities. Thus there are indications that the war itself is calling into existence a fund from which some of its own waste will be repaired. War and luxury are alike unproductive expenditures; but while the latter has been continuous, the former outlay is compressed into a comparatively brief period, thereby anticipating at one bound the disbursements upon luxuries during many future years.

It is in this way that the recapitalisation of industry will be provided, and that, it may be hoped, without undue delay. It is to be remembered that the productive capacity of the extractive industries remains unimpaired, except in those cases where a war lasts so long that permanent improvements in the land may become seriously depreciated. Though factories may be stopped during the war, to a large extent their productive capacity remains. In a country whose resources are ill-developed these are the only productive losses to be faced, and the recovery of them should not be difficult, particularly if it can be aided by moderate loans of working capital from outside. A highly developed region in which there has been great destruction of buildings and machinery requires larger outlay; but it will usually either have greater means for producing the new resources itself, or it can offer security to borrow what it needs abroad. Thus it would appear that great as the call upon capital will be, means may be foreseen by which it can be provided.

(To be concluded.)

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* Eth. Vic. iv. 20.

PREFERENCE FOR AMERICAN CABLES IN AUSTRALIA.

We reproduce the following from the *Melbourne Age* for January 5th, just to hand:—

"Strong resentment on the part of British firms in Victoria has been aroused by the extraordinary preference given to foreign manufacturers when material for construction work is wanted from abroad. The procedure is said to exhibit such a bias in favour of American manufactures that all others are practically excluded from consideration. The tenders are so framed that none but American goods can possibly meet the conditions. This state of affairs is particularly noticeable in respect of tenders for insulated wire for use in the new electric signalling system. In February, 1915, tenders were called for several miles of insulated cable. Nobody objected to that, but when it was mentioned that the cable in question must be of a particular brand, and that brand the trade name of an article manufactured solely by an American firm, a vast amount of indignation was caused. Representatives of British firms, seeing that their goods were shut out from competition, immediately applied to the railway department for leave to tender, but were blandly told that unless the goods were of the particular American brand specified their tenders would be futile. It was then suggested that an article similar in every detail to that desired by the department might be considered, but this was rejected also. When asked the reason for the great regard for this particular foreign commodity, the departmental officials stated that it had been used in the past, and that any extra cost entailed in its purchase was amply made up for by its lasting qualities. One of the British firms then secured samples of the foreign wire, which had been in use for 20 years, and sent them to England, where they were subjected to rigid scrutiny, after which the firm cabled its representative here to the effect that it could make an article similar in every respect, but, of course, could not call it by the particular name used by the American firm. It also quoted prices for this work. These in every case were from 50 to 70 per cent. cheaper than the American article. A tender was then submitted. The difference in price flabbergasted even the railway officials, who suggested that it was so great that there must be something wrong. Having been reassured upon this point, they then wanted to know if the article was that asked for in the specification. Having discovered that it was similar in everything but the name, the department finally rejected the tender, and gave the order to the American firm at a price vastly in excess of the offer made by the British manufacturer. British representatives in Victoria of insulated cable firms state that the American article is quite ordinary. There is no trade secret bound up in its manufacture, and it can be made by other firms, which cannot, however, use its American name. Added to that, the British firms can make it much cheaper. At a time like this, when the railway finances are in such a muddle, and cries for economy are heard on every side, one would naturally suppose that the railway department would like to buy as cheaply as possible without loss of efficiency, yet tenders are again to be called for the supply of a large quantity of insulated wire, and the specification is for the same American brand. The representatives of British firms in Victoria do not complain of open competition, but they do object to a particular tender being earmarked for an American firm in such a manner as to preclude competition by British firms, especially when the British firms can turn out an article equally as good for nearly half the money. If in two tenders for 30 miles of cable the difference in price is £18 per mile, and the quality of the goods is much the same, there must be something very queer about a department which refuses to pay any but the higher price. The management of the railways has not been a howling success, but the least that can be done is to allow open competition in respect of the supply of cables, and give the well-beloved American article a chance to prove its superiority."

The same newspaper in its issue of the following day returned to the matter thus:—

"That they do not favour American products to the detriment of British or Australian articles is the reply of the Railway Commissioners. The Commissioners, however, while appreciating the merits of the American wire referred to, have evidently steeled themselves against any possibility of a precisely similar article being manufactured within the Empire. They state that they are in possession of a sample of this brand of wire which has been in use in Victoria for 20 years, and the insulation is just as good as ever it was. If the Commissioners cared, however, to investigate they could find British-made wire whose lasting qualities are nothing inferior and a great deal cheaper than the American product. One of the British firms which was not allowed to tender in February, 1915, can produce samples of its own insulated wire which has also been in use for 20 years, and the insulation is just as good as ever. This wire was actually compared with a 20-year-old sample of the Commissioners' favourite, and although the insulation was not so thick and the wire had been carrying a higher voltage than the American wire, it was in an equally good state of preservation.

"In their reply, the Commissioners stated that the department's settled policy was that when any commodity was required an effort was made to obtain it in Australia, and, failing that, in England. They were constantly giving preference to home-made articles and paying a higher price for them in accordance with this policy. There were, however, some cases where the interests of the railway department and the State made it necessary to go outside to secure certain indispensable articles. In this particular instance, the insulated wire was required for certain portions of the automatic signalling scheme, and the American article mentioned in the tender was the most durable for hard wear and use in damp places that was known. While fully appreciating the desirability of fostering Empire industries, they were absolutely satisfied that in using this wire they were doing the right thing. This wire was obtained for a special purpose, and was used where the strain upon the dielectric for damp and other conditions was very great. The material used for insulating purposes was made from a formula which was a close trade secret, and which had not been discovered by any other American firm engaged in the manufacture of insulated wire. The necessity for effective insulation upon wires controlling the automatic signals was very great, as the whole of the running of the trains depended upon it, and a great expense and inconvenience would result if an inferior article were used. They could not understand why it should be assumed that they were so unpatriotic on the one hand and so foolish on the other as to pay a higher price for American goods than for British. The brand of insulated wire made in America had been proven to be a vastly superior article to any other, and it was only the great necessity for its use in a most important part of the railway system that prompted its purchase.

"The question that all this special pleading suggests is: How can the Commissioners be satisfied that the American brand of wire is the best obtainable for their purpose when they have never given any other kind a chance to prove itself? The business of producing insulated wire is not a new one. The problem of deep-sea cables has been solved years ago, so that it should not be a difficult matter for any firm to manufacture insulation which will stand for a long period the dampness and strain involved in an automatic signalling system."

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Inspection of Munitions.

"Commercial's" dictum, in your issue of February 16th, that the "British will always be fools," is undoubtedly to a great extent true, taken as a general statement, and he conclusively proves in his article that he is certainly British himself. I can assure him that he expects too much of the credulity of your readers in connection with his condemnation of the heads of the various War Departments and the inspectors under their control. They will not believe that all these men are fools—I doubt if any of them are prepared to accept his statement that the inspectors did not know a "cable from a cow." Only a fool would make such a statement.

What is the complaint that "Commercial" wishes to put forward? Apparently, that two Army officers made a 30 mile journey to inspect three coils of 7/22 wire, and that another gentleman made the "*same trip by train*" to see 200 ft of motor-car ignition wire. Then he proceeds, in a somewhat effeminate style, to reproach the British War Department for its methods of ordering material and dealing with such orders, basing his argument on the above two cases. From these he tries to prove that the country abounds with "hindrances to the business-like conduct of our present task," and "that we are plagued by the business amateurs" in the new War Departments.

Britain, as the world admits, has done wonders, and the co-operation between the War Department and the manufacturers of the country has proved to be most satisfactory. Many of the leading men in the country are giving their services in assisting to increase the efficiency of the production of munitions. The inspectors, too, have in many cases been of great help to the manufacturers, and it is a fact that their presence is welcomed by those whose ideas are to turn out reliable goods as well as to make a profit on their contracts.

"Commercial" is evidently quite unaware of how the Ministry deals with supplies; and, with such a narrow outlook, I doubt if he will ever become aware of the extensive scale on which the work is carried out.

He has the usual shop foreman's contempt for forms, but it would be well if he realised that no large business is carried on successfully without what, to the uninitiated, appears to be a confusion of "triplicate advices."

I happen to be a Government Inspector, and have had to deal with such goods as "Commercial" mentions. I have also made long journeys to inspect small lots; but my mission has in most cases covered several such lots, as well as the most important one of keeping in contact with the heads of the contracting firms.

It will be understood that there are very few firms in the country whose orders are limited to "three coils of 7/22" and a short length of "motor-car ignition wire." Most firms have extensive orders involving delivery over a long period, and it is often necessary in those cases to keep in touch with the work and to encourage the manufacturers to be as regular as possible in their deliveries.

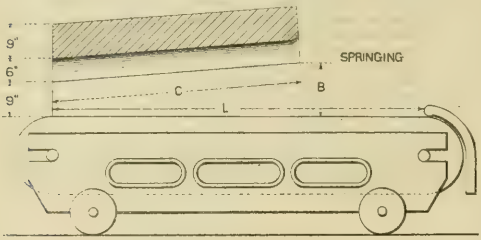
I quite agree that the "hide-bound, short-sighted policy of past years . . . still thrives in business," and I consider "Commercial" a good example of its supporters.

Albion.

Boiler-House Operation and Maintenance.

The interesting particulars of the dimensions given on page 193, Vol. LXXX., No. 2,047, of the furnace arches adopted at the generating stations at Brakpan and Vereeniging opens up a question which has not been given sufficient attention by boiler manufacturers, although the design of the furnace setting is a problem intimately connected with the burning of fuel, having regard to efficiency and smokeless combustion.

The sketch below gives an example of the empirical formula which has been developed at the Wood Lane Works of the Kensington and Notting Hill Electric Lighting Companies, with very satisfactory results, and may be useful to those who have to settle the dimensions of furnace arches for given lengths and areas of chain-grate stokers.



The formula submitted is not to be taken as final, although it represents a good start. Further, slight alterations wi'l suggest themselves under varying conditions, and the class of coal used.

Formula.

L = the effective length of the grate.

C = L × 2/3 plus 6 in. added for every foot of width between the furnace walls exceeding 5 ft. 0 in.

B = L taken in feet × 2.5, the result to be considered as inches.

C. Mancha Bennett,
Engineer.

London, *February 23rd*, 1917.

Fuse Failures.

As one privileged to witness a series of experiments carried out by Mr. Baynes, I venture to add a few remarks to those penned by Mr. Berry in your issue of February 16th as to the aim of these investigations.

According to my understanding, the object of these experiments was to confirm the conviction acquired as to the unsuitability of the use of metal-work cases in conjunction with fuse gear; which, as the article mentions, decided Mr. Baynes to adopt stoneware to remove the added danger of the arc spreading by a conducting case.

Mr. Berry's suggestion of the necessity of a "temporary expedient" is just the very risk that Mr. Baynes desired to guard against, being a more general practice than is appreciated.

Assuming that Mr. Berry's ideal fuse possessing an emergency "temporary expedient" has been realised, then it seems somewhat illogical to design a fuse with ample clearances without regard to the surrounding (usually earthed) metal case having equally safe clearances from live parts, the importance of which Mr. Berry makes no reference to.

From the photographic results of blowing a fuse (4 in. break), the size of iron box required to escape the arc would not be practicable, and the added internal mechanism of certain combinations of switch fuse gear would aggravate these conditions.

It was the above facts that induced Mr. Baynes to continue on with his views to call for non-conducting cases.

The adoption of either the "Zed" type or Messrs. Berry's pattern cannot correctly be regarded as a "graceful concession," but merely a question of merit of design, on which basis the fuses which my company submitted at the time were also considered.

The British Central Electrical Co., Ltd.
E. S. Conradi.

London, E.C., *February 21st*, 1917.

Curious Trouble with Lead-Sheathed Cables.

The troubles mentioned by Mr. Partridge in your issue of the 23rd inst. are very interesting, and are, I believe, due to continued bending and straightening of the lead at the points of fracture.

Such fractures are very common on aerial lead-covered cables carried on a suspension wire, and are due to vibration set up by the wind, failure taking place at the points of suspension where the vibrations are damped off.

As Mr. Partridge experiences the trouble in quiet as well as in busy thoroughfares, it would appear that vibration is only a secondary, but contributing, cause, the primary cause being the natural expansion and contraction of the cables due to the difference in heating between full and light loads.

The fact that some joints failed at both ends, and others at one end will be due to the stresses set up affecting both ends equally, or one end more than the other, due to (1) the symmetry of suspension or otherwise of the cable in the manhole, or (2) to the joint not being in the middle of the manhole, or (3) to the unequal expansion into the manhole from the stretches of cable on either side.

The last factor is influenced by the levels of the cables; if the cables fall from one manhole to the next, the tendency is for them to expand and contract downhill, a fact which explains the creeping of cables downhill when they are subjected to alternate excessive and light loads.

Possibly Mr. Partridge's cables are now operating at higher loadings than usual.

W. Nairn.

Glasgow, *February 24th*, 1917.

The trouble experienced by Mr. G. W. Partridge is rather an interesting one, as it brings to the fore a difficulty which may occur more repeatedly as stations are linked up by long trunk mains.

The information given in the letter neither states the size or sizes of the cables affected, nor the current densities at which they are run, so that it is impossible to work upon any definite data in this respect. I venture, however, to give the following suggestion, although it may have already received consideration.

It is generally accepted that the safe increase of temperature of a paper-insulated cable, with initial temperature of 60 deg. F., is approximately 90 deg. F. With this increase of temperature due allowance should be made for expansion and contraction of both the copper conductors and the lead sheathing at the joints. If one takes the coefficient of linear expansion of copper at .0000103 per deg. F., a 100-yard length of cable will expand, for 90 deg. rise in temperature, 3.33 in., or 4.8 ft. to the mile.

Under the same temperature rise, the lead sheathing would have an expansion of 5.18 in., or 7.7 ft. in one mile.

The lead sheathing being the outer and unserved would not attain this temperature rise, but, assuming the rise is 45 deg. F., the expansion of the sheathing would be 2.59 in.

Now, since the plumbed joints in the pits can be taken as fixed or rigid ends of a cable, the expansion and contraction has to be absorbed between these two terminations.

The lead sheath, being stiffened at the plumbed joint, has very little movement, but at the position where the cracks have developed the lead, being ductile, gives to variations in length, and it is presumably the subsequent fatigue which has brought about the failure.

It would be interesting to ascertain whether the cracks close when no energy is being transmitted, and open out when the amount of energy transmitted is at its maximum.

Mr. C. J. Beaver, in his paper on "Cables" (I.E.E. *Journal*, Vol. 53, No. 238, pages 65/66), gives some interesting results of tests on expansion and contraction of cables.

I might mention that Messrs. A. Reyrolle & Co. are the manufacturers of a special expansion joint for all voltages up to 20,000.

S. M. G. Teal.

Hornsey, London, N., *February 25th*, 1917.

The Homogenous Lead Coating Co.

My attention has been called to a notice that has been appearing in the technical Press that I have sold my interest in the Homogenous Lead Coating Co. Whilst this is a fact, the wording is misleading, as it implies that I am not entitled to carry on similar work.

I shall have before long the most up-to-date works, appliances, and processes for producing every description of lead-lined vessels and tanks for chemicals and other purposes.

Sherard Cowper-Coles.

Sunbury-on-Thames, *February 23rd*, 1917.

British v. German Turbines.

I have very much sympathy with Mr. A. Nichols Moore because, while he has been running A.E.G. turbines for 3½ years, I have been running them successfully for 10½ years. I may say that upon overhauling last year one bearing showed the original scraper marks that were made 10 years previously. But the clearances allowed in the labyrinth packing are very small, and in some cases a seizure means a new shaft. Their metallurgical knowledge also appears to be peculiar, as they put bronze and iron or steel together, so as to form electrolytic couples wherever possible. Their steam consumption is fair when new, but very quickly deteriorates, and I, personally, am delighted to have a change to British turbines, although I believe very much more depends upon the man who actually looks after the plant than upon the nameplate.

W. H. Sisson.

Stoneclough, *February 24th*, 1917.

P.S.—The A.E.G. also designed their early turbines so that it took a few days to get inside, and a similar time to replace and refit. Their experiments with nickel and other steels for turbine blades were also very unsatisfactory from the users' point of view.

Meirowsky Insulating Tubes.

Referring to the paragraph "Meirowsky Insulating Tubes" in your issue of the 16th inst., kindly note that I am Mr. George Schultz still and have not changed my name, but that it was my son, Mr. D. H. Schultz, who changed his name and is now Captain Scott.

Regarding the last paragraph on page 175, it seems to me that the reference to "sharp practice" may easily be construed to refer to my firm, George Schultz & Co., Ltd., but such reference did not apply to us.

Geo. Schultz.

London, E.C., *February 22nd*, 1917.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

B.T.H. Hand Lamp.

The British Thomson-Houston Co., Ltd., Rugby, has introduced a new type of hand lamp, which is primarily intended for workshop and factory use, is strongly made to withstand rough handling, and embodies certain improved features. Each lamp consists essentially of three parts: a handle, a holder, and a guard.

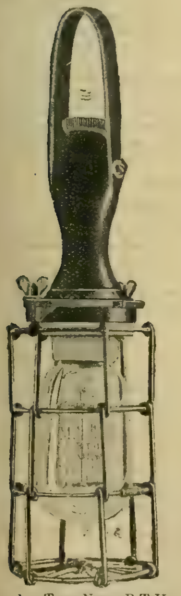


Fig. 1.—The New B.T.H. Hand Lamp.

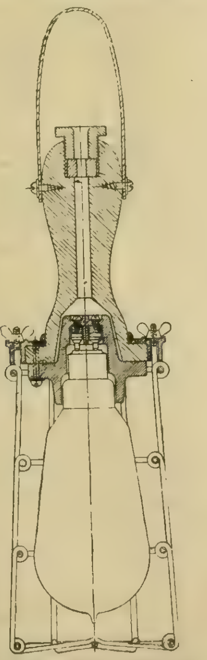


Fig. 2.—Sectional View of B.T.H. Hand Lamp.

The handle is made of ebonised wood, and furnished at the top with a rubber ring and insulated bush through which the flexible cord enters. It is further provided with a leather strap or handle securely attached by means of brass screws of such length as to prevent the possibility of their entering the wire-way in the centre of the handle.

The holder is constructed entirely of porcelain (apart from the plungers), and is provided with a flange whereby it is attached to the handle. This attachment is effected by screws which pass through the flange of the lampholder, through a wooden flange at the end of the handle and into a metal ring slipped over the latter. The attachment is therefore not dependent on wood screws fixed in the end grain of the wood. The holder is provided with a skirt entirely covering the cap of the lamp, and is so designed as to permit of easy wiring when unmounted.

The guard consists of strong galvanised iron wire made up in the form shown in the illustrations, and is secured to the handle by two brass wing-nuts. The attachment is made through two slots in the periphery of the metal ring referred to above, and so contrived that by slackening the wing-nuts a couple of turns, the guard can be disengaged by rotating it about the axis of the lamp. The size of the guard is large enough to accommodate any lamp up to and including 60-watt standard Mazda.

This hand lamp, which passes Home Office requirements, is entirely of British design and made at Rugby.

A New Demagnetiser.

The permanent magnetic condition imparted to pieces finished in magnetic chucks is clearly objectionable on some classes of work, as milling cutters for instance. Such cutters would attract and hold the chips produced when cutting, and they would act as some hindrance to maximum production as well as an annoyance to the operator. The demagnetiser here illustrated in diagram is built by Messrs. J. H. Humphreys & Sons, Oldham, for rapidly demagnetising pieces, and avoids some disadvantages of rotary-magnet patterns. It does not require any fixing, and can be put to work in any position. The complete equipment consists of demagnetiser (shown in plan), rotary converter, and starting rheostat. The demagnetiser contains fixed coils and is operated direct by a low-voltage alternating current supplied by the converter, which through the starting rheostat is connected to an ordinary direct-current lighting or power circuit. The converter spindle runs in ball bearings, and the brush gear, terminals, and wire connections are enclosed, no loose wires being exposed. The work is passed over the polished platens of the demagnetiser once, or in the case of heavy pieces, twice, the whole operation taking a few seconds. Pieces much larger in size than the platens can be thus demagnetised.—*American Machinist.*

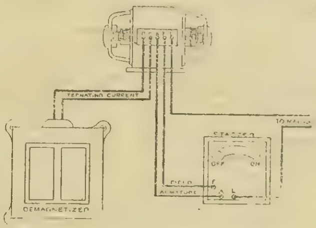


Fig. 3.—Humphreys' Demagnetiser.

LEGAL.

London County Council and Tramway Rating.

Settlement of Outstanding Appeals.

Following the decision of the County of London Quarter Sessions in favour of the London County Council in the latter's appeal against the quinquennial assessment of its tramways in the Borough of Finsbury, the Council and the Assessment Committees concerned have now agreed the figures in the remaining appeals. These related to tramways in Holborn (parishes of Saffron Hill, St. Andrew-above-the-Bars, and St. George-the-Martyr) and in Bethnal Green, and the Council's costs are to be repaid by the respective Assessment Committees.

In the case of the three Holborn parishes the County Council have secured a reduction of £787 in the gross value, which now stands at £8,453; and of £787 in the rateable value, which is now £3,261. In the case of Bethnal Green, the gross value has been reduced from £5,819 to £3,019, and the rateable value from £5,255 to £2,455. The total reduction of rateable value in these two boroughs is, therefore, £3,587.

The rateable value of the tramways in Finsbury was reduced by Quarter Sessions from £9,770 to £6,527, and the Local Government Committee of the County Council intimates that this reduction is equivalent to 33 per cent. of the rateable value in the list. As, however, reductions had already been made by the Assessment Committee, the total reduction represents 47 per cent. of the assessment in force before the quinquennial valuation, and 57½ per cent. of the assessment in force at the quinquennial valuation of 1910.

When the appeals relating to the tramways in Holborn and Finsbury came on for hearing, Mr. Clavell Salter, K.C., M.P. (on behalf of the Holborn Union Assessment Committee), raised a preliminary technical point—namely, that the County Council was not entitled to have the appeals heard, because the notices of objection to the valuation lists did not comply with the provisions of the Valuation (Metropolis) Act, 1869, as they did not state the alterations which the Council desired to have made, nominal figures only having been inserted. The Court decided against this objection, but assented to Mr. Salter's application for a case to be stated for the decision of the High Court upon the point. As a result of the agreement arrived at, the Assessment Committee will not proceed with this case.

The Local Government Committee of the County Council has had before it a statement showing the effect of the quinquennial valuation of 1915 upon the assessment of the Council's tramway undertaking. The total rateable value is £266,475. The rateable value of the tramway buildings, as compared with the valuations in force before the quinquennial valuation, shows an increase of £12,462. This increase is mainly due to the substitution of turbines for reciprocating engines at Greenwich generating station, but some increase has been caused by the enlargement of the capacity of Abbey Wood car-shed and Vauxhall and the Elephant and Castle sub-stations. The total rateable value of the lines has been reduced by £45,171. These reductions are in addition to those amounting to £51,087 (net), which were made in 1913-14, consequent upon motor-omnibus competition.

The Committee states that it was most anxious to avoid litigation and the expenditure of public money, especially under present conditions. It accordingly entered into negotiations with a number of Assessment Committees, and, with the exceptions of the Holborn Union and Bethnal Green, was able to arrange terms which it felt it could accept on behalf of the County Council. In regard to those two exceptions prolonged negotiations took place, and the chairman (Mr. E. L. Meinertzhagen, J.P.), had a number of interviews with representatives of the assessment authorities, but notwithstanding his efforts a settlement could not be arrived at. Accordingly the Committee was compelled to allow the matter to go to Quarter Sessions for determination.

A Disputed Leaving Certificate.

In the King's Bench Division, on February 22nd, before Mr. Justice Atkin, the British Thomson-Houston Co., Ltd., appealed against the decision of a Munitions Tribunal, in which Henry Sabin, a night watchman, was the complainant.

Mr. Maddocks, for the appellants, stated that Sabin was engaged as a night watchman. He was first paid 28s. per week, and later he was paid 43s. 9d. He applied for a rise in wages, and as this was not granted, he asked for a leaving certificate, which was refused by the firm. On the matter going before the Tribunal, it was decided that unless the firm were prepared to pay Sabin 49s. a week, it was unreasonable to refuse him the leaving certificate. There was no district rate of wages on which the firm could rely. The onus was upon Sabin to prove that he was entitled to a higher wage. Evidence was given before the Tribunal from two firms that higher wages were paid than those prevailing in the appellants' firm. On the other hand, evidence was given that lower wages were paid in some neighbouring works.

Mr. Slesser, for the complainant, contended that sufficient evidence had been afforded to enable the Tribunal to arrive at a decision as to the amount which should be fixed. The Tribunal heard the evidence of five witneses before coming to a decision.

Mr. Justice Atkin found that the Tribunal had no evidence upon which they could find that the amount fixed was the prevailing rate of wages. The appeal would be allowed.

High-Tension Electrometers for X-ray Apparatus.

Before the Controller of Patents, in the Patents Court, on Wednesday last week, Messrs. Fredk. R. Batt & Co., Ltd., London, applied for licence to use the German Patent 25,101, of 1912, in the name of Bauer, for the manufacture of high-tension electrometers to be employed in connection with X-ray apparatus. Patent 25,101 covers the combination with a unipolar electrometer, for connection to a high-tension circuit, of a casing surrounding the electrometer, the casing provided with means for reading the deflection of the electrometer, and being composed of material which readily gives up its charge to an ionised surrounding medium. The casing is readily penetrated by Röntgen rays. The high-tension electrometer comprises fixed metal plates, metal vanes carrying an indicating number, mounted to rotate relatively to the plates, and a spring tending to rotate the vanes in one direction, the casing surrounding the plates, vanes, and springs being provided with means for reading the deflection of the vanes.

Mr. J. H. Webb, the secretary of the company, said they had received orders for the Bauer electrometer. They had had difficulty in getting them from the firm who had obtained a licence to manufacture, Messrs. Newton & Wright. He concluded that they were not in a position to manufacture. Any firm making these electrometers needed to have special facilities. His own firm possessed special advantages for manufacture and sale. The Bauer electrometer was nothing more or less than an electrostatic voltmeter, and, to make one efficient in every way, a firm required to have a very good knowledge of the working of such instruments. They were somewhat difficult to manufacture, the mechanical parts rather than the electrometer. It was essential to employ the proper material in manufacture, otherwise the instrument became at once absolutely inefficient. The meter had to be placed on the secondary circuit of an X-ray apparatus for making measurements of the working of the X-ray outfit. The applicants were one of the largest manufacturers of X-ray apparatus, and were official contractors for the War Office. They held the opinion that if they could supply to the War Office, or to their X-ray Committee, an instrument made under the Bauer patent, which was absolutely efficient and made to their satisfaction, they would probably get a very large sale for it. He had been in communication with a firm of great repute in the manufacture of electrostatic instruments, and had made arrangements for early manufacture. The applicants themselves employed 90 men in manufacturing X-ray apparatus for the War Office. Every X-ray apparatus they used to sell in pre-war days included a Bauer electrometer, as they held it to be an integral part of the outfit. Since the war, however, these Bauer electrometers had not been included. The apparatus need not necessarily be used for surgical purposes. He proposed to pay a 5 per cent. royalty on the patented parts which the applicants fitted and manufactured. He wanted to advertise his firm as being in a position to supply, and in all probability the Bauer electrometer would be separately priced.

The **Controller** said he thought the case was one in which a licence should be granted. The royalty would be subject to revision after the war, and it would be foolish at this stage to put on a prohibitive royalty. The Board of Trade wished to promote the manufacture of a useful appliance, and it was well that the sale price, according to the cost of production, should be fixed within a reasonable limit.

Meirowsky Insulating Tubes.

A supplementary application to one reported in the Electrical Review of February 16th last, for licence to use the Meirowsky patent for insulating tubes, was heard in the Patents Court on 21st ult.

Capt. Donald Henry Scott applied for licence to use Patent 26,941 of 1906 covering this improved method and apparatus for forming insulating tubes.

The application was heard by the Controller of Patents, Mr. Temple Franks, and Sir Cornelius Dalton.

Capt. Scott (who had changed his name from Schultz to Scott) was conducting the English business of Meirowsky & Co. when the war broke out. He felt that upon him devolved the liability of carrying on the business. He was an English subject, and when he joined the Forces he invited Messrs. Schultz & Co., the well-known firm of electrical engineers (of which his father was managing director), to go to Manchester, take up the business, and manufacture under the patent.

Mr. Temple Franks said he saw no reason why the Court should not recommend the Board of Trade to grant a licence to him, and in the ordinary course that licence could be transferred to approved assignees. The Court would certainly suggest that his father, as representing Schultz & Co., would be an assignee that would be approved by the Board of Trade.

Mr. Moritz, representing Capt. Scott, said he understood the Board of Trade Committee would consider the case of the Meirowsky company, as they had given notice to that effect.

Mr. Franks: Were there no machines?

Mr. Moritz: Yes, of course, there were machines. I suppose they would have to control the transfer of these.

Mr. Franks: Probably it is not exactly a legal position at the present moment. Therefore, you want a proper transfer from the Controller to Schultz & Co. of the assets and machines.

Mr. Moritz: My client is willing to buy up the assets of Meirowsky & Co.

Mr. Temple Franks said if this were done, it would be an additional reason for recommending that a licence be granted to Capt. Scott, but, in any case, the Court would recommend a licence. He would communicate with the Board of Trade, and transmit to them the effect of those proceedings, and the applicant would, in due course, hear from the Board of the issue of the licence.

Wilde v. Walsall Electrical Co.

At Walsall County Court, plaintiff sued defendants for £5 19s, damages arising out of the repair of certain electrical apparatus.

For the plaintiff it was stated that he used a mercury vapour lamp for producing artificial light. In December something went wrong with it, and plaintiff's manager went to the defendants' works and saw Mr. Brown, defendants' manager, who eventually agreed to go down to plaintiff's premises. He found a wire had either fused or broken, and he repaired it. Subsequently, when the lamp was again lighted, a bulb fused, and the lamp was destroyed. Plaintiff subsequently found that by mistake Mr. Brown had connected the positive wire with the negative plug, and *vice versa*, with the result that the current was reversed, and caused the destruction of the lamp. For the defence, it was contended that Mr. Brown explicitly told plaintiff's manager that he had had no experience with mercury vapour lamps, and merely offered to do the best he could for plaintiff out of a spirit of kindness.

Judgment for the defendants, with costs.

Fowler v. Midland Electric Corporation for Power Distribution, Ltd.

In the Chancery Division, on Monday, Mr. Justice Eve delivered judgment in an action in which the plaintiff sought to recover the value of 18 £100 debentures issued by the defendants, and interest. The company had paid £1,800 into Court, together with interest up to June 30th, 1913, and a premium of £45, and the real claim was for interest subsequent to that day at 4½ per cent.

His **Lordship** said the action raised the question whether it was the duty of the issuers to seek their creditors "within the realm," and to pay the money without request. His Lordship held that the company was supplied the day after the debentures matured, with the information as to the proper person to whom tender of payment might be made. He thought there was no defence to the action, and he gave judgment for the plaintiff, with costs, for interest at 4½ per cent. as from June 30th, 1913, ordering the payment out to him at the same time of the amount paid into Court by the defendant company.

WAR ITEMS.

The Tramways of Vienna.—According to the "Daily Telegraph," if you want to travel by tramcar in Vienna now you must do so either between 5 a.m. and 9 a.m. or between 5 p.m. and 9 p.m. These are the only times when the tramcars run now. "Grave popular discontent has resulted."

Fire at Cockerill's Works.—A great fire at the famous ironworks of John Cockerill & Co., at Seraing, near Liège, has resulted in damage to the extent of £80,000. The cause of the fire is attributed to the enemy.—*Financial Times.*

Copper.—The Central News Paris correspondent says that the French Government will shortly submit to the Chamber a Bill making compulsory the declaration to the authorities of all copper or copper materials of any kinds except by persons holding less than 50 kilogrammes.

Engineering Wages.—The Mersey engineering employés who had applied for a 10s. per week advance, have by 1,700 votes to 1,410 (a total poll of 3,110 out of 8,000 members) accepted an award of 4s. awarded by the Committee on Production.

Higher Railway Rates after the War!—Lord Faringdon, chairman of the Great Central Railway Co., is credited with a remark which suggests that there may be higher rates for goods traffic after the war, owing to the excess of expenditure as compared with pre-war conditions.

A.E.G. Workers.—The Amsterdam correspondent of the *Daily Chronicle*, under date February 24th, says that 8,000 employés of the A.E.G. in Berlin have made united demands for higher wages and sufficient food.

Restricted Lighting: Accidents.—The number of fatal accidents in the Metropolitan Police District during the hours of darkness between August 1st, 1914, and January 31st, 1917, was 954. The number killed by Zeppelins in the same district was 137.

Export Prohibitions.—The Proclamation relating to export prohibitions is further amended by an Order in Council dated February 23rd. Changes are made in a number of headings. (See *London Gazette,* February 23rd.)

Exports to China.—Further additions to the list of persons and bodies in China and Siam to whom exports may be consigned are given in the *London Gazette* for February 23rd.

Electrical Export Prohibitions.—The following articles are in the list, issued by the War Trade Department, of things which are exempted from the necessity of licence or certificate as far as the prohibitions relating to the export of steel are concerned:—Electricity meters and electrical instruments. These are otherwise included in prohibition "C," which prohibits their export "to all destinations in foreign countries in Europe and on the Mediterranean and Black Seas, other than France and French Possessions, Russia, Italy and Italian Possessions, Spain and Portugal, and to all ports in any such foreign countries, and to all Russian Baltic ports."

Non-Essential Industries and National Service.—An important deputation is to be received on March 13th by the Earl of Derby, Sir Edward Carson, Mr. Neville Chamberlain, and Dr. Addison. It will represent the Federation of British Industries, the British Manufacturers' Association, the Association of Controlled Firms, and the Employers' Parliamentary Association, and is to be introduced by Mr. George Terrell. The object is to press on the Government that in all matters relating to labour and the restriction of raw materials used in non-essential industries the employers shall be consulted prior to instead of after the issue of orders. The present system, it is contended, has been productive of discontent, of unrest, and of loss of time and output, while the result in many cases has been the rescinding or amendment of the order.—*Morning Post.*

Exemption Applications.—At the Shoreditch Tribunal, Mr. G. Benkert, of 48, Wilson Street, E.C., electrical and general contractor, appealed for H. Burningham, aged 31 years, classed C 1, an electrician, for the second time. Mr Benkert said that the man was a qualified electrical man, and he was trusting him with the installation of a 10-wire telephone in a controlled factory, a job that he would only trust to a very experienced electrician. It was impossible nowadays to find anybody to replace hands in this business. He had a large number of contracts for electrical work for offices and buildings. The Tribunal dismissed the appeal. Mr. Benkert said he should appeal against the decision.

At the Newmarket Tribunal, the Electric Light Co. appealed for a stoker, aged 33 (married), one of two stokers employed. Three months' temporary exemption was allowed, the military authorities to try and find a substitute in the meantime.—The appeal of a youth of 18, described as a student of wireless telegraphy, for exemption until after an examination in April, was refused, but the father was informed that if he took to the recruiting officer a certificate that his son was to sit for examination within three months he would, in accordance with a War Office instruction, not be called up until after the examination.

The Military Representative at Northamptonshire Appeal Tribunal, on Friday, appealed from the decision giving exemption, with leave to make a further application, to A. Hutchins, 29, married, electrician, wireman, and motor inspector, and W. Trusler, 39, married, general labourer, both in the employ of the Northampton Electric Light & Power Co., Ltd. He said the appeal against Hutchins was on the ground of age, he being under 31, and the ground of appeal in the case of Trusler that he had forsaken what appeared to be a more useful occupation, that of a milkman, to become a labourer. Ald. F. H. Thornton, J.P., the chairman of the company, resisted the appeals. The certificates, which were for April 23rd, were extended to May 23rd, but that for Trusler was made final.

At Dover, further exemption for W. J. Holmes (39) was applied for, he being engaged in the delivery of coal to the Corporation electricity works. He is in B 1, and with the assent of the Military Representative, who said that they did not worry about B 1 men of that age, four months were granted.

At Brighton, a firm of electrical engineers appealed for an electrician, aged 39 and in class B 2, one of two left out of a staff of 18. The man, it was stated, had been in the business for 15 years, his work was skilled and important, and the Labour Exchange could not supply a substitute. Three months were conceded.

At Northwich, the Electrical Supply Co. appealed for an apprentice to electrical engineering, aged 18, engaged at a sub-station as attendant. It was claimed that the apprentice was in a certified occupation, and that much of the company's supply was utilised for munitions. The apprentice was in Class C 1 only, and the company offered, when the days got longer and the load was lighter, to try and release three other apprentices when they became of military age in April and May. The Tribunal allowed temporary exemption until May 31st.

Oswestry Tribunal has granted exemption until April 1st to Mr. W. H. Farrar (37), electrician, who is in Class A 1.

The Grantham Tribunal has disallowed a military appeal against conditional exemption held by P. A. Baxter (23), electric light and power wireman with the Urban Electric Supply Co.

At Peterborough, the Electric Traction Co. appealed for four men, with the following results:—J. G. Manning (28, Class A), tramway electrician and mechanic, three months; C. W. Armitage (29, Class A), tramway foreman, refused; G. A. Maywood (33), fitter and mechanic, three months; F Woodman (41, B 2), traffic inspector, two and a half months.

Before the Surrey Appeal Court, the Woking Electricity Supply Co. appealed for J. D. Fowler (23), electrical wireman, in Class B 2. The Chairman said that the Tribunal were of opinion that it would be a waste of power to let a skilled man go into the ranks of a labour battalion. He should be employed in a skilled capacity. If the Military Representative could assure them that he would be employed in that capacity they would be prepared to release him; otherwise they would not do so Lieut. Courthope replied that Fowler would probably be made a signaller. Exemption was refused.

At Shoreham (Sussex), exemption was sought for three electrical fitters engaged in the running and upkeep of electrical plant at Shoreham Camp, and who had never been badged. A final month was given in each case, the Tribunal being of opinion that if the men were needed the Military could look after them themselves.

At Paignton (Devon), the Electric Light Co. appealed for their assistant engineer, and he was, with the assent of the military, exempted until a substitute satisfactory to the company is found, the Tribunal to decide the question of suitability in case of dispute. The company had complained that a substitute sent to take the place of an electrician was utterly unfit for the position.

St. Ives (Hunts) Tribunal have granted six months' exemption to S. J. Allen, electrician in charge of the plant at the works of Messrs. Enderby & Co.

Aldershot Tribunal, on February 23rd, heard an appeal by the Traction Co. for Mr. A. E. Webster (31, general service), secretary to the company, and he was given one month final.

The North Riding of Yorkshire Appeal Court has dismissed an appeal by the Wensleydale Gas & Electricity Co., Ltd., against exemption granted until April 15th only, to the manager of the undertaking and to an electrician on the staff.

At Gloucester, the Corporation appealed for a storekeeper (32, in Class B 3), engaged at the tramway depôt. Mr. F. H. Corson, manager, said that the man was doing work which was highly specialised, the goods dealt with being quite outside the ordinary class of engineers' stores. Exemption until April 30th, with leave to appeal again, was granted.

A military appeal against conditional exemption granted last May to Mr. J. Launchberry (28), engineer in charge of the station of the Faringdon Electric Light & Power Co., has been disallowed by the Tribunal.

At Bexhill-on-Sea, the Corporation Electric Light Committee appealed for Messrs. R. C. Carter (28), chief assistant engineer; J. L. Eldridge (39), cable jointer, in Class B1; W. C. Winborn (29), engine driver on the heavy shift, general service; F. J. Stratford (22), senior shift engineer at night; and C. Hall (21), on the day shift. Mr. C. A. Frost, borough electrical engineer, said that Mr. Carter was the sole remaining technical engineer in the department. Before the war they had a staff of 47; now they had only 25. Eight men had been released, on account of the decrease in public lighting, and they were doing more work with fewer and younger men. He added that he could not possibly do without the men appealed for. Conditional exemption, without time limit, was given to Messrs. Carter, Eldridge, and Winborn; the other cases were adjourned for a month for the provision of efficient substitutes.

At Maidenhead, conditional exemption whilst they remain in their present occupation was granted to Mr. W. L. Chubb (32), assistant engineer and deputy-manager of the Corporation electricity undertaking; G. A. Cox (32), shift engineer; and F. G. Pink (35), shift engineer.

At the Shoreditch Tribunal, an electrical wire coverer appealed for a man, aged 38 years, classed "A" for general service, a mechanical fitter, for the second time. He said that the man was the only one they had to look after the machines, and they only had two other males in their employ, whilst they had 100 women constantly employed. They had orders for about £3,000 worth of covered wire, trench wires, and other electrical apparatus for the Government. They had 100 insulating machines going, and did all their own work. This man was absolutely indispensable in case of a breakdown. The turnover last year was £17,000, and the business was keeping up. The Tribunal granted four months' exemption.

At Bridlington, on February 23rd, the Borough Electricity Committee appealed for an indentured apprentice, aged 18 years and 3 months, on the ground that he was indispensable on account of the number of men who had left for military service. It was decided to respite the appeal for a month in order that the acting borough electrical engineer (Mr. Ffrench) might try a substitute offered by the Military.

BUSINESS NOTES.

New Zealand.—A firm at Hawera, controlling a lighting system there (three-phase alternating, 50-cycle; high tension 3,500-volt; low tension 220/230 light, 380/400 power), desires to get into touch with United Kingdom manufacturers of motors, transformers, lamps, fittings, and switchgear. The firm is also prepared to act as agent for United Kingdom manufacturers of all classes of engineering material.—*Board of Trade Journal.*

The Business Names Act.—Mr. James Martin, chairman of the Parliamentary and Commercial Law Committee of the London Chamber of Commerce, writes as follows:—

> May I seek the hospitality of your columns for the purpose of calling attention to the obligation imposed by the Registration of Business Names Act on shopkeepers and other tradesmen, and, in fact, on everyone carrying on a business or profession in this country (except limited liability companies and other corporations)?
>
> This Act provides that on and after March 21st next, all persons carrying on business in this country must trade under their own true names or else must be registered.
>
> The object of the Act is to enable everyone to know with whom they are trading, and if persons are trading under their own names, with no additions except their Christian name or names (or the initials thereof), it is not necessary to register; but if anything is added to the true name, or if a business is carried on under a fancy title, registration must be effected between **February 21st and March 21st, on pain of heavy penalties.**
>
> A simple instance will serve to show what is required. If, for instance, John Smith owns a business, he may trade as "John Smith" or "J. Smith," and need not register; but if he trades as "Smith & Co.," or adopts a fancy title, such as "The General Drapery Stores," registration must be effected. And in addition to registration, all business letters, trade catalogues, trade circulars and showcards which are issued or sent to any person in any part of His Majesty's Dominions, must show, in legible characters, the true name, or names, of the proprietors of the business, and the present nationality, or the nationality of origin, if other than British.
>
> The individuals and business firms who are not trading under their own name, or names (with no additions thereto), are liable, if not registered by March 21st next, to a penalty up to £5 per day for every day of the offence, or if such individual, or firm, enters into a contract while not registered, such contract cannot be enforced by the law if the other party should want to get out of it. It is also open to any private individual to set the law in motion against a defaulter, except in regard to Sec. 18 (publication in trade catalogues, &c.), where the consent of the Board of Trade must be obtained. It is understood that the forms for registration will be obtainable on and after February 21st, from the principal Post Offices, and the offices of the Registrar for England and Wales are at 39, Russell Square, W.C.

The British Industries Fair.—The third British Industries Fair is now open at the Victoria and Albert Museum and the Imperial Institute. In spite of the restrictions imposed by the war, it is larger, both from the point of view of the number of exhibitors and from the area covered, than it was last year. The Toy Section is in the Imperial Institute. The Pottery and Glass Section and other Sections are in the Victoria and Albert Museum. From the point of view of the number of exhibitors, the Toy Section is the strongest section in the Fair.

In the Glass Section there is an interesting exhibit showing the advance which has been made in the manufacture of chemical glass. No fewer than six firms are showing chemical glassware which was before the war almost entirely manufactured abroad. The China Section, too, contains specimens of laboratory porcelain, an almost exclusively German product previous to the outbreak of war.

The Fair, which will be open from 10 a.m. to 6 p.m. each day, will close on March 9th.

The following are selections from the exhibits announced in the Official Catalogue:—

Messrs. Anglite, Ltd., 68, Cowcross Street, London, E.C., exhibit "Anglite," a substitute for "Galalith," a German production, suitable for electrical fittings and insulating materials, telephone accessories, &c.

The British Ever-Ready Co., Ltd., of Hercules Place, Holloway, N., show their dry cells and batteries, accumulators, pocket lamps, torches, hand lamps, reading lamps, and other electrical specialities.

The British Glass Wool Co., of 134A, Holloway Road, N., exhibit glass wool for the electrical trade, glass fibre, commutator cleaners, &c.

Messrs. Doulton & Co., Ltd., of Lambeth, exhibit chemical laboratory porcelain.

Duroglass, Ltd., of 14, Cross Street, Hatton Garden, E.C., show chemical and laboratory and other glassware.

The Edinburgh and Leith Flint Glass Co., of Norton Park, Edinburgh, exhibit bulbs, tubing, and rods for electric incandescent lamps, black vitrite for electric lamp cap filling, &c.

Mr. P. Hayman, of 8, Long Lane, E.C., shows electrical toy specialities.

Messrs. Icknield Glass Works (Oslers), Ltd., of Birmingham, exhibit electric lamp bulbs, electric light shades, &c.

Messrs. W. A. & R. J. Jacobs, Ltd., of 94, Leonard Street, Finsbury, E.C., display their electric pocket lamps.

Messrs. Molineaux, Webb & Co., Ltd., of Kirby Street, Ancoats, show electric light and arc lamp globes and shades.

Messrs. John Moncrieff, Ltd., North British Glass Works, Perth, show engineering and laboratory glassware, miners' lamp glasses, and glassware for electrical purposes.

The Pytram Manufacturing Co., of Dunbar Road, New Malden, show electric light fittings, advertising novelties, &c.

Messrs. H. G. Richardson & Sons, of Stourbridge, exhibit glass electric fittings.

Messrs. Ward & Goldstone, of Springfield Lane, Salford, have an exhibit of their electric pocket and hand lamps, portable lamps, batteries of many types, model motors and dynamos, and electrical novelties, for all of which they are so well known to our readers.

Messrs. Thos. Webb & Sons, Ltd., of Stourbridge, in addition to many lines of glassware, show electric light standards, candlesticks, &c.

The Wood Bros. Glass Co., Ltd., of Barnsley, shows scientific and laboratory glassware, electric bulbs, flash lamp lenses, X-ray bulbs and tubing, &c.

Trade Announcements.—Messrs. Booth & Bomford, Ltd., announce that their new address, following the fire, is 21, Castle Street, Cardiff. Telephone 1466; telegrams: "Induction."

The New Switchgear Construction Co., Ltd., recently registered, has established works and offices at Sutton, Surrey, on a site immediately adjoining the L.B. & S.C. Railway, and close to Sutton Station. The premises are especially laid out for the erection of large power switchboards, and the machine tool equipment is quite modern. The buildings and site will admit of considerable extensions. The directors of the company are well-known business men and engineers, being Mr. C. E. Cleeves, a South Wales colliery owner; Mr. James Hall, for a number of years manager of the switchgear department of the Union Electric Co., Ltd., and lately general manager of the Switchgear Construction Co., Ltd.; and Mr. W. Walter Hughes, an electrical and mining engineer of wide experience, who will act as consulting engineer to the company. The company has acquired the business of the Switchgear Construction Co., Ltd., of Park Street, Southwark, London, S.E., from the Controller appointed by the Board of Trade, and will specialise in the production of high, medium, and low-pressure A.C. and D.C. switchgear, oil switches, and circuit-breakers, instruments and cognate accessories for the class of gear referred to. The high-tension gear is of designs which have been standardised, and is already well known, it having been given considerable vogue by the Union Electric Co., Ltd. The gear complies in detail with the official regulations as to the use of electrical energy in mines, factories, and textile mills. The new company is entirely British in its capital, directorate, and staff, and the heads of the firm have had lengthy experience of switchgear practice. The company is making special arrangements for the development of its export business.

Dissolutions and Liquidations.—Telephone Development Co., Ltd.—This company is winding up voluntarily. A meeting of creditors is called for to-day, at 22, Broad Street Avenue, E.C. Creditors should send particulars of their debts, &c., to the liquidators (Messrs. J. E. Kingsbury and A. Anns), by March 19th.

Wheatley Kirk, Price & Co., valuers, engineers, &c., 46, Watling Street, London, E.C.—Mr. E. A. Sherley-Price has retired from the firm. The business will be continued by Messrs. Henry Sherley-Price, J. Place, Horace Sherley-Price, and M. H. Cutler.

Fire.—A fire at the works of Messrs. C. Horne & Co., electrical engineers, Middlesbrough, last Friday, caused damage estimated at £1,000.

Bankruptcy Proceedings.—Whitehouse, J. R., Golder's Green, managing director of an electrical engineering company. Application for discharge refused on January 23rd, at Barnet Court, on the ground that the bankrupt's assets are not of a value equal to 10s. in the £ on the amount of his unsecured liabilities, and the Court being of opinion that the debtor's conduct during his course of trading has been most improper.

Catalogues and Lists.—Power Plant Co., Ltd., West Drayton, Middlesex.—Catalogue P84 (32 pages), containing full particulars, including technical notes, diagrammatical tables, price tables, weights, code, &c., of their turbo pumps with patent diffuser.

General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—Leaflet L2,092, giving particulars and prices of electric bells for use on power circuits.

Messrs. Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Postcards Nos. 654 and 655, giving diagrams relating to their industrial lighting reflector fittings for workshop and office lighting, also prices of same.

"Z" Electric Lamp Manufacturing Co., Ltd., Southfields, London, S.W.—A collection of advertising leaflets, giving prices and particulars of their drawn-wire lamps, traction, motor-car, candle-type, sign, and flashlight lamps. Trade buyers can have quantities overprinted with their own names, for use as correspondence enclosures, &c.

Messrs. Hart & Co., of Bonnington Works, Newhaven Road, Edinburgh, have sent us a large hanging calendar (monthly slips), the upper half of which is a coloured picture, "In the Good Old Days."

LIGHTING AND POWER NOTES.

Accrington.—Price Revision.—The Electricity Committee has decided to increase the flat rate for lighting from 4·8d. to 5d. per unit; for heating, from 1·2d. to 1·3d.; and to those who are on the rateable value tariff, the price of current per unit will be increased from ·6d. to ·7d. These charges are subject to 2½ per cent. discount. For power purposes there is to be an all-round increase of 10 per cent.

Australia.—Hydro-electric Proposals.—The report of Mr. de Burgh, engineer-in-chief for rivers and water supply, on the proposal to utilise the Murrumbidgee river at Barren Jack for hydro-electric and irrigation purposes, points out that 1,460 KW. could be made available continuously, providing over nine million units per annum within a radius of 100 miles, within which area a number of towns are situated. The proposal would facilitate electric pumping for water supply, and thereby save the cost of fuel for steam pumping, which fuel has to be conveyed from Sydney. The estimated cost of constructing a power house, with transmission lines and step-down transformers, to five towns, would be £100,000; the annual working and capital charges would be £9,095, while the revenue estimated to be derived from the sale of 3,600,000 units for power and light would be £11,686, leaving a direct profit. It is considered that there would be no difficulty in disposing of the remaining energy in towns in the area, and that a considerable saving of fuel from the State's coal reserve, or of timber, which is being used as fuel, would result.—*Sydney Morning Herald.*

Batley.—Minimum Charges.—The Electricity Committee has decided to impose the following minimum charges for the supply of electrical energy, exclusive of meter rents, as from April 1st next:—Lighting, 25s. per annum; power, £2 13s. 4d. per annum; lighting and power, £2 13s. 4d. per annum.

Bolton.—Linking-up.—A conference of representatives of electricity works in Lancashire was held at Bolton, last week, to discuss the linking-up of such undertakings. Another conference was to be held at Manchester, last Friday, to consider inter-action with a view to the better use of electricity in Lancashire.

Colchester.—Proposed New Power Station.—The T.C. has decided to prepare a scheme for a new generating station at Hythe, and to ascertain the cost of a motor-alternator for use at the power station, and of a main from the station to the shipyard of Messrs. Rennie, Forrestt, Ltd.

Continental.—Russia.—The Council of Ministers has approved two propositions for the supply to Petrograd of electricity generated by the Finnish waterfalls. It is proposed to use the smaller Imatra waterfall; at the same time, it is necessary to arrange for the expropriation of private interests that would interfere with the carrying out of the scheme. For the hydro-electric construction an assignment of 32,000,000 roubles is asked for, and it is intended to complete the work in 1918. A special Government Waterfall Committee is being formed, subject to the Minister of War as president of the Special Defence Council; the Council of Ministers has approved the proposition of the Imperial Finnish Senate to obtain for the Finnish Treasury the expropriation rights of the Vallinkoski waterfalls. The Finnish Senate proposes to use the power of these falls for the electrification of the Finnish railways and the transmission of electricity to Petrograd.

Italy.—The Italian Government has granted to the Società per la Forze Idraliche della Silla water-power concessions in the upper valleys of the rivers Neto, Arno and Ampollino, for irrigation and electric supply purposes. The concession is for 60 years, when the works, &c., revert to the State; the company undertakes to supply energy for working the Calabro-Lucanno railway, and to produce 20,000 H.P., the estimated cost of the scheme being 70,000,000 lire. —*B. of T. Journal.*

Dungannon (Co. Tyrone).—A public meeting has been held to support a scheme by Mr. John Cunningham, an ex-member of the Urban Council, for lighting the town by electricity.

Gorey.—E.L. Scheme.—A syndicate is being formed at Gorey (Ireland) for the purpose of lighting the town by electricity.

High Wycombe.—Street Lighting.—The Electricity Co. has issued a writ against the T.C. for the sum of £1,290, claimed to be due to it under the lighting contract for the year ended December 31st last. The action is to be defended.

Hull.—Loan Sanction.—Sanction has been received from the L.G.B. for the borrowing of £60,000 for extensions of the electricity undertaking. Of the total amount, £30,000 is for new mains and £15,000 for a sub-station.

Huddersfield.—Year's Working.—The Corporation electricity department made a gross profit for the last financial year of £24,651, as against £21,610 in the previous year; and after allowing for the usual capital charges, &c., £2,200 is applied to relief of rates and £1,899 carried to the depreciation fund, which amounts to £10,569—of which £10,000 is invested in War Loan.

India.—The official opening of the electric power station of the United Provinces Electric Supply Co., at Lucknow, took place on January 17th, his Honour the Lieut.-Governor performing the ceremony. Owing to the war, it has not been possible to obtain the delivery of the large engines ordered, but a small supply will be available from the auxiliary plant and battery for the use of the public. In order to meet the anticipated demand, the company has purchased two second-hand plants which were available in Calcutta; each of these is 200 KW.—*Indian Engineering.*

Kilmarnock.—Year's Working.—The annual accounts of the Corporation electricity undertaking show that 5,026,000 units were sold during the year ended May 15th last, as compared with 2,629,000 in the previous year; of these, power absorbed 4,233,000 units, as against 1,933,000 units in the previous year, lighting and traction units also showing a small increase. As shown in the description which appeared in our columns last June, the Kilmarnock undertaking now comprises a very large tract of country outside the borough, served by 11,000-volt, three-phase transmissions, and a considerable load is developing, mainly for power supply. The plant capacity has risen from 3,030 to 5,530 KW. in the year; the rotary sub-station plant from 800 to 1,550 KW.; and the transformer sub-stations from 10 of 1,315-K.V.A. capacity to 25 of 4,120-K.V.A. capacity. The total H.P. of motors supplied increased from 4,127 to 7,314, of which 2,375 H.P. is in the extended area. The maximum load for power and light was 2,400 KW., and for traction 245 KW. During the year, 14,285 tons of coal (at 8s. 7d.) per ton) were used, as against 8,237 tons (at 4s. 2d.), and the average coal cost rose from ·157d. to ·293d. per unit sold, the load factor having improved from 21·5 to 24·3 during the year. The financial results, briefly, were a total revenue of £22,299 (the average price received for the whole supply being roughly 1d. per unit); total working costs, £12,266 (·585d. per unit sold), and a gross profit of £10,033, as compared with £8,282 in 1914-15. After meeting interest and loan charges, the net profit was £3,342, as against £3,726 in 1914-15. The reserve fund in hand amounts to £10,338, and the depreciation account to £3,726.

Leicester.—Price Increase.—The Electricity Committee has decided to increase its charges for electricity for power purposes by 15 per cent. on the existing charges, and the charges for electric light supply from 4d. and 4½d. per unit to 5d. and 5½d. per unit. The total number of customers connected to the power supply mains from the Lero station is 292. The total H.P. installed on consumers' premises at the present time is 11,100 H.P., which shows an annual net increase of 22 per cent.

Loughborough.—Plant Extensions.—The T.C. has decided to apply to the L.G.B. for sanction to the borrowing of a loan of £27,225 for proposed extensions at the electricity works, being part of a large scheme which it is estimated will eventually cost the town £50,000.

Mexboro'.—Plant Extensions.—The Council's electricity works have been twice enlarged since they were erected, and a further scheme of extension, at an estimated cost of £10,000, is at present under consideration.

Norwich.—Proposed Loan.—The T.C. has decided to make application to the L.G.B. for sanction to the borrowing of £3,500 for the construction and equipment of the King Street sub-station.

Tasmania.—Mr. J. H. Butters, manager of the Government Hydro-electric Department, has just finished a tour of inspection of the King River, with a view of determining its suitability for the generation of hydro-electric power for the Mount Read Roseberry mines, a new company under the control of the Mount Lyell Co., which is establishing large metallurgical works at Zeehan for the treatment of the zinc and lead ores of the West Coast. Mr. Butters states that the scheme would generate about 23,000 H.P., but surveys which were to be carried out might reveal greater sources of power.—*Melbourne Age.*

According to the *Melbourne Age*, it is officially stated that the Mount Lyell Co.'s officers have found an almost ideal scheme for generating hydro-electric power on the King River, which will give approximately 10,000 H.P. The catchment area is over 200 square miles.

West Ham.—The L.G.B. has informed the T.C. that as the Ministry of Munitions does not consider the proposed electrical machinery necessary for war requirements, it is unable to give sanction to a loan for it. The L.G.B. is to be asked to reconsider the matter.

TRAMWAY and RAILWAY NOTES.

Accrington.—Fare Increases.—The Tramways Committee has recommended the T.C. to increase the fare on the Haslingden section from 3d. to 4d., and to discontinue the penny return fares for workpeople, the twopenny return fares to remain as at present.

Argentina.—The Anglo-Argentine Tramway Co. has presented a petition to the Chamber of Deputies asking that it should be excepted from the operation of the new law creating a 5 per cent. import duty on articles hitherto imported duty free, so far as effects the construction of its underground lines and the surface lines connected therewith. The company points out that its underground system was projected on the basis of cost prices of articles, free of duty, and submits that it would be unjust to place this burden upon the later stages of the construction. Moreover, the Tramway Co. is exempted from all national taxation, and also the falling off in receipts during the past two years would make the projected tax fall very heavily upon it.—*Review of the River Plate.*

Australia.—The proposed expenditure on railway works in Victoria during the current financial year includes £775,000 for the electrification of the Melbourne suburban lines, excluding the construction and structural alterations of rolling stock.—*Tenders.*

Bingley.—On the recommendation of the Electricity and Tramways Committee, the Council is arranging to interview the Keighley authorities with regard to facilitating the linking-up after the war of the Keighley tramways with the Bradford tramways, which extend through Bingley to Cross Flatts.

Blackburn.—The receipts on the Corporation Tramways for the past 11 months were £57,901, or £1,363 below those of the previous year. The recent increase in fares has made little difference in the number of passengers, but has increased receipts considerably.

Blackpool.—The traffic returns from April 1st last show receipts of £87,727, an increase of £13,268 on the previous year, and over £2,000 more than in the record year of 1913.

Brighton Railway Electrification.—The chairman mentioned at the company's annual meeting that the contractors for the electrification were proceeding as well as could be expected under the present conditions. Certain widenings were required, and they proposed to proceed with them as rapidly as possible, so that greater use might be made of electrical working when the opportunity occurred.

Burnley.—The Tramways Committee has decided, owing to reduced income, to recommend the Council to abolish ordinary discount tickets and the periodical tickets issued to students and apprentices.

Hyde.—The Joint Tramways and Electricity Board has decided to support the Hyde petition against the Ashton Corporation Bill.

Kilmarnock.—Year's Working.—Published data for the year to May 15th, 1916, shows that 2,412,087 passengers were carried and 275,349 car-miles run. The revenue amounted to £8,865, and after meeting working expenses (about £1,000 in excess of the previous year) and providing for interest and loan charges and £1,160 to depreciation, there was a net deficit of £3,964, as against £2,377 in the previous year. Unlike many other undertakings, the revenue showed only a slight increase, but the percentage of operating expenses to receipts increased from 79·6 to 87·5.

North-Eastern Railway Electrification.—Presiding at the annual general meeting held at York, last week, Lord Knaresborough stated that they had now had more than a year's experience of operating the Newport-Shildon mineral line by electricity, and although the accounts for cost of construction were not yet complete, they were satisfied that the venture would justify a charge of £100,000 against capital.

North-London Railway Electrification.—Lord Rathmore, presiding at the annual meeting of the company, referred to the progress of the electrification of the line which formed part of the large scheme of the North-Western Co., mentioning that the falling off in passenger traffic had been arrested, and until fares were raised and services restricted, there had been increases week by week.

North-Western Railway Electrification.—Speaking at the annual meeting of the company, Sir Gilbert Claughton mentioned that arrangement had now been made for a through service of electric trains from Watford to the Elephant and Castle, using tube rolling stock. The Broad Street-Richmond electric services were started in October, and gave promise of a return of the large passenger traffic which that line formerly enjoyed, but they could not look forward to a complete fulfilment of their hopes until the complete scheme was in operation.

Oldham.—The local Tramways Committee has been informed by the Manchester Tramways Committee that it cannot put any additional cars on the Manchester to Oldham line, owing to the scarcity of skilled labour.

Paraguay.—The employes of the tramway company of Asuncion are again on strike, as are also those of the electric power station. The city has been without electric light. The strike movement threatens to spread to other industries.—*Review of the River Plate.*

Rochdale.—The Tramways Committee has declined an application from the female conductors for a war bonus, leaving the latter to apply to the Committee on Production if they think fit.

South-Western Electrification.—At the annual meeting of this company, Mr. Hugh W. Drummond stated that although the final accounts had not yet been settled, the actual cost of the portion of the electrification scheme carried out would amount approximately to £1,365,000. During the whole of the year their increased revenue from local passengers in the electrified area was £77,000. The additional maintenance and working expenses due to electrification were £120,000, and the saving in locomotive expenses owing to the discontinuance of the steam trains was £73,000. In the first year of electrification a profit had therefore been secured of £30,000, after charging revenue with the necessary amount to provide for the replacement of the electrification machinery and equipment. The experience of the electrified portion of their suburban lines had been, in every sense, satisfactory.

U.S.A.—Extension of Milwaukee Electrification.—The directors of the Chicago, Milwaukee and St. Paul Railway are about to electrify two additional engine divisions, extending eastward from Seattle to Orthello, about 220 miles, and crossing the Cascade Mountains on to the plain in the eastern part of the State of Washington.

Across the plain, 200 miles away, is the western extremity of the original 440-mile electrification of this company, at Avery, Idaho. For the present this level intermediate section is to be steam operated; ultimately, however, it is proposed to electrify the whole western end of the system to the Pacific, a distance of nearly 900 miles.

According to Mr. Goodnow, assistant to the president, the new electrification is being undertaken because of the phenomenal success of the electric zone already completed, the outstanding feature of which is the ease with which heavy freight trains are handled on the mountain grades. Five freight trains of about 60 cars each are moved daily each way across the mountains by the electric locomotives, and it is estimated that four hours' time is saved by each train on each 100 miles of road.

The surveys for the new work have been made and similar equipment will be provided, the line operating on the 3,000-volt direct-current system.

The Great Northern Railway, St. Paul, Minn., is arranging to construct a 120,000-H.P. hydro-electric plant at Lake Chelan to supply energy for operating its Cascade division.

Owing to the shortage of available power from the Niagara plant, the International Railway, Buffalo, has had to temporarily suspend service on its Niagara Falls local lines for several hours a day.

West Ham.—At a conference between representatives of the L.C.C., West Ham, Leyton, and East Ham Councils, a new scale of fares was arranged to come into operation on through-running routes on March 1st, 1917. Female labour is to be engaged to undertake car cleaning during the day. The Tramways Committee has adopted a report from the electrical engineer upon the condition of the machinery at the generating station, and suggesting that further converting plant be installed, and certain alterations in the traction supply network be made to enable a larger proportion of the work to be dealt with through the medium of the general alternating current supply.

TELEGRAPH and TELEPHONE NOTES.

Australia.—On December 20th, Mr. Justice Higgins gave final judgment in the claim of the Australian Postal Electricians' Union against the Postmaster-General and the Public Service Commissioner. He said he had substantially adopted the provisions of the more recent linemen's award in order to give officers the benefit of acting in higher positions, whether those positions had occupants or not, and to give them the benefit of the increments as well as the minimum salary for higher officers. He had been frustrated by Section 12 of the Public Service Act of 1915 in his endeavour to prevent the appointment of adults of 30, 40, or 50 years as junior mechanics. There were no fewer than

167 successful candidates for appointment as junior mechanics, and only 23 of these were under 21 years of age. This seemed to him to be a scandalous abuse of the position of junior mechanics, which was primarily meant for boys.—*Sydney Daily Telegraph.*

Calcutta.—The Director-General of Posts and Telegraphs has decided to open public telephone call offices at local post and telegraph offices in Calcutta. Should the system be found to pay its way, it will be extended to other places in the city. The charge will be annas 2 per connection of three minutes' duration.—*Indian Engineering.*

New Wireless Stations.—A wireless station has been erected at Cape Juby, W. Africa, which will be in communication with Spain *viâ* the station at Teneriffe. Stations are also to be installed at Arauca and Orocue, in Colombia, the former communicating with Venezuela.

Persia.—Telegrams may now be forwarded to the undermentioned places at the rates stated :—Abadan, Persia, 2s. 7d. a word ; Koweit, Mesopotamia, 2s. 3d. a word.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—March 7th. Powell-Duffryn Steam Coal Co. Electrical goods for 12 months. Stores Manager, Aberaman Offices, Aberdare.

March 8th. U.D.C. Annual tenders for cable, meters, joint boxes, electric lamps, &c., for the Electricity and Tramways Department. See "Official Notices" February 23rd.

Australia.—Adelaide.—March 28th. P.M.G.'s Department. Telephones, telephone parts, line and battery material, &c. Schedules 444 to 453. See "Official Notices" February 2nd.

Melbourne.—March 7th. Council. 1,048 electricity recording meters. See "Official Notices" February 9th.

Barrow.—March 5th. Corporation. Electrical stores for 12 months. Borough Electrical Engineer.

Bedwas (Mon.).—March 8th. Bedwas Navigation Colliery Co., Ltd. Twelve months' supply of electrical goods, &c. Mr. G. Morgan, Secretary.

Belfast.—March 3rd. Electricity and Tramways Committee. Tramway stores, including electrical accessories, cables, lamps, &c. See "Official Notices" February 23rd.

March 14th. Electricity and Tramways Committee. Six or twelve months' supply of stores, including several electrical items, for the Electricity Department. See "Official Notices" Feb. 23rd.

Bolton.—March 7th. Electricity Committee. Materials and stores. See "Official Notices" February 16th.

March 19th. Corporation Tramways Committee. Materials and stores for a year. See "Official Notices" to-day.

Brighton.—March 9th. T.C. Five-ton steam motor-wagon and 3½-ton electric motor-wagon. Particulars from Mr. H. Talbot, Town Clerk.

Burnley.—March 19th. Electrical goods, for the Board of Guardians. Mr. J. S. Horn, Clerk.

Canada.—March 28th. Toronto Electric Commissioners. Synchronous condensers, 5,000, 7,500 or 10,000 K.V.A. capacity. See "Official Notices" February 9th.

Grenada.—March 31st. The time for tendering for the Government electric light and power concession, already announced, has been extended to March 31st.

Harrogate.—March 5th. Corporation. By-product steam boiler plant. See "Official Notices" February 2nd.

Kilmallock.—March 5th. Kilmallock (Co. Limerick) E.L. & P. Co., Ltd. Hydraulic turbine, dynamo and motor booster, battery and switchboard. See "Official Notices" February 16th.

London.—Kensington.—March 8th. B. of G. Six months' supply of electric fittings, lamps, &c. Mr. W. R. Stephens, Clerk, Guardians' Offices, Marloes Road, W.

Londonderry.—March 17th. Corporation. Engine-room stores, carbons, electricity meters, cables, &c., for the Electricity Department. Town Clerk.

Macclesfield.—March 14th. Cheshire County Asylum. Electrical goods for one year. Mr. W. G. F. Tingay, Clerk to the Asylum, Parkside.

Manchester.—March 7th. Electricity Committee. Coal-conveying plant and suction ash plant. See "Official Notices" February 9th.

March 14th. Corporation. Nine 40-H.P., three-phase, slip-ring motors. See "Official Notices" February 23rd.

Rhondda.—March 21st. U.D.C. Twelve months' supply of house-service meters. See "Official Notices" to-day.

Stockton-on-Tees.—March 12th. Stores for the T.C. Electricity Department. See "Official Notices" February 23rd.

CLOSED.

Swansea.—B.C. Tenders for extensions of the plant at the generating station (at an estimated cost of £6,000) :—

Water-tube boiler and accessories. Stirling Boiler Co., Ltd.
Mechanical draught fan. Musgrave & Co., Ltd.
Boiler feed pump. Weir, Ltd.

The Education Committee has accepted the tender of Messrs. Thomas & Evans for electrical fittings for the cookery and laundry departments at £145.

FORTHCOMING EVENTS.

Society of Engineers.—Monday, March 5th. At 5 p.m. At Burlington House, Piccadilly, W. Paper on "High Tensile Steel *versus* Mild Steel for Reinforced Concrete," by Mr. A. W. C. Shelf.

Institution of Civil Engineers of Ireland.—Monday, March 5th. At 8 p.m. At 35, Dawson Street, Dublin. Ordinary meeting.

Institution of Civil Engineers.—Tuesday, March 6th. At 5.30 p.m. At Great George Street, Westminster, S.W. Paper on "The Commercial Metering of Air, Gas, and Steam," by J. L. Hodgson.

Liverpool Engineering Society.—Wednesday, March 7th. At the Royal Institution, Colquitt Street. Paper on "Some Problems on Railway Curves," by Prof. S. W. Perrott.

Institution of Electrical Engineers.—Thursday, March 8th. At 8 p.m. At Victoria Embankment, W.C. Paper on "Voltage Regulation of Rotary Converters," by Mr. G. A. Juhlin.

Greenock Electrical Society.—Thursday, March 8th. At 7.45 p.m. At 22, West Street. Paper on "Notes on the High-speed Engine," by Mr. S. V. Thorp.

Physical Society of London.—Friday, March 9th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Ordinary meeting.

Salford Technical and Engineering Association.—Saturday, March 10th. At 7 p.m. At the Royal Technical Institute, Peel Park. Paper on "Our Aerial Ocean," by Mr. J. Bacon.

NOTES.

The Need for Home Support for British Electrical Industry.—In the course of a paper on "Stores Organisation at Collieries," read before the West of Scotland Branch of the Association of Mining Electrical Engineers at Glasgow, last month, Mr. P. J. Sims, general manager in Scotland for the General Electric Co., referred to the need for British users to give full support to British manufacturers. According to a report in the *Glasgow Herald*, he said that they never needed that support and assistance more than now. He continued :—British manufacturers were practically debarred from quoting for railway electrification schemes, because British railway companies had almost totally ignored railway electrification. The result was that British manufacturers had had a negligible amount of experience in this class of electrical engineering. How, then, could it be expected that a foreign railway company would entrust a contract to a British manufacturer when the British railway companies had denied the British manufacturers the right to electrify British railways? A similar state of things prevailed in regard to heavy winders. Germany, America, and other countries had developed the electrical winder to a remarkable extent, and that development had only been made possible by the support given by the colliery owners in these countries. In Great Britain heavy electric winders were few and far between. Our manufacturers had not had the experience they ought to have had, and in pre-war days all electric winding contracts of any size for abroad went to those foreign manufacturers who could show winders actually at work. To quote a final instance, he would refer to Britain's position in regard to the steam turbo-generator. The turbine was invented in Great Britain, and the finest turbines to this day were still made in this country, but owing to the extreme cautiousness—to use the most charitable expression—of British municipalities and other supply authorities, we had been left far behind in the manufacture of large machines. The manufacturers could only advance sufficiently fast if they were given the support of the users. The advantages were mutual, for the user benefited by the reliability and efficiency of the plant.

Industrial Policy.—At a meeting of the Swansea Chamber of Commerce a special committee appointed to deal with the question of commercial and industrial policy after the war made a recommendation in order to encourage better relations between Capital and Labour. It suggested that "all factories and industries employing power plant should as far as possible work three shifts of eight hours each daily and further, that labour generally is entitled to a proportionate share of the wealth it helps to produce. On the other hand, we feel strongly that labour should stop all attempts at restriction of output, that there should be no stoppage of work either to strike or lock-out pending the settlement of any dispute, and that a form of compulsory arbitration should be adopted which would nullify any advantages from a stoppage of work expected by those responsible by means of a National fund contributed to by Capital and Labour, from which the non-defaulting party would be compensated for losses incurred during such stoppage."

The fostering and protection of skilled female labour was also recommended in view of the hitherto unascertained great National asset which the war had disclosed.

Electric Furnaces.—The needs created by the war have given a great impulse to the use of the electric furnace for the manufacture of steel, and more than 100 have been installed in the belligerent countries. The number actually now existing in the world is 300, while in 1913 there was hardly half that number. The United States constructed 50 last year, and 30 have been installed in England. Italy has made additions, while Germany turned out 130,000 tons of electric steel in 1915 against 90,000 tons in 1914. In France, in the neighbourhood of Limoges, there has been installed a Keller furnace, in which 30 tons of waste are daily converted into high-priced metal. The furnace takes up little room in the car depots of the tramway company, and by the use of automatic apparatus needs little attention. Its consumption of current is between 700 and 800 KW. per 100 kilos of metal produced. The question, says *Industria e Invenciones*, is of great interest to our country, since, if the electrical undertakings were to study the means of facilitating the installation of electric furnaces, there would be a great development of the iron industry, and more particularly the conversion of scrap and waste into iron and steel.

A Railway Cooking Installation.—As mentioned in a recent issue of the ELECTRICAL REVIEW, the companies operating the Underground group of railways have equipped a luncheon and social club near Earl's Court Station for their female administrative staff, where some 200 meals a day are served; this club was recently opened by Sir Albert Stanley.

Practically the whole of the cooking is done electrically, the kitchen installation consisting of four "Tricity" ovens, each fitted with a hood on the top for simmering, &c., as shown in our view.

Each oven has two circular ribbed type heaters, top and bottom, arranged for two loadings, 250 and 900 watts, each heater being controlled by a "high and low" switch, of the pattern manufactured by Messrs. Lundberg under the British Electric Transformer Co.'s patent for dissimilar metal contacts.

The ovens are mounted on a central table, together with five "Tricity" boiling plates, each with two loadings, 850 and 225 watts, controlled by high-low switches, the boiling plates being used with a fish kettle, bain marie, and other boiling equipment. The main control panels for this equipment are fitted with Zed fuses, switches, and indicating lamps.

Topical] [Press Agency.

ELECTRICAL KITCHEN AT THE UNDERGROUND RAILWAYS' CLUB.

We understand that a "Tricity" restaurant type grill, with top and bottom heat, is being added to the equipment. Two other ovens have been temporarily installed of a size suitable for large joints, one being of the Jackson type, and the Jackson Co. has also supplied two carving tables and hot cupboards, one being in the servery adjacent to the dining rooms, also a vegetable boiler with six steamers, and two electric urns. The Jackson equipment is provided with control panels containing Zed fuses, Diamond H switches, and indicating lamps. As will be gathered, the cooking equipment is not yet completed, the demands of the club members having exceeded anticipations.

Y.M.C.A. Canteen Cooking Installation.—On Saturday last a new canteen, administered by the Y.M.C.A., at a well-known engineering works in North London, was formally opened by Princess Victoria of Schleswig-Holstein. The whole of the cooking will be done by electricity, a complete installation for supplying meals to 2,000 employés having been supplied by the British Electric Transformer Co.

Aluminium.—The Ministry of Munitions announces that all existing permits for the sale, purchase, or re-melting of aluminium scrap and swarf are cancelled as from March 1st. Regulations have been issued governing all dealings. Applications for permits should be made to the Director of Materials, A.M. (2), H., Hôtel Vitoria, Northumberland Avenue, W.C.

Change of Address.—Queen Anne's Chambers, Westminster, S.W., being required by the Government, the following firms announce that they have secured suitable premises at 25, Victoria Street, Westminster, S.W.:—

Nathan & Allen.
Wardle Engineering Co., Ltd.
Parmiter, Hope & Sugden, Ltd.

Their telegraphic and telephonic addresses are unaltered.

Institution and Lecture Notes.—The Institute of Metals.—A special feature of the forthcoming Spring Meeting of the Institute, to be held on March 21st and 22nd, will be a general discussion on metal melting, a subject which hitherto has received very little attention from the scientific societies. The president, who will preside over the discussion, is Sir George Beilby, F.R.S., the head of the new Government Board of Fuel Research. A series of six communications will be read bearing on all phases of the question of the melting of the non-ferrous metals, whether by high-pressure or low-pressure gas, coke, oil fuel, or electricity. The papers to be contributed include the following:—

"Metal Melting as Practised at the Royal Mint." By W. J. Hocking.

"An Electric Resistance Furnace for Melting in Crucibles." By H. C. Greenwood, D.Sc., and R. S. Hutton, D.Sc.

"Ideals and Limitations in the Melting of Non-ferrous Metals." By Carl Hering (Pa., U.S.A.).

In addition to the metal-melting discussion, several important communications bearing on other phases of metallurgical work will be presented at the meeting, amongst which may be mentioned the following:—

"The General Properties of Stampings and Chill Castings in Brass of Approximately 60/40 Composition." By Owen W. Ellis, B.Sc.

"Aluminium Production by Electrolysis: A Note on the Mechanism of the Reaction." By R. Seligman, Ph.Nat.D.

On account of Caxton House having been commandeered by the War Office, the address of the Institute of Metals will in future be 36, Victoria Street, London, S.W. The new offices are much more extensive and better suited to the purposes of a scientific society than those recently vacated, and include a reading room and library, available to members, as well as a spacious meeting room. The telephone number (Victoria 2320) and the telegraphic address ("Instomet, Vic., London.") remain unaltered.

Particulars of membership can be obtained from the secretary, Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, S.W. All candidates for membership whose applications are in the secretary's hands before March 14th will be entitled to take part in the proceedings at the London meeting. Members elected at the forthcoming meeting will have the privilege of membership, not for the usual 12 months, but for the extended period ending June 30th, 1918. The present membership of the Institute is 660—a record total.

The seventh annual May Lecture will be given at the Institution of Civil Engineers, on May 3rd, 1917, at 8.30 p.m., by Prof. W. E. Dalby, M.A., F.R.S., on "Researches Made Possible by the Autographic Load Extension Optical Indicator."

MR. HARRY WEBBER, electrical engineer to the Keighley Corporation, lectured on Saturday evening last before the Keighley Association of Engineers on "Progress in Electric Power Plants," illustrating his observations with lantern slides.

Institution of Civil Engineers.—On Monday, March 12th, at 5.30 p.m., the first of a series of special extra meetings is to be held. The subjects chosen for these meetings are matters of special importance to engineers at the present time, and a discussion will follow each of the lectures. On March 12th, Mr. Edgar Crammond is to lecture (under the Vernon-Harcourt Trust) on "Foreign Trade and its Relation to the Investment of Capital Abroad"; and at the later meetings, the subjects will be:—"Decimal System of Coinage, Weights and Measures," and the "Standardisation of Engineering Materials." Members of the Institutions of Mechanical Engineers, Naval Architects, and Electrical Engineers, and of the Iron and Steel Institute, are invited to attend Mr. Crammond's lecture.

The Engineers' Club.—On Wednesday evening, Mr. Ben H. Morgan, of the Technical Department of the Ministry of Munitions, delivered an address before this club at Manchester on "Dilution of Labour in Munition Works."

Institution of Mechanical Engineers.—At the meeting on February 16th, Mr. Michael Longridge was declared elected president. The vice-presidents were Mr. Dugald Clerk, Sir Robert A. Hadfield, and Mr. Mark Robinson; members of Council, Sir A. T. Dawson, Mr. G. Hughes, Mr. R. Matthews, Mr. D. B. Morison, Sir Gerard A. Muntz, Bart., and Mr. W. Reavell.

Fuel Research.—On the recommendation of its Advisory Council, the Committee of the Privy Council for Scientific and Industrial Research has appointed a Board of Fuel Research. Sir George Beilby will act as Director of the new organisation, and will be assisted by the Hon. Sir Charles Parsons, Mr. Richard Threlfall, and Sir Richard Redmayne, the Chief Inspector of Mines, as members of the Board. By arrangement with the Governors of the Imperial College of Science, the Lord President has retained Prof. W. A. Bone as consultant to the Board. Prof. Bone will continue to hold his chair at the Imperial College, but will abandon all private consulting work while he is connected with the Department of Scientific and Industrial Research.

Proposals for research initiated by the Coal Conservation Sub-Committee appointed in July, 1914, will stand referred to the Fuel Board, to which also will be transferred the material collected by the Fuel Committee which the British Association formed in 1915. The Admiralty and the Ministry of Munitions have also been making tests and investigations on fuel problems, and it is hoped that their work will be co-ordinated with that of the new Board.

The work of the Board will be to investigate the nature, preparation, and utilisation of fuel of all kinds, both in the laboratory and, if necessary, on an industrial scale. Sir George Beilby, with the assistance of his colleagues on the Board, will be responsible for drawing up the schemes of research, and when these have been approved by the Advisory Council and the Committee of the Privy Council, authority will be given him to carry them into effect. In this way he will have the whole weight of the Department and its finance behind him, and since he will have direct access to the Lord President, who is the responsible Minister, there will be no danger of his recommendations lying pigeon-holed among Departmental files.

Development of French Hydro-Electric Works.—The history of the industry whose object is the utilisation of the waterfalls in France represents a struggle against the inadequacy or obscurity of the Civil Code and administrative regulations, followed by a modification which has perhaps hastened the threat of more restrictive legislation. Almost all of these measures were instituted at a remote period when it was impossible to foresee the advantages which engineers would derive from the waterfalls. Nevertheless engineers finally succeeded, aided by well-informed lawyers, in accommodating themselves to situations which were the least favourable in appearance, and individual hydro-electric works have been established of a capacity of several thousands of horsepower on the mere basis of precarious authorisations capable of being revoked. In certain cases the French Administration, by simple decree, has sanctioned important diversions from navigable waterways, all of which legally form part of the public domain. The non-navigable waterways which are subject to the rights of riparian owners have been brought into service through the assistance of obliging intermediaries. In fact, the hydro-electric industry has triumphed over all obstacles and routine; it has become prosperous and is visibly developing at the present time.

The results hitherto obtained have been set forth by the work undertaken by M. de la Brosse in relation to the region comprised between the Rhone, the Alps, and the Mediterranean—the "white coal" region. Two tables have been prepared by this engineer at an interval of six years, showing the remarkable progress which has been made in this period. It is generally estimated that the total power available from the falls of the Alps amounts to 2,000,000 H.P. at low water and over 4,000,000 on the average, the latter representing about one-half of the aggregate power capable of being obtained from the French waterfalls as a whole. The first table indicates that the plant installed in the French Alps for lighting and power purposes, metallurgy, electro-chemistry and traction amounted nominally to 469,835 H.P. in 1910 and 662,545 H.P. in 1916, whilst the works in course of construction represent a further 93,100 H.P. Apart from the extensions already in hand, it is noteworthy that out of the total power installed in 1916 more than 256,000 H.P. were being utilised for electro-metallurgical work and 110,000 H.P. for electro-chemical operations. It is also worthy of note that only works of a combined capacity of 90,000 H.P. are deriving power from public waterways, whilst nine-tenths of the energy produced by works on the public waterways are utilised for the public supply of light and power. It is considered that the disinclination of manufacturers to avail themselves to a greater extent of the public watercourses is due to the fact that hydro-electric works of this kind are more expensive to construct and that the prospect of innumerable formalities with the Administration, which is lacking in resolution through the fear of being suspected of favouring private interests, is not calculated to encourage private enterprise in this direction. It is therefore suggested that legislation should be promoted to facilitate development of the waterways under the designation of public domains and of the non-navigable watercourses in so far as they are still available for that purpose.

Use Solid Wire in place of Small Stranded Cable.—The Cable Makers' Association has recently addressed a letter to the engineers of central stations, pointing out that the Government requirements in small stranded wires are at present so great as to require the use of practically every wire-drawing and stranding machine in the country. Thus the demand for such wires other than for direct military or naval needs entails considerable delay in execution of orders. Many engineers to public authorities and companies insist upon the use of stranded conductors for wires below a specified sectional area, and some prohibit the use of solid conductors entirely. If such restrictions can be *temporarily suspended during the war*, the cable makers will be enabled to put forth the full capacity of their plant for the military and naval needs, and yet meet the requirements of other customers carrying out other essential work. The Association therefore suggests that during the war

No. 18 S.W.G. be used in place of 3/22 S.W.G. or 7/25 S.W.G.,
No. 16 S.W.G. in place of 3/20 or 7/23 S.W.G.,
No. 14 S.W.G. in place of 7/22 and 7/21½ S.W.G.,

and hopes that permission will be given to contractors in each district to use solid conductors as an emergency measure.

In view of the urgent military necessity for restricting the use of small stranded conductors for the present, we feel sure that the Association may safely count upon the patriotic co-operation in this matter not only of station engineers, but also of all users of such materials. In addition to circularising the station engineers, the Association is also advertising the matter in the technical Press.

The Control of the Electric Motor Vehicle Business.—Referring to our leading article on this subject last week, we are sorry to learn that the Agents' Section, Ltd., a body that is associated with the Motor Trade Association, has resolved to follow the line advocated by the Scottish Advisory Council of the M.T.A., and to oppose the Bill which would enable central electricity supply undertakings to store, charge, inspect and repair electric vehicles, the opposition being based, it is stated, on a strong objection to any extension of municipal trading. We note, too, that Electromobiles (Leeds), Ltd., have written to the *Motor Trader* congratulating it on its outspoken leader, adding that they "hope the time is not far distant when the motor trader will take up 'electrics' enthusiastically, and will offer them to his customers for use in their proper sphere, continuing to offer petrol or steam where he thinks these types will serve his clients best. We do not agree that the development of the electric vehicle has been held up for want of charging facilities, but simply for want of knowledge. As soon as it is better known what the electric will do, sales will come readily enough, and the electricity can always be provided when the demand exists."

Linking-up Electricity Works.—The Committee for the Interconnection of Lancashire and Cheshire Electricity Supply Systems informs us that a conference of delegates representing the Municipal and Company Electricity Supply Authorities is to be held in Manchester Town Hall to-day (Friday), at 11 a.m., to consider the proposals set forth in the report of the Committee with regard to the interconnection of electricity supply systems. The conference will be presided over by Mr. G. H. Roberts, M.P., the Parliamentary Secretary to the Board of Trade, and the electricity supply authorities will be represented by about 120 delegates. The report was published in our issue of October 13th, 1916.

Memorial to the late Prof. Silvanus P. Thompson, D.Sc., F.R.S. The Council of the Finsbury Technical College Old Students' Association has appointed a small Committee to arrange for a memorial to the late Prof. Silvanus P. Thompson. Another Committee has also been formed amongst certain friends of Dr. Thompson and representatives of the scientific societies with which he was connected, to purchase the very valuable scientific library which Dr. Thompson collected. It is proposed to present the library, which is one of the best of its kind in existence, to the Institution of Electrical Engineers, to be accessible to the public on the same conditions as the Ronalds Library. The Committee of Council of the Old Students' Association hopes to raise a sum of not less than £250, and proposes to divide the subscriptions sent to it into two parts—one of these parts to be appropriated to the establishment of a suitable memorial to be placed in the City and Guilds Technical College, Finsbury, with which Dr. Thompson was so long connected, and the other to form a contribution from the Finsbury Old Students' Association to the library fund. Mr. J. E. Raworth, president of the Association, will be very pleased to receive subscriptions, which may be of any amount, and should be addressed to him at 28, Broadway, Queen Anne's Chambers, Westminster, S.W.

Prohibited Exports.—The Supplement to the *Board of Trade Journal* of March 1st contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported from Denmark, France (including Algeria), Italy, Japan, and the Netherlands. The Supplement also contains a list of articles (complete to date) which are prohibited to be exported from the United Kingdom.

Fatality.—On February 21st a labourer was killed by scalding, and another badly injured, through the bursting of a boiler tube at Derby Corporation electricity works.

Inquiries.—The makers of the McClelland lamp-locking device (Patent No. 299/09) are asked for; also makers of electric boot and knife cleaning machines.

Volunteer Notes.—First London Engineer Volunteers. Headquarters: Balderton Street, Oxford Street, W.—Orders for the week, by Lieut.-Col. C. B. Clay, V.D., Commanding:—

Monday, March 5th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30—8.

Wednesday, March 7th.—Instructional Class, 6.15. Platoon Drill, Platoon No. 1.

Thursday, March 8th.—Platoon Drill, Platoon No. 7. Ambulance Class by M.O., 6.30. Signalling Class.

Friday, March 9th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Recruits' Drill, 6.25—8.25.

Saturday, March 10th.—N.C.O.'s Class, 2.30; Company Commander Castell, "Knots and Lashings."

Sunday, March 11th.—Special work at Bombing School. Parade Clapham Junction Station (City & S.L. Tube Railway), 9.45 a.m. Uniform, haversacks, water bottles. Mid-day rations to be carried.

(By order), Macleod Yearsley, *Adjutant.*

South African Electrical Supplies.—In recent issues of the *South African Mining Journal* we read the following:—

"There has been quite a lot of buying of electrical material, more particularly cables and megohm wires, also small motors, as well as the general run of electrical fittings other than the ordinary lighting lamps, of which there are ample supplies in the town. The British Government has put a bar on the exportation of anything containing copper, and as this metal predominates in electrical materials, a sudden hurry occurred to secure stocks. The Public Works Department requisitioned for some miles of cables, also the Premier Diamond Mine came forward with substantial orders for electrical fittings, wiring, &c. The Municipalities, Mines, and Railway Department have been purchasing rather freely, as well as the Messina Copper Mine in the Northern Transvaal. Delagoa Bay and another couple of coast towns came into the market in a lesser degree. The demands created quite a lively diversion in the direction of activity amongst the electrical merchants.

"The Japanese supplies are coming forward very regularly, and so keeping up our already ample household stocks. The American goods are anything but regular of late, and the British must also be classed in the same category. The electrical jobbing work is very much on the poor side, as property owners seem very loath to spend any money whatever, except on work that cannot be postponed."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The Bingley District Council has advanced the salary of Mr. Pedley, the electrical engineer, by £25 per annum.

Mr. C. A. Frost, assistant engineer, has been appointed, at a commencing salary of £300 a year, to succeed the late Mr. Le Feuvre as borough electrical engineer at Bexhill-on Sea.

The Mexborough U.D.C. has advanced the salary of Mr. J. B. Feltham, the electrical engineer, by £50 per annum.

General.—The many friends of Mr. W. Crawford, who has been so long associated with Messrs. Belliss & Morcom, will learn with much regret that he lies seriously ill in Cardiff. For some time his friends passed a very anxious time, but the latest news is that he shows distinct improvement. There is no man in the country who has done more to establish the name of Messrs. Belliss & Morcom as a household word among engineers, whether in municipal or industrial life, and all these will join in wishing Mr. Crawford a speedy and complete recovery.

Sir Maurice Fitzmaurice, C.M.G., late chief engineer to the L.C.C., has been appointed chairman of the Committee to control canals taken over by the State.

Mr. W. H. Sisson, who for the past 10½ years has been engineer to the Kearsley Spinning Co., Ltd., Stoneclough, has been appointed engineer to the Falcon Spinning Co., Ltd., Bolton. He was formerly managing engineer of the Witney Electric Supply Co., Ltd., and foreman for Messrs. Dick, Kerr & Co., Ltd., and for the Mersey Docks and Harbour Board.

Messrs. V. Lindop and M. C. Mattinson have been appointed local directors of the River Plate Electricity Co. Mr. B. C. Wilson has been appointed manager and engineer of the La Plata station of the same company.—*Review of the River Plate.*

Mr. W. N. Y. King has been appointed assistant (civilian) inspector of munitions.

Roll of Honour.—Captain Eric Sutherland Phillips, 8th Battalion Border Regiment, of Rugby, died of wounds received in action on February 21st, aged 22 years. At the declaration of war, Captain Phillips was a pupil in the works of the British Thomson-Houston Co., Ltd., Rugby. He volunteered for service, and enlisted as a private in September, 1914. His Colonel writes:—

"He was a most excellent young officer, always willing and cheerful. During the time when he was in charge of the Machine Gun Detachment of the Battalion he did very good work. He was very plucky under fire, and a very good leader. We shall all miss a cheery, plucky comrade, and a great favourite in the Battalion."

Captain Phillips was the son of Mr. J. A. Phillips, assistant manager of the B.T.H. Co.'s supply department at Rugby.

Private J. Stamper, Northumberland Fusiliers, reported missing, was in the electrician's department of Messrs. David Brown & Sons, Ltd., gear cutters, &c., Lockwood.

Private R. Fletcher, of the Machine Gun Corps, who has been killed in action, was employed by the Lancashire Dynamo Co., Trafford Park.

Private A. Lord, of the East Lancashire Regiment, who has been killed in France, aged 39, was employed in the Bacup Corporation electricity department.

Private L. Walters, who has fallen in action before Kut, was for several years in charge of the electric light plant at Wood Norton, near Evesham.

Lance-Corporal P. B. Pettitt, of the Manchester Regiment, who is in hospital in Devonshire, suffering from wounds, was employed by the Lancashire Dynamo Co., Trafford Park.

Sapper F. C. Shenton, of the R.N. Division, has been killed at the age of 36 years. He was formerly employed as an electrician at the Hyde Road depôt of the Manchester Corporation Tramways.

The *London Gazette* for February 27th contained the following:—"London Regiment.—Second Lieutenant (Acting Major) H. C. Sparks, D.S.O., M.C., is seconded for duty as Assistant Director of Labour. January 2nd, 1917."

At a meeting of the Barrow Corporation electricity employés at the Town Hall, on Monday, occasion was taken to mark the honours won by Company Sergeant-Major R. A. Williams, who had received the Military Cross for gallantry in the field. Ald. Smith presided. The Mayor of Barrow, on behalf of the employés, presented Company Sergeant-Major Williams with a spirit tantalus and a case of carvers. His Worship said that Sergeant Williams commenced with them as a labourer in 1902, and became a jointer in 1909. He joined the Colours in September, 1914, and worked his way up to company sergeant-major, and now he was about to proceed to a cadet training school with a view to taking up a commission. He had won the Military Medal, which was a very high honour for a non-commissioned officer, by taking charge of his company after all the officers were casualties, and keeping control until ordered to retire.

Obituary.—Mr. J. R. Preece.—We regret to record the death, which occurred at Kensington on February 25th, at the age of 73 years, of Mr. John Richard Preece, C.M.G., youngest brother of the late Sir William Preece. In the year 1870, Mr. Preece went out to join the Imperial Persian Telegraphs as assistant engineer, and he resigned that office to join the Consular Service there. He afterwards became H.B.M. Consul-General at Ispahan, Persia. The deceased gentleman many years ago read a paper on the Persian telegraph system before the Society of Telegraph Engineers in London.

Ald. J. Brodie.—The funeral of the late Ald. J. Brodie took place at Blackpool Cemetery on February 22nd. The remains were borne to the grave by six inspectors and timekeepers of the tramway department. The staffs were largely represented, and in the funeral procession were three cars driven by motormen and conducted by women with crepe-banded sleeves. Wherever cars were encountered on the route they came to a halt while the cortége passed, and at Foxhall Square the staffs of the electricity works and the car men stood reverently to attention.

POWDERED COAL BOILER FURNACE.

In our issue of November 3rd last, we referred at some length to the subject of powdered coal as a fuel for boiler firing. As mentioned then, one of the difficulties has been to find a suitable form of furnace, which, while allowing of complete combustion, would at the same time withstand the very high temperatures resulting, which with ordinary construction would melt down the furnace linings.

In this connection, a letter in the December *Journal* of the American Society of Mechanical Engineers, from Mr. C. L. Heisler, of Schenectady, describes a most simple form of furnace (fig. 1) which has been in continual and regular service under a boiler at the American Locomotive Co.'s works since March, 1915. The furnace is believed to be entitled to a world's record for low cost of maintenance; the CO_2 rarely drops below 16 per cent., and is oftener above 17 per cent.

Evaporative tests show that a materially higher evaporative efficiency is obtained than from a duplicate Franklin boiler fired by mechanical stokers and supplied with feed water at the same temperature, also the powdered coal fired boiler responds much more readily to increased steam demands, and an ordinary fireman provides all the necessary attendance.

With a previous experimental furnace under the same boiler, the brickwork failed to withstand the temperature, and there were excessive accumulations of hard slag in the furnace bottom and deposits of unburned products round the tubes.

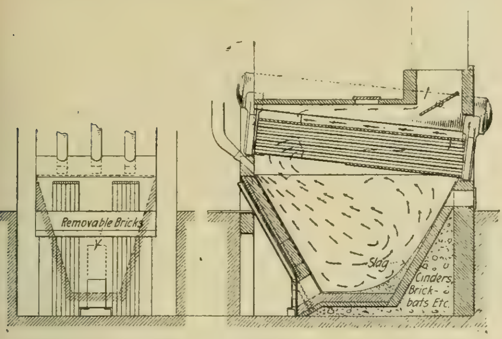


Fig. 1.—Powdered Coal Furnace at the American Locomotive Works.

Several years ago Mr. Heisler concluded that the only way to prevent the destruction of vertical walls and arches in powdered-coal furnaces was not to have them, and substitute incandescent ignition surfaces formed by simple outwardly inclined walls which would be automatically maintained by a coating of protecting slag. The furnace now in use has been in continual service for 18 months without a single repair expense on the hopper-shaped furnace walls. These walls are coated with about 1 in. to 3 in. thickness of slag, and are seemingly in as good condition as at the time they were built. The fire pit openings are covered by temporary iron plates.

The three original inlet tuyeres are yet in service, and apparently may be in service for another year; they consist of three ordinary wrought-steel pipe nipples, 10 in. in diameter and 24 in. long, which, when originally installed, protruded downwardly a few inches into the furnace. After a short time the inner ends burned away and gave them their present form.

Powdered coal is fed by a screw feeder from a hopper into the air blast at a point about 3 ft. away from the furnace tuyeres. This distance may be very much more, but not less, for the purpose of thoroughly mixing the coal with a properly proportioned air blast that passes downwardly through the tuyeres at a pressure of ½ to 1½ oz.

A plurality of tuyeres and feeders is essential to good combustion, so as to reduce the effects of imperfect feeding of any one feeder or of flooding through a feeder from slips in the coal hopper. No particular form of feeder is necessary for successful operation. Fig. 2 shows a feeder set with eight outlets.

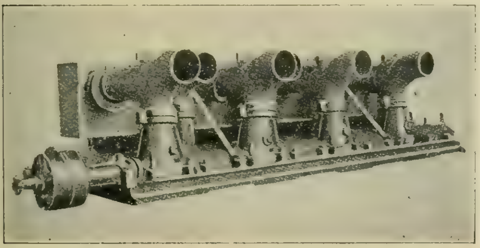


Fig. 2.—Powdered Coal Feeder Set.

There is a very slight air inlet suction at the slag hole in the base of the furnace. In the furnace near the boiler the pressure is equal to atmospheric. If the gas passes the pressure is slightly less than atmospheric, an amount depending upon the resistance of friction to a flow of the gases into the uptake.

The lower row of water tubes was shielded by tiles for the purpose of giving sufficient heat-reflecting surface to maintain the desired furnace temperature for the working capacity of the boiler. The best results were obtained when approximately the lower back half of the water tubes was shielded as illustrated in fig. 1. This shielding prevents all tendency to lift and deposit unconsumed fuel in the passes, which, therefore, do not require more cleaning than the passes in the adjoining mechanical stoker-fed boilers. No trouble whatever is experienced from coke or cinder-clogged water tubes; this is largely due to the hopper-shaped furnace, wherein all the downwardly jetted fuel and air from the three tuyeres is thoroughly blended and ignited in the confined space between the inclined and incandescent walls at the bottom of the furnace. Thereafter the resulting gases are permitted to freely expand as they slowly rise upward into the enlarged space under the boiler, in a manner which gives the flames a slow rolling movement from the bottom rearward, upwards, then forward to meet the front end of the boiler, through the full length of a 30-ft. path, before coming in contact with heat absorbing surfaces.

NEW COMPANIES REGISTERED.

British Electron Co., Ltd. (146,067).—Private company. This company was registered on February 19th, with a capital of £3,000 in £1 shares, to carry on the business of importers and exporters of and dealers in metals, metal scrap and ores, chemical manufacturers, metallurgists, detinners, tinplate makers, &c. The subscribers (each with one share) are: H. D. Ashworth, Old Dalby, Ellesmere Road, Eccles, metal refiner; A. Keating, 31, Stockport Road, Ardwick, Manchester, metal refiner; C. R. Adams, 127, Queen's Road, Cheetham, Manchester, metal refiner. The first directors are H. D. Ashworth, A. Keating, and C. R. Adams. Solicitors: Vaudrey & Co., 30, St. Anne's Street, Manchester.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

James Keith & Blackman Co., Ltd.—A memorandum of satisfaction in full on January 11th, 1917, of debentures dated August 13th, 1914, securing £500 has been filed.

Electrical Installations, Ltd.—A memorandum of satisfaction to the extent of £100, on January 26th, 1917, of debentures dated December 5th, 1906, securing £2,000, has been filed.

International Electric Co., Ltd.—Mortgage on freehold property at Tottenham, dated February 8th, 1917, to secure all moneys due or to become due from company to London & South-Western Bank.

Torpoint Electric Supply Co., Ltd.—Second debenture, charged on the general assets, dated February 5th, 1917, to secure £1,089. Also issue on same date of £1,280 debentures, part of a series of which particulars have already been filed.

Llanrwst Electricity Supply Co., Ltd.—A memorandum of satisfaction in full on September 5th, 1916, of first, second, and third mortgage debentures dated 1905, securing £900, £600, and £400 respectively.

CITY NOTES.

Notting Hill Electric Lighting Co., Ltd.

Capital expenditure during 1916 was £995, and the total now exceeds the receipts by £45,320. The lamps connected increased from 238,981 to 241,859, and the profit (less income-tax) fell from £22,617 to £18,782. There are 4,400 consumers, all excepting 20 being supplied at 200 volts. Revenue from sale of current increased by £767 to £43,185. The reduction in profit is due to increased cost of fuel and labour, higher assessment for rates, and an addition of £1,871 to income tax. Kensington Council approved of the company's proposal to increase charges to consumers by ½d. per unit to compensate for these burdens, but the increase was only brought into force during the last three months of the year. From the available profit of £23,730 there are taken £3,000 for depreciation, renewal and reserve, £2,016 for debenture interest, Kensington and Notting Hill debenture stock charges £3,695, £4,525 for income-tax, £250 for the staff under the co-partnership scheme, and £10,243 remains. After paying the 6 per cent. preference dividend and 3s. per share, less tax, on the ordinary shares, £403 remains to be carried forward. Annual meeting: March 6th

Yorkshire Electric Power Co.

At the annual meeting, Mr A. G. Lupton said that the underlying principle on which the company's business was founded was the economy of fuel which could be secured by the production of electricity on a large scale. The demands upon the company were increasing rapidly in every part of its area. The development of the company in the past had resulted in many undertakings taking a bulk supply instead of building separate generating stations for themselves, and it was gratifying to find that there was a general awakening to the principles on which the power companies were established by Parliament. Last year the Bradford Corporation and the company entered into a reciprocal agreement to supply electricity.

Mr. A. H. Meysey-Thompson, who seconded, said that at last the company had arrived at the turning of a long lane, and they could now feel that they had done their share in clearing the West Riding of the pall of smoke which had so long hung overhead. He hoped that the reciprocal agreement with the Bradford Corporation was an indication of a happier spirit in the relationship between the company and the municipalities in its area.

City and South London Railway Co.

In his speech at the annual meeting, Lord Stuart of Wortley said (according to the *Times* report) that the effect of present conditions on their expenses was very serious. Fortunately, their electrical energy was now supplied from the power station at Lots Road, Chelsea, but the cost of current was necessarily based upon the price of coal, which had more than doubled since the beginning of the war, and was still rising. There had also been a deterioration in its average quality. The increased cost of living had led to demands from their men for additional bonuses. In the case of controlled railways this additional charge was borne by the Government, but in their case it must be found entirely from their own resources. They would have been unable to pay this bonus were it not for the operation of the common fund agreement. In obtaining supplies they were having considerable difficulty. The labour available was limited in amount, and necessarily less skilful than their old trained staff. While nothing had been neglected which was essential to the safe running of the trains, the standard of maintenance—as must be the case with all railways during the war—was not all they would desire under more normal conditions, and this in spite of the fact that expenditure under this heading was above the normal. A year ago he expressed regret at the necessary postponement of the projects for improving and modernising the line and rolling stock, and making what they believed would be a most valuable connection with the London Electric Railway at Camden Town to permit of through running to Hampstead and Highgate. These projects could not proceed until the return to normal conditions.

London Electric Railway Co.

Lord Farrar, at the annual meeting on February 23rd, said (according to the *Financial Times* report) that the extension nection with the L. & N.-W. Railway of the train service to Watford in con- had been delayed on account of the difficulty of obtaining the necessary joint rolling stock, but arrangements had now been made for this company temporarily to supply rolling stock on reasonable terms, and it was anticipated that the through service could be initiated about the beginning of April. The result shown by the Queen's Park extension and the through running to Willesden had, even in these abnormal times, been excellent, and the directors anticipated further improvement from the extension to Watford, although the 50 per cent. increase of fares on the main line railways ordered by the Government would undoubtedly retard the development of the traffic. Suggestions had been made from time to time that the company's fares should be increased, but the directors felt that, as this was a great public utility company, they must consider a matter of this kind from the point of view of public interest, as well as that of revenue-earning power; and, moreover, their past experience had shown that in their area the best way to secure the largest net revenue was to obtain a large volume of traffic by low rates, coupled with quick and frequent service, rather than fewer passengers at high rates. New factors, however, had entered into the problem, owing to war conditions, one of which was the falling purchasing power of money, and if the price of all the commodities the company had to buy continued to rise they felt that a readjustment of fares would be justifiable.

Metropolitan District Railway Co.

Lord George Hamilton, at the annual meeting, said that the working expenses during the year 1916 had heavily increased. The difficulty of securing labour and material for really adequate maintenance of the property had been recognised by the Government, and a special allowance was made to controlled railways to cover this deferred maintenance; but it was doubtful whether the amount, so far as this company was concerned, was sufficient, and increases of reserves against this liability were essential. It had, therefore, been recommended that a total sum of £45,000 be added to the reserves for renewals and contingencies, as against £35,000 last year. While they were under Government control any raising of their fares was, without the consent of the authorities, out of their power, even if it seemed desirable from the revenue point of view. They had always been believers in the lowest reasonable rate of fare, not only because, as a public transport company, they must always carefully consider their relations to the public, but also because they realised that in the long run they made a higher net earning for the shareholders by carrying many passengers at a low fare rather than fewer passengers at a high rate. Low fares and good service stimulated traffic, and that had hitherto been their aim. While they remained believers in the lowest "reasonable" fares, it must be remembered that the decrease in the purchasing power of money in the last two years had practically resulted in a drastic reduction of their fares. The present position, however, could not continue indefinitely, and some readjustment of fares might be necessary. This they would look upon as a reinstatement of fares rather than an increase.

Underground Electric Railways Co. of London, Ltd.

For 1916 the net income from investments, &c., after deducting general expenses, and including balance from last account, was £664,666. After paying the interest on the 4½ per cent. bonds, also the payment under the guarantee on Central London Railway Assented stocks, and the interest on the 6 per cent. first cumulative income debenture stock, there is a surplus of £436,812. The interest at the rate of 5 per cent. per annum, plus income-tax, on the 6 per cent. income bonds due 1948 absorbs £406,178, leaving £30,634. The income from investments, &c., was £653,361, a decrease of £27,380, or 4.02 per cent. for the year. The income-tax on the interest on the 4½ per cent. bonds due 1933, and on the 6 per cent. income bonds due 1948, together with loss on foreign exchange in respect of coupons encashed abroad, was £134,015, an increase of £56,805, or 73.57 per cent. The aggregate gross revenue of the five companies parties to the Common Fund was £6,038,529; the aggregate retained by them for revenue liabilities, including reserves, was £5,531,562, leaving £506,968, an increase of 12.32 per cent. as compared with 1915. Sir Albert Stanley resigned the managing directorship when he became President of the Board of Trade, and Mr. W. O. Burton takes his place.

Under the provisions of the London Electric Railway Act, 1912, authority was given for the through running of trains from the Bakerloo Section of the railway to Watford on the electrified portion of the London & North-Western Railway. The North-Western Co. had arranged to provide the joint rolling stock required for the services, but its manufacture has been delayed owing to the war. In order to give the public the benefit of this new service without further delay, arrangements have been made between the two railway companies whereby the London Electric Co. will, for the present, provide the necessary trains and work the train service. It is anticipated that this through running will commence early in April.

In order to provide for a larger increase of output from the Associated Equipment Co.'s factory at Walthamstow, extensions of the premises have recently been carried out in co-operation with the Ministry of Munitions.

Para Electric Railways and Lighting Co., Ltd.

At the annual meeting, Mr. Follett Holt said that the net revenue in milreis during the year was the largest yet obtained by the company. This was due to an increase of more than 11 per cent. in the combined gross earnings of the tramways and lighting departments, and to the fact that operating expenses were only 7 per cent. higher than during 1915. The cars carried a total of over 20,000,000 passengers, or 13 per cent. more, whilst the fact that the sale of electricity for lighting and power purposes had increased by 10 per cent. showed that they had reaped some benefit from the greater commercial activity and prosperity of the city of Para. During the year a small investment had been made in the debentures of the Para Gas Co. The progress of the gas business had been slow, but not unsatisfactory, although the full benefit of the combined supply of gas and electricity would only mature after the gasworks had been thoroughly overhauled, which would require some little time. In connection with important public works executed by the Municipality to improve the thoroughfares between the city and the port, certain sections of the tramway system had been relaid and modified, and this had resulted in a better public service and greater facilities. Regarding the present situation of the rubber trade, so intimately connected with the welfare of Para, comparing the crop season ended at June 30th, 1916, with its predecessor, rubber exports from the Amazon district increased from 33,500 tons to 36,725 tons. The total production for the calendar year 1916 was 37,250 tons, as against 37,000 tons during 1915. This figure had been practically constant for the last three years. It was anticipated that the supply for the current year might be somewhat in excess of this average, owing to an abnormally low river, which had enabled rubber collection to be continued somewhat longer than usual. Prices in the London market for fine hard Para had fluctuated during the year between 4s. 1d. and 2s. 7d. per lb., with an average of 3s. 1¾d., the value at present being about 3s. 4½d. per lb. Business generally at Para was distinctly brisk, and the country people were prosperous.

City of London Electric Lighting Co., Ltd.—Subject to audit, the directors have decided to provide in full for allowances to employés on service and war bonuses to staff and employés, to place £40,000 to reserve, and to pay 12s. per share (6 per cent. per annum) on the preference shares, and 16s. per share (8 per cent. per annum) on the ordinary shares. On account of these dividends, 6s. per preference share and 6s per ordinary share was paid in September, 1916. After payment of the dividends, less income-tax, and providing for other appropriations, about £17,000 remains to carry forward.

Liverpool Overhead Railway Co.—For 1916 the gross revenue receipts were £107,850, and the working expenses, including reserve, were £77,794. The total passengers carried were 16,674,643, as against 15,082,502 in 1915. The concern continues to operate under the agreement with the Government. After deducting debenture interest, adding the balance brought forward, and paying 5 per cent. on both classes of preference shares, a final distribution at the rate of 4 per cent. per annum on the ordinary shares is to be made, making 3¼ per cent. for the year, leaving £6,801 to be carried forward.

Arizona Copper Co.—This company is paying a dividend of 80 per cent., free of income-tax (equivalent to 100 per cent.), for 1916.

Castner-Kellner Alkali Co., Ltd.—Dividend for 1916, 22 per cent.; £50,000 to depreciation; £39,404 carried forward.

Pennsylvania Water & Power Co.—Dividend, 1¼ per cent. for the quarter to March 31st.

Fife Tramway, Light & Power Co.—Presiding at the annual meeting, Mr. W. Low said that the tramways showed some improvement. Pending receipt of the Treasury consent, the company could not make any arrangements for dealing with the construction of the Rosyth lines. Power and lighting progress had been quite satisfactory, for, although net revenue had been affected by increasing costs, a larger revenue had been obtained. The increased revenue was entirely due to the capital expenditure of past years producing additional business. The total revenue received from the power and lighting undertakings as dividends, fees, &c., amounted to £14,671, against £13,567 for the previous year. The real improvement in the combined undertakings was better than shown by the figures, as they had been able to leave a sum of upwards of £2,000 out of profits in the coffers of the power and tramways companies available for contingencies, so that the improvement over the previous year in the power and lighting properties was upwards of £4,400.

Traction & Power Securities Co., Ltd.—Net revenue for 1916, after deducting expenses, £26,211, plus £8,578 brought forward. The directors recommend a dividend of 6s. per share, free of tax, absorbing £25,623, and leaving £9,167 to be carried forward. Investments in the Mersey Railway Co. and the Clyde Valley Electrical Power Co. remain unchanged. The position of the Clyde Valley Power Co. continues to improve. According to a valuation furnished by Glasgow brokers, the holdings in both preference and ordinary shares are worth their book cost. In October last this company declared a first dividend upon its ordinary shares. In view of the Government measures with the object of maintaining foreign exchanges, almost the whole of the company's American investments have been realised.—*Financial Times*.

Compania de Electricidad de la Provincia de Buenos Aires.—The gross receipts for the year ended July 31st last from the supply of light and power were £189,883, against £177,888 for the preceding year, an increase of 6.73 per cent. The total receipts from all sources, £192,239, show an increase of 7.50 per cent. The increase on the total operating expense is only 10.07 per cent. The resulting net profit from operation is £62,728, against £61,160 for the preceding year. The directors have placed the whole of the available balance of £11,639 to the reserve for depreciation and doubtful debts. The results do not permit the payment of a preference dividend.—*Times*.

Oxford Electric Co., Ltd.—The profit for 1916 was £11,682, plus £968 brought forward. Debenture interest absorbs £2,000; there is written off on account of hire-purchase installations £639, 5 per cent. is paid on the preference capital, and 5 per cent., less income-tax, on the ordinary, £649 being placed to the credit of reserve and renewals, leaving £645 to be carried forward. Reserve and renewal of plant account has been charged with the cost of plant replaced. War-time conditions have further decreased the demand for light, and the heavy cost of fuel, &c., has also adversely affected the revenue. Several extensions of mains have been carried out.

British L. M. Ericsson Manufacturing Co., Ltd.—The profit for 1916 constitutes a record, and the prospects for 1917 are excellent. The net profit, after charging £13,963 for depreciation, £6,580 for income-tax, and £2,500 for debenture interest, is £47,146, plus £6,616 brought forward. The preference dividend absorbs £5,999; 8 per cent. on the ordinary shares (free of income-tax) requires £8,001; there is placed to reserve £9,000, and to reserve for extra depreciation £5,000, leaving £25,761 to carry forward, subject to Munitions Levy and Excess Profit Duty.

Telegraph Construction & Maintenance Co., Ltd.—Net profit for 1916, £111,915, after charging interest on the debentures; £110,474 brought forward, making £222,389. Interim dividend of 5 per cent. already paid. A further dividend of 10 per cent., together with a bonus of 12s. per share, free of tax, now to be paid, and there is to be put to supplement the reserve fund £20,000, leaving £112,749 to be carried forward.

County of London Electric Supply Co., Ltd.—After paying the preference dividend (6 per cent.), a final dividend at the rate of 9 per cent. per annum, less income-tax, is recommended on the ordinary shares, making 7 per cent. for the year. £45,000 is put to reserve for depreciation, and £18,000 carried forward.

Yorkshire (West Riding) Electric Tramways Co., Ltd.—According to the *Times*, the directors are preparing an amended scheme, after considering the points discussed at the recent meeting.

Electro Bleach and By-Products, Ltd.—Further interim dividends on account of the year 1916 of 3½ per cent., less tax, on the preference shares, and of 7 per cent., less tax, on the ordinary shares.

W. T. Henley's Telegraph Works Co., Ltd.—Warrants for the dividend on the preference shares were posted on February 28th.

Mirrlees Watson Co., Ltd.—A financial contemporary says that the dividend for 1916 is 10 per cent., less tax, as against 5 per cent. for 1915.

Brazilian Traction, Light & Power Co., Ltd.—Quarterly dividend 1½ per cent. on the cumulative preference shares.

Blackpool & Fleetwood Tramroad Co.—At the annual meeting, Mr. John Greenwood said that during the year the company had carried nearly 300,000 more passengers. With regard to the cliff encroachments adjoining the tramroad, it could only be said that the negotiations had not yet reached a stage which enable the board to make any report to the shareholders.

Kensington & Knightsbridge Electric Lighting Co., Ltd.—Dividend, 3½ per cent. on the ordinary shares for the last half-year, making with the interim dividend 6 per cent. for the year.

Stock Exchange Notice.—Application has been made to the Committee to appoint a Special Settling Day in—

Marconi International Marine Communication Co., Ltd.—Further issue of 43,916 shares of £1 each, fully paid, Nos. 306,085 to 350,000.

Newcastle-upon-Tyne Electric Supply Co., Ltd.—Subject to audit, the directors recommend a final dividend of 4½ per cent. on the ordinary shares, making, with the interim dividend of 2½ per cent., 7 per cent. for the year.

Halifax & Bermudas Cable Co., Ltd.—Interim dividend, 6 per cent. per annum, free of income-tax, on ordinary shares for the past half-year.

Direct West India Cable Co., Ltd.—Interim dividend, 6 per cent. per annum, free of income-tax, on ordinary shares for the past half-year.

City of Carlisle Electric Tramways Co., Ltd.—After paying debenture interest and putting £2,000 to redemption of second debentures, £775 remains to carry forward.

STOCKS AND SHARES.

Tuesday Evening.

The very success of the War Loan has tended to exercise a slightly depressing effect upon markets of the investment order. It is difficult to find words in which adequately to describe the result of the Loan, but the figures themselves are sufficient to do away with the necessity for any exaggeration or picturesqueness. There was, let it be confessed now, just a shade of disappointment in the City when the earlier result of 800 millions was announced; but for the total to have passed the £1,000,000,000 mark is regarded as a triumph, while the news of the fine advance of the British on the Ancre forms a fitting complement to the financial operations at home.

Nevertheless, as already pointed out, other markets are dull, and must perforce be so, because of the withdrawal of so much capital from the ordinary investment channels. The effect of the War Loan is likely to be felt for some weeks, and, meanwhile, the purely investment stocks lie under a cloud of quietude, for the simple reason that people have not got the money wherewith to buy them—to buy them, that is to say, in sufficient amounts to compensate the ordinary stream of selling which is common to all times.

Most of the London electric lighting companies have now declared their dividends, and the results are certainly good. No change has taken place in the declarations of the City of London, County, St. James', South Metropolitan, or Westminster Companies. The Kensington & Knightsbridge, paying 6 per cent., shows a reduction of 1 per cent. on the year; and the dividend on Notting Hill ordinary shares is reduced from 5s. to 3s. Considering, however, that the Notting Hill shares are held privately, that they are of the nominal value of 1s. each, and that they stand at something like £2 in the market, it cannot be said that the Notting Hill is a factor in the situation.

The disappointment this half-year has been with the results of the London Electric Supply Corporation, where the reduction of the preference dividend came as a sharp shock. Several other announcements are due this week, but the market, in the light of those made so far, which we have quoted, professes itself to be fully satisfied with the announcements already published. The Daylight Saving Bill will hold less terror for the illumination companies than it did a year ago, and is not at all likely to lead to any particular selling. On the week, County of London ordinary are better at 10⅛, City Preferences are ⅛ up, and so are Westminsters. London Electrics naturally continue depressed, and in other shares no recordable changes have occurred.

Brazilian Tractions have fallen back 2 to 46½, this being due to the flatness which overtook most things connected with Brazil upon Mr. Lloyd George's statement that imports of coffee from foreign countries were to be prohibited. The bonds of the various tramway companies are not much affected, the limited character of the market saving them from any particular fall. But most other stocks and shares connected with the country are easier.

The Argentine group is heavy; and so far as Mexicans are concerned, nothing fresh has transpired in the way of news to give any stimulus to the various industrial issues. Mexican things generally, in fact, are flat; and the question remains unanswered as to why America is unable to control the handful of turbulent folk who live across the Mexican frontier.

It is of academic interest to holders of electric lighting shares to notice that the Welsbach Incandescent Co. has formulated a scheme whereby a re-arrangement of capital has been sanctioned by the Treasury; and the company is now offering to its shareholders further shares of £1 each at par, with a commission of 9s. per share to subscribers—which, in other words, means that the £1 shares will produce 11s. for the benefit of the company.

The speculation in Marconis has come to something of an abrupt stop, and, in consequence, the parent shares have fallen back 3/16, which brought about a slight reaction in the quotations for the subsidiaries also. The telegraph market as a whole is quiet. Great Northerns rose 10s., while Eastern ordinary lost a similar amount. Oriental Telephones are good, with a further rise of 1/16 at 2⅛.

Of the manufacturing shares, Henleys are a little lower at 15, but the preference at 4 ex dividend have recovered the amount of the deduction. India-Rubbers fell ¼. British Insulated ordinary had a sharp rise of 12s. 6d. to 12½. Recent buyers have found a growing scarcity of shares; and as soon as the very small handful on offer in the market had been disposed of, the effect of the demand became apparent. Other industrials are quiet, without commanding much business, but most of those connected with the electrical industry maintain their prices. One of the present features is a strong market in shares of rubber companies which confine themselves to the production of rubber. Those engaged in the coffee business, in addition to rubber, are being put down because of the restriction of the imports of foreign coffee, but the remainder of the list is exceedingly firm, enjoying also a good deal of business.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1914.	Dividend 1915.	Price Feb. 27, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary ..	5	5	8¾	—	7 8 2
do. do. do. 4½ Pref..	4½	4½	8 9/16 xd	—	7 1 2
Chelsea	5	4	3	—	6 18 4
City of London	9	8	11	—	7 5 5
do. do. 6 per cent. Pref.	6	6	9⅞	+ ⅛	6 1 6
County of London	7	7	10⅛	—	6 18 3
do. 6 per cent. Pref.	6	6	9⅝	+ ⅛	6 6 4
Kensington Ordinary	9	7	5⅜	—	5 11 7
London Electric	4	8	1	—	Nil
do. do. 6 per cent. Pref.	6	6	8¾ xd	+1/-	5 6 8
Metropolitan	8½	8	2¼	—	6 13 4
do. 4½ per cent. Pref.	4½	4½	8⅛	—	7 4 0
St. James' and Pall Mall ..	10	8	6	—	6 13 4
South London	5	5	2⅞	—	6 19 0
South Metropolitan Pref. ..	7	7	1 3/32	—	6 7 8
Westminster Ordinary	9	7	6¾	+ ⅛	6 1 9
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	94	—	6 7 8
do. Def.	80/-	83/6	22	—	6 16 4
Chile Telephone	8	8	6 15/16	—	5 15 3
Cuba Sub. Ord.	5	5	8¼	—	6 8 6
Eastern Extension	7	8	13¾	—	*5 16 4
Eastern Tel. Ord.	7	8	186½	— ½	*5 17 4
Globe Tel. and T. Ord.	6	7	11½	—	*5 19 2
do. Pref. ..	6	6	9¾	—	6 3 1
Great Northern Tel.	22	22	34½	+ ½	6 7 5
Indo-European	13	13	46½	—	6 19 9
Marconi	10	10	2 13/16	— 3/16	8 11 2
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord. ..	10	10	2⅛	+ 1/16	4 14 1
United R. Plate Tel.	8	8	6⅝	—	*6 5 6
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13¾	—	*5 16 4
Home Rails.					
Central London, Ord. Assented	4	4	60½ xd	—	6 8 0
Metropolitan	1½	1	26	—1	4 7 0
do. District	Nil	Nil	15	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	— ⅛	Nil
do. do. "A" ..	Nil	Nil	5,6	—	Nil
do. do. Income	6	6	85	—	*5 17 8
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4 15/16	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	2⅞	— 1/16	9 11 4
do. 2nd Pref. ..	5½	5½	2⅝	— ⅛	—
do. 5 Deb. ..	5	5	64½	—	7 15 0
Brazil Tractions	4	4	46½	—2	8 12 0
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	61	—	8 4 0
do. do. Preferred	—	Nil	43	—	Nil
do. do. Deferred	—	Nil	37½	—	Nil
do. do. Deb.	4½	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	25	—	Nil
do. 6 per cent. Bonds	—	Nil	22½	—	Nil
Mexican Light Common ..	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	14½	—	Nil
do. 1st Bonds ..	Nil	Nil	27½	—	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	2¾	—	5 9 1
British Aluminium Ord. ..	5	7	28/-	—	5 7 2
British Insulated Ord.	15	17½	12½	+ ⅝	7 0 0
British Westinghouse Pref. ..	7½	7½	2 9/32	—	6 11 3
Callenders	15	20	12¼	—	8 4 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	8⅜	—	6 10 3
Edison & Swan, £3 paid ..	Nil	—	½	—	Nil
do. do. fully paid ..	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	61½	—	6 10 1
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9¼	—	6 9 9
do. Ord.	10	10	13¾	—	7 5 6
Henley	20	25	15	— ¼	8 6 8
do. 4½ Pref.	4½	4½	4 xd	+ ⅛	5 12 6
India-Rubber	10	10	11½	— ¼	*8 13 10
Telegraph Con.	20	20	87	—	*6 15 2

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, February 28th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Oxalic	per lb.	1/6	..
a	Ammoniac Sal	per ton	£75	..
a	Ammonia, Muriate (large crystal)	,,	£54	..
a	Bisulphide of Carbon	,,	£28	..
a	Borax	,,	£34	..
a	Copper Sulphate	,,	£63	£3 dec.
a	Potash, Chlorate	per lb.	2/6	..
a	,, Perchlorate	,,	2/-	..
a	Shellac	per cwt.	170/-	14/- inc.
a	Sulphate of Magnesia	per ton	£16	..
a	Sulphur, Sublimed Flowers ..	,,	£30	£5 inc.
a	,, Lump	,,	£23	£4 inc.
a	Soda, Chlorate	per lb.	1/-	..
a	,, Crystals	per ton	120/-	..
a	Sodium Bichromate, casks ..	per lb.	..	..
	METALS, &c.			
c	Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c	,, Tubes (solid drawn) ..	,,	..	..
c	,, Wire, basis	,,	..	..
c	Copper Tubes (solid drawn) ..	,,	1/8¾ to 1/9¼	½d. to ⅝d. in.
g	,, Bars (best selected) ..	per ton	£174	£4 inc.
g	,, Sheet	,,	£174	£4 inc.
g	,, Rod	,,	£174	£4 inc.
d	,, (Electrolytic) Bars ..	,,	£151	£4 inc.
d	,, ,, Sheets ..	,,	£176	£4 inc.
d	,, ,, Wire Rods	,,	£159	£4 inc.
d	,, ,, H.C. Wire	per lb.	1/7	⅛d. inc.
f	Ebonite Rod	,,	3/-	..
f	,, Sheet	,,	2/6	..
n	German Silver Wire	,,	2/3	..
h	Gutta-percha, fine	,,	6/10	..
h	India-rubber, Para fine	,,	3/3½	1d. dec.
i	Iron Pig (Cleveland warrants) ..	per ton	Nom.	..
l	,, Wire, galv. No. 8, P.O. qual.	,,	£38	..
g	Lead, English Pig	,,	..	..
g	Mercury	per bot.	Nom.	..
e	Mica (in original cases) small ..	per lb.	6d. to 8/-	..
e	,, ,, ,, medium	,,	8/6 to 6/-	..
e	,, ,, ,, large ..	,,	7/3 to 14/- & up.	..
d	Silicium Bronze Wire	per lb.	1/10	..
r	Steel, Magnet, in bars	per ton	..	..
g	Tin, Block (English)	,,	..	..
n	,, Wire, Nos. 1 to 16	per lb.	3/-	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Scarcity of Materials in Germany.—Swiss members of the Société des Installateurs Suisses who attended the yearly meeting of the German Union of similar societies at Frankfort-on-Main, in July last, have given in the Swiss *Elektro-Industrie* an account of their impressions of the present condition of the German electrical industry. Their opinion is that, contrary to the usual view, Germany is not short of copper, as the requisition of German domestic copper utensils had produced some 300,000 to 400,000 tons of copper, sufficient to supply needs for three years of war. Furthermore, German and Serbian mines were producing, and other supplies were furnished by all the neighbouring neutral countries. Moreover, Germany required, when exporting machinery to neutral countries having copper or copper alloy constituents, an excess of 30 per cent. of copper or copper alloys in any return imports from neutral countries. The substitution of zinc or iron for copper in certain cases had also effected considerable saving of that metal. As regards aluminium, the Swiss Neuhausen works were under contract to supply the whole of their output to Germany; further, an alloy of aluminium and other metal was made use of for the building of aircraft. An antifriction alloy had also been found to replace in most cases the usual antifriction compound. Hence the Swiss delegates think Germany is able to do well without copper imports from other countries. A different aspect to this favourable estimate of German conditions is furnished by a fraud, pointed out by *La Revue Electrique*, which German manufacturers are resorting to, which consists in coating substitute metals with copper. The Geneva Chamber of Commerce recently called attention to this subject, and stated that there existed in Switzerland a whole stock of machines thus fraudulently manipulated, which must await the end of the war in order to be put into a condition to be of service. With regard to rubber the Swiss delegates admit that the scarcity is practically absolute.

Although some imaginary admissions are made as to German conditions by this Swiss report, it is to be observed that the journal which publishes them does not scruple to avow its pro-German proclivities, while the Swiss delegates themselves, as being guests of their German hosts, could not but speak in a way most agreeable to them.—*La Revue Electrique.*

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING JANUARY, 1917.

The returns of electrical exports and imports for the opening month of the year show a considerable appreciation in value in both sections as compared with the closing months of 1916. The electrical exports for the month were valued at £556,984, as compared with £405,921 in December last, the total being a very satisfactory one judged by last year.

This total was due mainly to the export of, roughly, £100,000 worth of telephonic material to France, aided by an all-round improvement in business. The cable exports increased from £70,000 in December to £96,000 in value last month, while machinery exports were similarly £10,000 to the good, and advances took place in other directions, the only appreciable falling off being in telegraphic exports.

The imports of electrical material reached £309,381 in value, as compared with £246,252 in December, the increase being traceable to the higher values of machinery entering this country, as also to increased battery imports, which together more than compensated for a considerable falling-off in telegraphic, telephonic, lamp, and cable imports.

The re-exports, at £33,557, far exceeded the December value, and indeed reach a comparatively high level.

During the month France, for obvious reasons, was our best customer, and Russia (principally) and the Scandinavian countries absorbed a high value of material from this country, while India, our Australasian Colonies, and Argentina were also prominent purchasers.

The bulk of the increased imports into this country were of American origin, although it may be worth noting that Japan's share of the business reached nearly £20,000 in value, and was, therefore, only a little inferior to that of Holland, which has for some time occupied the second place.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	7,163	14,484	479	531	114	2,505	27,489	3,849	432	1,565	6,404	9,369	74,384
Netherlands, Java and Dutch Indies ...	134	3.081	850	...	49	134	1,670	184	43	39	1,243	713	8,140
Belgian Congo...	38	...	...	77	...	...	...	...	...	...	48	23	186
France	2,836	8,433	1,242	593	11	12	22,945	12,239	552	...	103,398	948	153,209
Portugal	...	2,015	...	...	...	115	537	111	28	...	52	210	3,068
Spain, Canary Isles and Spanish N. Africa...	1,216	405	151	...	...	1,550	7,090	982	33	...	36	1,273	12,736
Switzerland, Italy and Austria-Hungary ...	645	925	...	...	...	252	1,961	...	31	...	898	5,269	9,981
Greece, Roumania, Turkey and Bulgaria ...	...	...	...	...	...	...	...	...	...	130	...	...	130
Channel Isles, Gibraltar, Malta and Cyprus...	107	...	10	46	...	163	16	70	150	...	...	8,360	8,922
U.S.A., Philippines and Cuba	1,534	...	202	...	...	114	4,527	...	...	38	315	296	7,026
Canada and Newfoundland	294	31	543	22	...	77	213	33	...	229	...	9,953	11,395
British West Indies and British Guiana ...	10	14	52	...	...	...	459	202	25	26	...	17	805
Mexico and Central America	...	157	...	...	...	...	...	...	...	...	253	38	448
Peru and Uruguay	57	9,338	150	159	...	12	115	...	136	79	4	81	10,131
Chile	164	429	314	148	...	373	2,399	110	117	16	66	82	4,218
Brazil	866	580	170	488	...	474	4,178	108	226	99	140	2,260	9,589
Argentina	1,757	3,783	4,422	1,068	...	798	3.456	870	3,711	150	3,153	4,779	27,947
Colombia, Venezuela, Ecuador and Bolivia...	186	157	3	24	...	...	502	...	...	...	267	76	1,215
Egypt, Tunis and Morocco	76	130	28	404	...	176	915	170	1,061	...	105	232	3,297
British West Africa	23	216	86	36	...	...	349	...	...	...	163	245	1,118
Rhodesia, O.R.C. and Transvaal	1,259	940	1,070	813	...	90	6.057	3,205	224	76	...	73	13,807
Cape of Good Hope	402	1,795	703	227	...	...	2.217	297	196	...	195	28	6,060
Natal	375	2,158	137	161	...	30	3,598	47	377	3	1,858	106	8,850
Zanzibar, Brit. E. Africa, Mauritius & Aden	465	424	57	421	...	...	181	261	27	50	63	201	2,150
Azores, Madeira and Portuguese Africa ...	3	159	36	...	...	47	323	47	...	...	...	400	1.015
French African Colonies and Madagascar...	...	...	...	...	...	...	232	...	...	...	...	10	242
Persia	...	...	...	...	...	...	...	...	...	...	...	...	...
China and Siam	1,301	2,233	1,473	1,061	2,117	331	5,957	180	...	...	123	1,050	15,826
Japan and Korea	3,905	...	34	13	...	411	1,342	256	419	...	...	221	6,601
India	2,178	5,570	4,260	2,510	30	2,029	25,433	2.766	4,917	111	2,001	219	52,024
Ceylon	86	231	93	64	...	65	...	...	50	...	47	...	636
Straits Settlements, Fed. Malay States and Sarawak	176	659	962	286	...	91	1,802	44	134	94	26	367	4,641
Hong Kong	957	289	633	347	...	722	2,033	304	153	3	48	...	5,489
West Australia	...	429	1,772	55	...	851	588	...	...	...	77	...	3,772
South Australia	54	57	180	128	...	...	250	420	460	37	371	132	2,089
Victoria	1,235	15,401	2,372	468	...	729	13,533	670	196	...	699	39	35,342
New South Wales	833	14,899	1,133	510	12	670	4,442	3,243	192	31	236	124	26,325
Queensland	13	...	48	45	...	...	795	...	30	...	...	...	931
Tasmania	3	...	30	35	...	...	775	...	10	...	...	...	853
New Zealand and Fiji Islands	312	6.784	2,288	264	14	352	2,425	567	5,819	...	311	3,250	22,386
Total, £	30,663	96,206	25,983	11,004	2,347	13,173	150,804	31,235	19.749	2,776	122,600	50,444	556,984

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
Russia, Norway, Sweden and Denmark ...	75	...	...	568	3,743	...	3,940	380	3.632	1,915	12		14.265
Netherlands	131	870	...	16,062	5,064	...	209	10	1,163	...	...		23,509
France	96	...	4	58	80	1,088	1,198	80	7,853	1,327	222		12,006
Switzerland	3,291	...	417	31	40	816	1,083	68	2,658	3,933	...		12,337
Italy	18	1,019	...	...	...	...	1,912	...	...	...	...		2,949
Japan	1,366	...	4,718	12,327	1.347	...	...	...	65	...	72		19,895
United States	6,255	10,172	1,962	4,420	1,717	7,163	15,613	108,251	27,118	8,936	30,419		220,026
Total, £	11,232	12,061	7,101	33,466	11,991	9,067	23,955	108,789	42,489	16,111	30.725		306,987

Additional imports.—Canada, glow lamps, £54 ; arc lamps, £75 ; meters, &c., £12 ; batteries and accumulators, £1,988 ; telephone and telegraph appliances, £265.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
Various countries, mainly as above ...	3,223	22,782	35	2,692	269	754	1,998	...	65	279	1,460		33,557

Total Exports: £556,984 **Total Re-Exports: £33,557** **Total Imports: £309,381**

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned which is not necessarily the country of origin.

SOME POINTS IN CONNECTION WITH ENGINEERING SPECIFICATIONS.

By J. SHEPHERD, M.I.E.E.

(*Paper read before the* YORKSHIRE LOCAL SECTION *of the* INSTITUTION OF ELECTRICAL ENGINEERS *at Leeds.*)

THE importance of specifications to the purchaser, the contractor, and the engineer, can hardly be overestimated, as they form the basis of contracts, and should include a concise description of the purchaser's requirements so as to enable orders to be placed in a business-like way for the plant required.

Specifications, whether long or short, should contain all salient facts necessary for the contractor to carry out his work, and should include a lucid description of the conditions under which the contract is to be completed.

Specifications for work of some magnitude usually consist of three distinct parts, namely, general conditions, detailed technical requirements, and a bill of quantities.

General Conditions.—The general conditions, which are of the nature of standing orders, are usually of a legal character. They are of great weight and importance, and are usually drafted by solicitors or town clerks. In many cases they have grown to imposing documents, and unfortunately have sometimes formed a weapon which has been used to the detriment of the industry generally, since they have resulted in orders being sent abroad where the foreign contractor, owing to his distance from this country, has escaped the results of several of the conditions.

The British Electrical and Allied Manufacturers' Association have been engaged for the last few years in framing an independent set of conditions. These favour the manufacturer's rather than the purchaser's interests, and up to the present have not received general acceptance. The Institution have drawn up and issued an independent set of conditions, and as the committee entrusted with the work comprised representatives of both manufacturers and engineers, the result has been a set of conditions which are generally equitable to both parties.

Whatever general conditions are adopted, I am strongly of the opinion that all matters in dispute should be referred to independent arbitration, provided that the progress of the work is not prejudiced thereby; that is to say, the two sides should agree as to what points are in dispute, and these can then be the subject of independent arbitration after the work is completed.

Detailed Technical Requirements.—This part of the specification is entirely the engineer's province, and in it he has clearly to define his requirements. Before he can do so he must make up his mind as to what he really does want, and, having done so, he should lay down his requirements in the simplest language, so that, if possible, a child could understand the story.

There should be no necessity in modern specifications for the threadbare phrase: "Notwithstanding any errors or omissions the work omitted shall be included as though specifically mentioned."

Bill of Quantities.—Wherever possible the work should be scheduled, and a complete list of quantities closely estimated and arranged for pricing up should be given. In this bill of quantities should be included any provisional sums for extra work or for any special apparatus which it may be desired to purchase.

Having very briefly outlined the skeleton of a specification, a few examples may now be given of various specifications drafted during the last dozen years for various classes of engineering work required for a large public body who was the purchaser. In considering these specifications the attitude of the purchaser must not be forgotten. That attitude might perhaps be defined thus:—

"The market includes a large number of willing and eager suppliers anxious for our contracts at reasonable prices; the engineer shall therefore draft a clear and concise specification free from all looseness of thought or description or errors of any character. When the tenders are received to such a specification, we can, without misgiving of any kind, accept the lowest tender, no matter from whom it may be, and in order that we may know that the prices tendered are reasonable, the engineer shall, with the tenders, and before they are opened, submit his estimate of the cost of the work."

The specifications described below have all been drafted to suit such a general condition of affairs as far as it is possible to do so, and those members who do not agree with the drafting of the specifications must bear in mind the conditions under which they were drawn up.

One essential difference between a specification for machinery of standard design and a specification for, say, civil engineering or architectural work, should at once be observed. No engineer with whom the author is acquainted is so bold as to issue working drawings of, say, a turbo-generator, high-speed engine, or water-tube boilers which he may desire to purchase. On the other hand, nearly all civil engineering and architectural work is the design, and is carried out to the detailed drawing, of the civil engineer or architect. But even in this branch of the profession the old order is changing with newer methods of construction, such as structural steel work, reinforced concrete, &c., which require certain of the designs to be left to the specialists who handle this type of construction, and there is but little doubt that in the future the change will become more pronounced.

The engineer has the choice of two methods of specifying. These are:—

1. Issuing detailed drawings of his requirements and accepting the responsibility of the design, leaving the contractor to be responsible for the material and workmanship.
2. Defining the conditions and results to be obtained, leaving the contractor to meet the requirements with his standard products if and when they are suitable.

If the engineer specifies the conditions and the results required, and leaves the manufacturer to offer his standard designs, the results will generally be satisfactory if the engineer is allowed to select as his contractors a firm of known excellence and of ripe experience. Unfortunately, however, the tender of such a firm is seldom the lowest, and the premises were that the lowest tender should be accepted.

Again, the manufacturer has not always extensive experience of the running of his own plant, or the opportunity of rectifying the weak features of a design, which use alone will discover. Also, it is not uncommon for some manufacturers to perceive with difficulty any defects in their products. The defects, when investigated, not infrequently are found to be due to an inexperienced draughtsman or to drawing-office instructions not reaching the shops in a clear form, or poor workmanship.

The following are the salient features of a number of recent specifications:—

COAL.

In a large generating station having a good load factor, efficient turbine units, good superheat and condensing conditions, and coal at normal prices, the generating costs per unit may be taken to be as follows:—

Salaries and wages	0.030d.
Coal and ashes	0.160d.
Oil, waste, and stores	0.004d.
Repairs to plant and buildings	0.012d.
Total	0.206d.

Coal and ashes thus represent 78 per cent. of the total, *i.e.*, out of every sovereign spent in the station 15s. 6d. is required for the supply of coal and the removal of ashes, excluding for the moment questions of capital charges. With the present high prices of coal the proportion is now even higher.

With such high costs the desirability of buying coal cheaply is apparent. A buyer with free power to purchase in the open market, and with plenty of storage capacity for the coal when purchased, will probably buy most cheaply by picking up "spot lots" where available, and especially at or near a port, but, of course, such conditions do not apply to present times.

When buying by contract, some form of scientific specification is necessary where locality and circumstances allow a free market, and the specification described below is framed with a view to buying coal in this manner. As over 1,000,000 tons have been purchased in this way, it may be said to have proved itself useful by the only true test, namely, experience.

Roughly, the specification may be said to contain and set out—

Quantity required, viz., 165,000 tons per annum.

Minimum quality to be accepted, viz.:—

Calorific value not less than 11,000 B.TH.U.

Moisture must not exceed 14 per cent. for washed nuts, or 9 per cent. for unwashed nuts.

Small coal must not exceed 30 per cent.

Ash must not exceed 15 per cent.

Delivery by steamer, and the berthing conditions are also set out.

Methods of sampling are given in detail, but in later specifications the final sampling was done by a motor-driven crusher and sampler.

Methods of testing are then specified, namely:—

(*a*) For small coal, through a sieve with a mesh $\frac{3}{8}$ in. square.

(*b*) Calorific value by Mahler bomb calorimeter.

(*c*) Moisture after drying at a temperature of from 104 deg. to 111 deg. C.

(*d*) Ash determined by ignition at a low red heat.

When tendering, the contractors are requested to state both the price and the values offered of the following particulars:—

(A) Calorific value in British thermal units.
(C) Moisture in percentage by weight.
(E) Small coal percentage by weight.
(G) Ash percentage by weight.

These values must not be inferior to the minimum values allowed, as already described.

The specification provided for the adjustment of the price paid for any particular cargo in accordance with the values actually obtained for that cargo, the adjustment being made as set out below.

"Should the quality of the coal in any cargo, as ascertained by samples tested, be found different, as regards calorific value, moisture, small, or ash from the values offered in the schedule, the prices or sums payable as aforesaid shall be varied in the manner following, viz.:—

"(*a*) If the calorific value be greater than the number of British thermal units per lb. offered in the schedule, the price per ton shall be increased in the same percentage ratio as the increase in the calorific value.

"(*b*) If the calorific value be less than the number of British thermal units per lb. offered in the schedule, the price per ton shall be decreased in the same percentage ratio as the decrease in the calorific value. Provided always that the Council shall have the right to reject the whole cargo if the calorific value be less than 11,000 British thermal units per lb.

"(*c*) If the moisture be less by weight than the figure offered in the schedule, the weight of the coal to be paid for shall be increased beyond the quantity actually weighed out by a percentage equal to the percentage decrease of moisture.

"(*d*) If the moisture exceed by weight the figure offered in the schedule, the weight of the coal to be paid for shall be decreased below the quantity actually weighed out by a percentage equal to the percentage increase of moisture. Provided always that the Council shall have the right to reject the whole cargo if the moisture exceed 14 per cent. by weight for washed nuts or 9 per cent. by weight for unwashed nuts.

"(*e*) If the proportion of small coal in either singles or doubles be less by weight than the figure offered in the schedule when determined in the manner set out in Clause No. 10 of this specification, the weight of the coal to be paid for shall be increased beyond the quantity actually weighed out by a percentage equal to one quarter of the percentage decrease of small coal.

"(*f*) If the proportion of small coal in either singles or doubles exceeds by weight the figures offered in the schedule, when determined in the manner set out in Clause 10 of this specification, the weight of the coal to be paid for shall be decreased below the quantity actually weighed out by a percentage equal to one quarter of the percentage increase of small coal. Provided always that the Council shall have the right to reject the whole cargo, if the proportion of small coal exceeds 30 per cent. by weight.

"(*g*) If the percentage of ash when determined in the manner set out in Clause No. 10 of this specification be less than the figure offered in the schedule, the net rate per ton of coal shall be increased by 1d. for every 1 per cent. reduction in ash.

"(*h*) If the percentage of ash when determined in the manner set out in Clause No. 10 of this Specification be more than the figure offered in the schedule, the net rate per ton of coal shall be reduced by 1d. for every 1 per cent. increase in ash. Provided always that the Council shall have the right to reject the whole cargo if the proportion of ash exceeds 15 per cent."

The adjustment may appear somewhat cumbrous, but in practice is not found to be so, and an actual copy of an invoice worked out in detail is set out below.

Cargo of Scotch Nuts.

Weighed on delivery, 1,447 tons 10 cwt.

	Values determined by analysis.	Values offered in tender.	Difference.
Small	14·70 %	20%	+ 5·3
Moisture	13·45 %	9%	− 4·45
Cal. Val.,	13,070 B.TH.U.	12,500	+ 579 = 4·56%
Ash	8·53 %	10%	+ 1·47%

Basis price for quality tendered, 15s. 10d. per ton.

	T.	cwt.	qr.	£	s.	d.
Coal as weighed...	1,447	10	0			
Deduct for 4·45 % moisure	64	8	1			
	1,383	1	3			
Add for small ¼ (5·3) = 1·325 %	19	3	2			
	1,402	5	1 at 15s. 10d. =	1,110	2	6
Add for calorific value, 4·56 %				50	12	5
Add for ash, 1·47d. per ton				8	17	4
				£1,169	12	3
Note price at net rate of 15s. 10d., *i.e.*, 1,447 tons 10 cwt. at 15s. 10d. would have been				£1,145	18	9
Bonus on the cargo				£23	13	6

The reasons for the adjustments of prices are fairly obvious. The price varies directly as the calorific value, and inversely as the percentage of moisture. As regards small coal, for each 4 per cent. increase, the rate is diminished 1 per cent.

The ash is indirectly allowed for by diminished calorific value, but a further penalty of 1d. per ton for each 1 per cent. increase over the standard figure is deducted to cover the cost of conveying the ashes away by barges.

As the coal tendered by different contractors may, and usually does, vary in value, the rates per ton offered cannot be directly compared without adjustment to a common basis of "standard coal" which, for the purpose of comparing tenders, was taken at:—

Small 20 per cent.
Calorific value 12,500 B.TH.U.
Moisture 9 per cent.
Ash 10 per cent.

After the comparison had been made and the tenders awarded, all further adjustments for payment were made in a similar manner to the example already given.

The volume of business dealt with by specifications of the character described was 100,000 tons in 1906, increasing year by year to 160,000 tons in 1915. This necessitated the removal from the boiler house of from 10,000 tons to 16,000 tons of ashes per annum.

The coal usually purchased under these specifications was Scotch washed nuts, shipped from various ports on the Firth of Forth, and Yorkshire washed nuts, shipped from Goole. The Yorkshire coal has the higher calorific value, but when burnt under water-tube boilers it was found to be more destructive of the brickwork settings, a factor which the specification does not, of course, allow for.

If the recovery of by-products becomes practicable in a power station, modifications in the specification for coal will no doubt become necessary to suit the nitrogen contents of the fuel.

In passing, it might be remarked that a specification for fuel is somewhat unique, having nothing quite analogous in the ordinary run of civil engineering or architectural practice.

The specifications have enabled purchases to be made in the open market for the past 10 years without giving rise to a single dispute as to the value of the coal determined on delivery, and for which the price was adjusted on the determination.

(*To be concluded.*)

Discussion.

Mr. Selbey said one of the things people ought to be on their guard against was making the specification too elaborate. He had come to take the view that the safest way for a man to buy, who was not acquainted in great detail with what he wanted, was not to attempt the elaborate kind of specification which Mr. Shepherd had dealt with, but to specify for the supply of apparatus necessary to produce a certain result, and if it was made clear that that result was to be got, and the contractor accepted that obligation, the buyer's rights in common law would be just as good as any detailed specification could give him. His experience was that causes of trouble were almost entirely what was known as case law, depending upon previous decisions, and there was a better chance on the concrete issue whether the contractor had really supplied apparatus which would fulfil the purpose desired than when he had supplied the apparatus to a detailed specification.

Mr. Woodhouse said he felt that conditions of contract drawn up by manufacturers favoured manufacturers rather than the interests of the purchasers, and he was afraid some of these conditions were obviously unjust. The present was scarcely the time to talk much about the matter. To-day the purchaser was very glad to get practically what was offered to him, but he hoped that when the war was over there would be a better feeling between the purchaser and the manufacturer, and that they would all be able to agree upon some standard conditions, or, at any rate, upon some broad conditions. Those which the Institution had printed were a considerable improvement on the previous conditions, but they might be still further improved. What was wanted was some reasonable compromise between the two extremes of the purchaser's point of view and the manufacturer's. An important point about specifications was the necessity of putting on record all essentials. That was the first object. Nowadays there were a number of details for which there were standard specifications, and if these were proper and applicable they should be embodied, and in that case the particular specification in question would only deal with modifications of the standard. There was a third class of data which one often liked to get into a specification, and that was a record of the practice to be adopted in regard to the building of the machine. The purchaser desired to bind the maker of the machine to adopt a particular method of construction, because it was very valuable for the person who had to operate the machinery afterwards to know just how certain things had been done. In building work, there was often a question in regard to the specialists' work, whether the man's contractor was the builder or the specialist, or whether the purchaser was to make two contracts, one for the specialist and one for the builder. In the case of reinforced concrete work, at the present time the specialist in reinforcement was also a merchant of steel. Would they, therefore, make him the principal contractor and the builder the sub-contractor? If so, that had obvious disadvantages. On the other hand, if they made the builder the principal contractor, the specialist might find that he was put in rather a difficult position. With regard to coal specifications, he was not a believer in calorific value. The figures of moisture and ash and small coal were all excellent, but he thought that in practice one found that whatever figure one got in the calorimeter it did not indicate fully the value of the coal to the user. In the case of a coal which was very dirty with, say, 50 per cent. of ash—on the ordinary mechanical stoker the coal would be unburnable, so that the value of the coal depended on the amount which was combustible, and as the ash increased the value of the coal decreased still more rapidly. The question of coal was very complex, and they wanted to know a great deal more about it. Though the existence of a certain amount of water in coal when it had been fired was in many cases extremely valuable, they did not want to buy water at coal prices. Some very interesting results had been published of the mixing of lime with coal to get more heat out of it, and he thought there was something in that.

Mr. Campion asked as to the practice with regard to the penalty clause, observing that when he was seeking to apply it he was told that it was never done. He wished to know how many coal merchants were found willing to tender to the coal specification. He agreed with the author that the Yorkshire coal destroyed the brickwork a good deal.

Mr. Jewell said that in working under such specifications as the author had described there must be a great advantage in having a full bill of quantities, especially in regard to the settling up afterwards. Congratulating the author upon the results of his work in connection with the electrification of the L.C.C. tramways, he expressed his particular satisfaction that only £1,500 had been spent abroad, and said this set a great example to other corporations.

Mr. Lang said his idea of the real purpose of a specification was that in the first place it was intended to enable them to avoid litigation, and in the second place to provide the seller with a guide as to what he would be called upon to do. He doubted very much whether these purposes were being served by the specifications of to-day. He thought it would be well if the engineering profession would take a leaf from the book of Lloyds, who would draw up on half a sheet of notepaper a specification for insuring property to almost any amount against fire.

Mr. Shepherd, in reply, said with regard to the point raised by Mr. Woodhouse as to what was a model specification, he once asked that question of a very experienced gentleman, who said that, from the point of view of the purchaser, the best specification he had ever seen was written on the back of an old envelope, and said, "Wanted, a steamer for the Derry trade." The effect of that, said his friend, was that if the hinges on the doors were not right, or the colour of the paint was not what he had expected it to be, he could hold that the steamer was not what he had wanted, and was not suitable for the Derry trade. He had not declared that the specifications that he had put before them were the ideal, but only that they were specifications that one had had to work under for a number of years because the tenders were always advertised for, and the lowest tender always had to be accepted. He could not confine the competition to a few well-known firms, as Mr. Lang suggested, but had, in one case, actually to accept a tender from a firm absolutely unknown, and which had never done any work of such magnitude as that for which it had tendered. The tender of that firm was for less than half the highest price of the others, and yet the work was done right. With regard to the arguments about the calorific value of coal, he had taken some pains to indicate the difference between what one might do when a free agent, and what had to be done in the conditions in which he was placed at the time referred to. He had had to buy from any merchant in London who would put in a satisfactory price, because he had no other course open to him when he had to be responsible for running a station of such a size that it turned out annually as many units as were used, both for lighting and tramways, by both Liverpool and Glasgow put together. With regard to the point that such long specifications must involve a lot of legal disputes, that had not been his experience. There would be some 200 contracts to carry out all the works for the electrification of the tramways of London, and out of all these only one legal question arose, and in that case the parties amicably agreed to refer the matter to an arbitrator. As to the penalties, he agreed that it was one of the most difficult things to obtain penalties under a specification, especially for a public body. They had one contract for the supply of goods to be delivered in six months, and no portion of them was in fact delivered in nine months. The contract was for £14,000. In consequence of the delay, 22 miles of tramways lay idle for three months at a loss of revenue of £50,000. In that one case the full penalty of £13,000 was exacted. In order to get the penalty it was certainly necessary to be able to prove that there had been loss to at least an amount corresponding to the amount of the penalty. Reverting to the coal question, he had been asked from how many merchants in London they got tenders. The reply was from practically all. In Yorkshire, no doubt, they could deal directly with the colliery proprietors, but the colliery proprietors would not tender to a calorific value; the coal merchants of London were more enterprising, and they got the coal from many sources and blended it so as to extract as big a bonus as they could. This method gave an incentive to the coal merchants to buy as cheaply as possible. During a period when his authority had to buy from hand to mouth at spot prices, the calorific value varied from 11,000 b.th.u. to 14,500 b.th.u., the ash varied from 5 per cent. to 35 per cent. The variation in quality was far wider than any variation in price. In answer to Mr. Jewell, he would say that he did not see how it would be possible to make up a tender without a bill of quantities. The main item of the specification was the bill of quantities, and the variation from the quantities would be excessive if it was more than 10 per cent. plus or minus. With regard to another question, he did not want to be dogmatic, but he preferred mica before everything else, and wherever he used mica he had it thoroughly impregnated. If they were using high-tension winding without such impregnation they were simply asking for trouble. Even with low-tension they should impregnate, fill up all air spaces, and keep out all moisture. As he had indicated, now that he was not a public official, but a free agent, he could please himself about his manner of buying. A well-known cable maker once said to him, "I buy nothing by specification, and buy mostly on the telephone, but I sell nothing at all on the telephone, and wholly by specification," and specification of some kind was necessary to define what the purchaser was buying and what the other man was supposed to be selling.

REVIEWS.

Telegraphy. By T. E. Herbert. London: Whittaker & Co. Price 9s. net.

To those connected in any way with telegraphy, it were almost sufficient to say: "The third edition of Herbert's 'Telegraphy' is ready"; whilst to others singularly unfortunate or immature, one might explain that this book is a detailed exposition of the telegraph system of the British Post Office, and enough would be said. However, a volume of this size, representing so much labour and skill by author and publishers alike, and offered at such a remarkably moderate price, deserves more than passing mention. The purpose of the work is still to provide an up-to-date and detailed treatment of the telegraph equipment and practice of the British Post Office, and also to cover the field of Post Office and City Guilds' examinations in telegraphy. During the ten years which have passed since this book first appeared there have been many advances in the ways and means of telegraphy, particularly in the field of high-speed telegraphy, to which the author has devoted much space and care. Quite a large proportion of the book has been rewritten or rearranged, and for this reason, if for no other, it is well to outline the arrangement and scope of the enlarged work as it now appears.

That a considerable amount of elementary matter is included goes without saying, but it is presented clearly, concisely, and in a manner which is in keeping with the whole scope and nature of the book and the needs of readers. "Advanced" matter is also included as regards the construction of apparatus and the working of systems, but there is a complete absence of mathematics other than the simple calculations with which the student must be made familiar. An ample number of numerical examples is included in the text. The first chapter is concerned with primary cells, which are of great importance in telegraph practice. The improved Leclanche cell is now used by the Post Office to the exclusion of all other primary cells, and the work done by J. G. Lucas in this connection is not so well known as it might be. A long chapter is devoted to calculations in connection with circuits and conductors—the arrangement of cells, joint resistance, and division of current, resistance of wires of various dimensions, electro-magnet problems, &c. The author deals correctly with the method in which cells should be joined up under different circumstances, the distinction between the correct basis and one which was formerly given general acceptance having been exposed in great detail by Dunton. About 100 pages are devoted to ways and means of measuring current, e.m.f., and resistance as practised by the Post Office, and these chapters embody matter which should be valuable to every electrical student, and not merely to him who is to specialise in telegraphy. The present-day equipment of the Post Office in the way of measuring instruments is worthy of the work which has to be done, and every year sees some improvement in the interests of efficiency. The old "Q. and I." detector is almost as obsolete as the terms which gave it its cryptic name.

Chapters VI to XV deal with the principles, construction, and use of the apparatus employed by various telegraph systems, viz.: single-current systems, the double-current system, the differential and bridge duplex systems, the quadruplex, and various high-speed systems. A long chapter is devoted to the Wheatstone automatic system, which, thanks to keyboard perforators and receiving perforators, remains a formidable competitor amongst those systems which have been developed to meet modern traffic conditions on trunk lines. The Wheatstone A.B.C., the Steljes recorder, the Rebesi typewriting telegraph, and the Hughes system are dealt with, and then come chapters dealing with what the author terms "the outstanding feature of the past ten years," viz., the development of the Baudot by Major A. C. Booth, and the introduction of the Murray multiplex. The Baudot sextuple duplex system, giving 12 channels over a single wire, is now in daily use in this country. The Murray multiplex has been developed specially to work in conjunction with the Baudot multiplex, of which there are about 400 circuits in existence. The explanation of these complex systems, or, rather, of the complex apparatus which they employ, is by no means a simple task, but it is one which the author has accomplished very creditably. The excellent line illustrations are a great assistance to him and to the reader alike. In a few cases the lettering is painfully small, but never actually illegible.

The central-battery telegraph, invented by C. J. Mercer, is now in extensive use, and in Chapter XVI the author describes various central-battery duplex systems and telegraph switching systems. The construction and use (in telegraphy) of secondary cells are next dealt with, an important section being devoted to alterations in circuit connections for universal battery working. Successive chapters treat of repeaters, the test box, protective devices (against fire, lightning, and power circuits) and telegraph testing, and the formation of special circuits. The sections of the chapter on testing deal with the morning test (for which a Megger is now used in place of the Eden test), fault localisation, resistance tests, underground cable tests, tests for fault position and resistance of earth connection; tracing instrument faults, and the making of good or faulty circuits. The last two chapters occupy nearly 150 pages, and are devoted to the construction of aerial lines and underground lines; both are well illustrated, and leave no room for criticism. Provided that it is revised from time to time, it is difficult to see how this book can ever lose the position and repute it undoubtedly holds at present. The latest edition should be in the hands of every worker and student of telegraphy.

A Treatise on the Theory of Alternating Currents, Vol. II. By Alexander Russell, M.A., D.Sc. Second edition. Cambridge: University Press. Price 15s. net.

Dr. Russell's treatise on the theory of alternating currents has long occupied the position of a standard work in regard to the subject of which it treats, and we are glad to welcome a second edition of its second volume.

Readers will remember that the first volume is devoted to alternating current phenomena and problems which are largely independent of specific forms of machinery and apparatus. The second volume deals with the working of alternating apparatus and machinery, and it thus touches problems which are more intimately connected with the occupation of the engineer; indeed, its theorems are to a large extent an analysis of the performance and properties of the machinery which the engineer has created for the service of mankind.

In the present edition a number of alterations and additions have been made in order to bring the matter up to date. Thus, several types of machinery which have become increasingly important in recent years have been introduced for the first time as illustrations of the theoretical work, *e.g.*, the La Cour motor converter, the synchronous booster, the split-pole converter, and frequency changers.

Among the portions which have been largely rewritten, the author mentions in his preface the theory of armature reaction, which he now treats according to the method suggested by Prof. Lyle, the theory of the induction motor and the theory of power transmission. The last-named subject is treated largely by means of hyperbolic trigonometry, and in order to explain the use of the hyperbolic functions employed, a new chapter on hyperbolic trigonometry has been added.

It is, perhaps, unnecessary to summarise the contents of a book which is already so well known, and it would be difficult even to attempt an adequate criticism in detail of a work involving such an enormous amount of labour as the author has bestowed on the mathematical theory contained in this volume.

The work is, in fact, an admirable exposition of the application of mathematical analysis to the performance of modern electrical machinery and appliances extending over a very wide field. Perhaps some readers will be inclined to regret that the treatment of the various problems is so much restricted to a purely mathematical analysis, and that many elegant graphical or geometrical methods of illustrating performance under various conditions, which have proved themselves of so much value in practice, have been omitted. Probably such readers would also have welcomed a more liberal introduction of curves which would help to visualise the mathematical results arrived at. Other users of the book, again, who have grown used to the simple notation for complex quantities, which has been used with such effect by Steinmetz, will perhaps think that some of the problems might have been solved with greater ease by the introduction of the symbolic notation. In the hands of the author, however, the methods of algebraic analysis appear to afford the most powerful weapons of attack, and he generally prefers to proceed by general methods to general solutions. At the same time, in some chapters he has borrowed a number of graphical solutions for those problems to which they are peculiarly adapted.

It will be gathered that the book is one which is rather to be used for reference in connection with matters of fundamental theory than of the every-day questions of behaviour or design. At the same time, the practical engineer who may be called upon to deal with difficult problems connected with electrical machinery will do well to keep it on his bookshelf for reference—always assuming that he has also provided himself with sufficient facility in higher mathematics to enable him to follow its analyses.

A useful list of references is appended to each chapter, while it is hardly necessary to say that, like the other volumes in the Cambridge Physical Series, the clearness and excellence of production of the volume leave nothing to be desired.

Les Surtensions dans les Distributions d'Energie Electrique. By I. van Dam. Paris: Librairie Gauthier. Price 12f. 50c.

We have in the work now under review a comprehensive treatise on high potentials superimposed upon electrical distributing systems, and consequently upon machinery and apparatus, due to resonance, to atmospheric action, to harmonics in alternator waves, to the electrical state of the installations, or other causes.

As a book, it is well printed, but bound in the inadequate fashion characteristic of French literature, even when technical and of permanent value.

The first chapter deals with "potential explosif," or breakdown voltage, and starts with air. Tables are given showing the sparking distances between spheres, points, and plates, obtained by different experimenters.

The next chapter treats of corona discharge, with more tables, and formulæ for calculating the strength of the electrostatic field produced by different voltages.

In Chapter III different forms of insulators for overhead transmission are considered, and to those who are familiar with the latest American publications there is little here that is new.

Chapter IV discusses self-induction and capacity in overhead and underground lines, and the usual formulæ for calculating these quantities are given, with substituted condensers in three-phase conductors, and all the considerations with which the aforesaid American publications have made us so familiar.

Harmonics in the alternator wave are investigated in the fifth chapter, and, properly studied, it leaves little uncertainty in the student's mind.

A consideration of resonance forms the subject-matter of Chapter VI, and the formulæ required are given, with practical examples from American and other practice. Resonance may be due to an accidental earth, and the causes of resonance and means of preventing trouble are considered. So far as preventive means are concerned, the author at once informs us that there is no apparatus which will prevent "surtensions" due to the equality of the periods of oscillation of the network and of the source. General counsels are given—do not put on a feeder before the machine is up to speed and full voltage; do not use concentric cables on extended networks; choose a generator the wave of which does not contain harmonics likely to be troublesome; make oscillographic investigations; and so on and so forth.

Chapter VII tells us of the rise in pressure at the end of long lines without load, which was first noticed on the famous Ferranti mains from Deptford to the West End, we forget how many years ago.

Variations in the electrical state of the installation give rise to "surtensions" (we rather like this word), and Chapter VIII goes carefully into this matter. Some examples are given taken from the 30,000-volt network of the Berliner Electricitätswerke, and the Deptford case is mentioned, together with the old original station of the Westminster Electric Supply Corporation at Horseferry Road. Variations on any system can be caused by switching in or out of circuit a transformer, or an aerial conductor, or by the sudden rupture of a short circuit. Protective devices find a place in this chapter.

The ninth chapter deals with atmospheric effects, and the tenth with lightning arresters, and the different forms of resistances used with such apparatus. Again, practical cases are given, including some occurring in Norwegian practice.

Earthing is considered in Chapter XI, and contact between high-tension and low-tension lines in Chapter XII.

The thirteenth, and last, chapter gives specifications for cables and machinery according to French, German, British, and American practice.

The book is clearly the work of one who has specialised in his subject, and as such it should form a valuable textbook to those who wish to do the like, and a very useful work of reference to those who, while lacking time and opportunity for specialisation, desire to keep in touch with the fundamentals of the subject.

Mechanical Drafting. By C. B. Howe. London: Chapman and Hall, Ltd. Price 7s. 6d. net.

This work is intended to assist the student to a knowledge of the principles of mechanical drawing and their practical applications, and, as its title indicates, is based upon American practice; but the draughtsman's art is an international language in itself, and as the text is not obtrusively "United States," the book should be very useful to British readers. One of its best features is the profusion of drawings and sketches of apparatus, materials, and methods of use, so clearly outlined and so detailed as to speak eloquently for themselves; but this is not made an excuse for slurring over the descriptive matter, which is equally lucid and explicit. As an example of the former, we may cite a *half-tone* reproduction of a pencil drawing, showing, as no other method could show, the faint outlines of the details at the commencement, and the strengthening of the lines as the drawing proceeds, as well as the method of laying out the centre lines and commencing the design. Another figure shows the proper order to follow in inking the lines or making a tracing, in five stages. After fully treating of the manual operations involved, the author discusses the geometry of drawing, and inculcates the system according to which the plan is placed above the elevation of an object. The curves of intersection of surfaces of various shapes are well illustrated, and the development of surfaces is dealt with at some length. The technique of working drawings is then discussed in detail, with very numerous examples of parts of machines. Architectural and building plans occupy a good deal of space, and here valuable aid is afforded by half-tone illustrations, showing the final appearance of the details drawn. Plotting surveys and map drawing, with the use of surveying instruments, is followed by a chapter on pictorial representation and sketching, and the last chapter deals with blue printing, with illustrations printed in colours. Altogether it is an excellent work of its kind, which we can cordially recommend to the engineering draughtsman who desires to perfect himself in his art.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

TRANSIT OF GOODS THROUGH FRANCE.—The official *Board of Trade Journal* for January 11th publishes a full statement of the regulations now in force respecting the transit through France of goods sent from the United Kingdom to Switzerland, Italy, and Spain *viâ* France. Firms interested should consult the *Journal*, or they can obtain full information from the Department of Commercial Intelligence, 73, Basinghall Street, E.C.

MOZAMBIQUE.—A revised Customs Tariff for the territories of the Province of Mozambique which are under the direct administration of the State has recently been promulgated, containing new schedules of import and export duties. Among the former may be noted the following :—

Rate of Import Duty.

	In the districts of Lourenço Marques, Inhambane and Mozambique.	In the districts of Quelimane and Tete.
Lead in bars, sheets, or plates, unwrought	3% *ad val.*	3% *ad val.*
Copper (pure), bronze, brass and similar alloys in bars, sheets, or plates, unwrought	3% ..	3% ..
Transmission belts for machines	1% ..	Free
Engine and boiler packing of rubber, asbestos, or any other substance... ...	1% ..	Free
Tin in bars, rods, granulated, and in powder	3% ..	3% *ad val.*
Fuses	3% ..	3% ..
Metal wire covered with rubber, with any textile, or with paper	10% ..	10% ..
Wire, plain	3% ,,	10% ,,
Books, catalogues, newspapers, &c. ...	Free	Free
Printed matter, not bound (includes printed matter in loose sheets, unpaged pamphlets, &c.)	10% *ad val.*	10% *ad val.*
Machines, apparatus and instruments for use in industry, agriculture and mining and accessories therefor	1% ..	Free
Telegraph material (apparatus, &c.) ...	3% ..	3% *ad val.*
Metals, not specially mentioned, in the rough	Free	Free
Metals, not specially mentioned, manufactured	10% *ad val.*	10% *ad val.*
Motors for use in industry, agriculture and mining	1% ..	Free
Zinc in bars, plates or sheets, not worked	3% ..	10% ..

The new schedule of export duties comprises the following among others :

	Rate of export duty.
Rubber—	
(*a*) Extracted by boiling	20% *ad val.*
(*b*) Extracted by boiling and by modern processes and modern crushing machinery	8% ..
(*c*) Extracted by means of incision —impure...	8% ..
(*d*) ,, ... pure ...	3% ..
Goods of kinds admitted free of Customs duty, when exported	2% ..
Ores produced in the province	Free

BRITISH DOMINIONS AND POSSESSIONS.—Complete lists of the articles which are prohibited to be exported to various destinations from British India, Canada, New Zealand, South Africa, Newfoundland, Egypt, Malta, Cyprus, Mauritius, Ceylon, Straits Settlements, Hong-Kong, Nigeria, Gold Coast, Jamaica, Barbados, Trinidad and Tobago, and British Guiana, have been issued as Supplements to the *Board of Trade Journal* for January 18th and 25th. The information in these Supplements supersedes that given in the Supplements issued on October 12th and 26th respectively. Copies of the Supplements may be obtained, price 3d. each (post free 4d.), from H.M. Stationery Office, Imperial House, Kingsway, W.C.

SWEDEN.—The exportation of electricity meters and other electrical measuring instruments, and parts thereof, has been prohibited from December 31st last, and of purple ore containing three-tenths per cent. of nickel from January 14th.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

2,082. "Process for manufacture of thin metallic tubes." S. O. Cowper-Coles. February 12th.

2,083. "Process for removal of zinc from scrap galvanised iron." S. O. Cowper-Coles. February 12th.

2,084. "Process for recovery of tin from tinned iron scrap, &c." S. O. Cowper-Coles. February 12th.

2,085. "Removal of enamel from enamelled articles." S. O. Cowper-Coles. February 12th.

2,092. "Electrical generating apparatus." J. Thompson & R. J. Thompson. February 12th.

2,093. "Wireless telegraph apparatus." J. Thompson & R. J. Thompson. February 12th.

2,098. "Frames or casings of alternating-current electrical apparatus." F. Coates, J. Mirrey and A. Reyrolle & Co. February 12th.

2,103. "Electromagnetic brake." H. V. James. February 12th.

2,106. "Device for testing magnetos and sparking plugs." E. Morgan. February 12th.

2,133. "Device for supporting shades or reflectors upon incandescent electric lamps, and for locking lamp to holder." W. Waller. February 13th.

2,157. "Electrically-driven cranes, &c." J. Bentley & W. H. Scott. February 13th.

2,158. "Continuous-current measuring apparatus." Allgemeine Elektricitats Ges. February 13th. (Germany, June 24th, 1914.)

2,159. "Wireless telegraphy and telephony." I. Hortik. February 13th.

2,161. "Insulation of electric machinery, &c." C. J. Baker & C. H. Klyne. February 13th.

2,162. "Electric heaters." A. F. Berry. February 13th.

2,179. "Electric torch." S. D. Williams. February 14th.

2,191. "Automatic circuit breakers." E. D. Rodway & Switchgear and Cowans, Ltd. February 14th.

2,194. "Wireless telegraphy and telephony." I. Hortik. February 14th.

2,214. "Continuous-current dynamo-electric machines." R. Boin. February 14th.

2,219. "Electric speed indicators." R. Bosch (firm of). February 14th. (Germany, February 26th, 1916.)

2,228. "Method of manufacturing metal felloes with uptyrned electrically-welded flanges." R. Kronenberg. February 14th.

2,268. "Electromagnetic switches." British Thomson-Houston Co. (General Electric Co., U.S.A.). February 15th.

2,269. "Dynamo-electric machines." British Thomson-Houston Co. and A. A. Pollock. February 15th.

2,280. "Manufacture of electric signalling, &c., lamps." H. E. F. Goold-Adams, G. S. Hague & O. Lucas. February 15th.

2,281. "Method of mounting cams in magnetos." E. J. J. Salmson. February 15th.

2,294. "Electrical signalling system." Sir G. T. Buckham & Sir A. T. Dawson. February 15th.

2,296. "Telegraph apparatus." Indo-European Telegraph Co. & A. H. Morse. February 15th.

2,320. "Electric switch." W. A. Clark, H. G. Longford, W. W. Longford & The Sphinx Manufacturing Co. February 16th.

2,332. "Sealing and bonding glands for electrical junction boxes." G. S. Boothroyd and Callender's Cable & Construction Co. February 16th.

2,333. "Tapping-keys or switches for electric signalling systems." R. F. Rowe. February 16th.

2,340. "Process for joining-up electric, &c., wires." Slot & Zwijnenberg and J. H. van Viersen. February 16th.

2,368. "Accumulator cells." W. H. Exley. February 17th.

2,382. "Sparking plugs for internal-combustion engines." W. Entwistle. February 17th.

2,386. "Magneto-electric machines." British Thomson-Houston Co. and A. P. Young. February 17th.

2,398. "Manufacture of multi-cell batteries." A. V. St. Armande. February 17th.

PUBLISHED SPECIFICATIONS.

1915.

9,522. Electrical Water Heater. J. H. Robinson. June 30th. (December 30th, 1915.)

16,602. Electric Furnaces. F. Cochlovius. November 24th. (November 24th, 1914.) November 24th.

1916.

The numbers in brackets are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

1,036. Signalling Lamp. W. T. Coulson & Optalyte, Ltd. January 22nd, 1916. [103,498.]

1,038. Electric Lampholders and the like. J. C. White. January 22nd, 1916. [103,499.]

1,098. Automatic or Semi-automatic Telephone Systems. Relay Automatic Telephone Co. & T. M. Inman. January 24th, 1916. [103,502.]

1,299. Galleries for Gas and Electric Fittings. T. Cracknell. January 27th, 1916. (Cognate application, 10,563/16.) [103,518.]

1,469. Electrical Selectors or Impulse Responders. Relay Automatic Telephone Co. & L. C Bygrave. January 31st, 1916. [103,524.] (Addition to 9,345/15.)

1,530. Indicating Apparatus to Assist in Teaching Accurate Shooting at a Target. C W. Wedgwood. February 1st, 1916. [103,527.]

1,584. Magnetic Compasses. S. G. Starling, A. J. Hughes & H. Hughes and Son. February 2nd, 1916. [103,530.]

1,595. Transmission of Wireless Signals. R. C. Galletti and Galletti's Wireless Telegraph & Telephone Co. February 2nd, 1916. [102,400.]

2,681. Terminals for Electrical Machinery and Appliances. F. J. Hadfield. February 23rd, 1916. [103,545.]

2,895. Telephone Transmitters. E. A. Petithory. February 26th, 1916. [103,549.]

4,319. Self-controlled Aerial Machine embracing a Torpedo and sustaining means therefor. F. W. Buck. March 23rd, 1916. [103,557.]

4,343. Means for Controlling the Electric Lighting of Motor Vehicles. W. Curtis. March 23rd, 1916. [103,558.]

10,101. Protective Relays for Electric Circuits. British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.). July 18th, 1916. [103,609.]

12,406. Safety-controlling Gear for Electrically-propelled Vehicles. F. Garrett & H. K. Pratt. September 1st, 1916. [103,617.]

12,517. Dry Batteries. A. H. Sheppard & British Ever-Ready Co. September 4th, 1916. [103,618.]

1917.

254. Process of Electric Welding. T. E. Murray. February 18th, 1916. [103,636.]

THE

ELECTRICAL REVIEW.

VOL. LXXX. MARCH 9, 1917. No. 2,050.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: March 9, 1917. [No. 2,050.

Page
The Manchester Conference 253
Problems of Industry 254
Scientific Information 255
High-Pressure Cable Joints, by S. G. (*illus.*) 255
Prospects of the French Electrical Industry 256
Train Control on the Great Indian Peninsula Railway ... 257
Correspondence—
  Small Municipal Electricity Undertakings and War-time Losses 258
  Curious Trouble with Lead-Sheathed Cables 258
  The Inspection of Munitions 258
  Fuse Failures 258
Fighting Hail and Storm by "Electric Niagaras" 275
New Electrical Devices, Fittings and Plant (*illus.*) 259
War Items 260
Electric Lighting in France 261
Refillable Fuses 261
Legal 262
Trade Statistics of Switzerland 263
Reviews 264
Business Notes 265
Notes... 268
City Notes 272
Stocks and Shares 274
Some Points in Connection with Engineering Specifications, by J. Shepherd (*concluded*) 276
Economic Recuperation after War, by Prof. W. R. Scott (*concluded*) 277
The Parallel Operation of Electric Power Stations 278
Electric Ship Propulsion, by W. L. R. Emmet 279
New Patents Applied for, 1917 280
Abstracts of Published Specifications 280
Contractors' Column ... ... Advertisement page xx

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MELBOURNE: The Mining & Engineering Review, 90, William Street; Gordon & Gotch, Queen Street.

MILAN: Fratelli Treves.

NEW YORK: D. Van Nostrand, 25, Park Place.

PARIS: Boyveau & Chevillet, 22, Rue de la Banque.

PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Loescher & Co., Corso Umberto 1° 307.

SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.

TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank. Newgate Street Branch."

THE "ELECTRICAL REVIEW'S"
ELECTRICAL & ALLIED TRADES DIRECTORY
(THE RED BOOK),
1917 EDITION
IN THE PRESS.
H. ALABASTER, GATEHOUSE & KEMPE,
4, Ludgate Hill, London, E.C. 4.

THE MANCHESTER CONFERENCE.

WHATEVER may be the final result of the conference convened by the Board of Trade, Friday, March 2nd, 1917, will always stand out as a landmark in the history of the electricity supply industry of this country. Our readers will recollect that, prior to the Board's circular letter regarding coal economy, the engineers of the supply undertakings of Lancashire and Cheshire held a meeting last spring, and appointed a representative committee of 12 to investigate the possibilities of interconnecting systems in suitable districts. After much work had been done, a preliminary report was issued in September, which outlined a scheme for dealing with four groups of undertakings, which were favourably situated, and a recommendation was made that a conference of the authorities concerned should be convened by the Board of Trade, and be presided over by a Government representative. After some delay, arising out of departmental methods and the replacement of the Coalition Government by the present War Cabinet, the Board of Trade adopted the suggestion, and appointed its Parliamentary Secretary, Mr. G. H. Roberts, M.P., to preside over it, and he was accompanied by important permanent officials.

We commend to the full consideration of our readers the remarks by this gentleman which appear elsewhere in this issue in the account of the proceedings in Manchester. From these it is quite clear that the Board of Trade is now being directed by courageous gentlemen who have a clear conception of what this country owes to electricity for the part which it has played in this war in getting a quick output of munitions, and who are determined to have the supply of it put on a satisfactory basis, from the points of view of both cheapness and security of supply. Mr. Roberts showed that he had a firm grasp of the part which electricity is destined to play in the national life, both in assisting cheap production in industry and in securing the more efficient use of our coal. He also showed a refreshing courage in indicating that the Government's views on electricity supply had been conceived on too narrow lines in the past, and that broader views must in future prevail. The Town Clerk of Salford elaborated this point, and gave convincing reasons why electricity supply should not be confined by municipal frontiers—a happy expression of which more will be heard in years to come. An essential feature of the Lancashire and Cheshire scheme is that a working arrangement should be made between the proposed Municipal Board of Management and the Lancashire Electric Power Co. Considering the unfortunate antagonism which has existed in the past between municipalities and power companies, it is gratifying to note that Dr. Parshall indicated the willingness of his company to make such an arrangement. The conference of 125 delegates, representing 42 undertakings, showed remarkable unanimity in support of the report under consideration, and it is of good augury for the future that no dissentient voice was heard, and that there was no adverse criticism. The Board of Trade has now requested the Interconnection Committee to proceed to elaborate its scheme, and to bring forward detailed proposals for its approval.

There can be no doubt that the Lancashire Committee will follow up energetically by preparing a scheme based on voluntary co-operation, with a view to a portion of it being at work next winter, as it is notorious that coal difficulties, shortage of plant, &c., demand prompt measures in the national interest. The work of the Committee and of those whom it calls into its counsels will be followed sympathetically and with keen interest throughout the country.

In connection with this matter, it is pertinent to call attention to the fact that the report of the Board of Trade Commitee on the Electrical Industry after the War has not yet been published. We suggest that it might be of great use to the framers of the Lancashire and other linking-up schemes, at this stage, and we should welcome an announcement that it will shortly be available. We believe that the Committee's proceedings reached the concluding stage last week. In the meantime, it is valuable to note that the Board of Trade appears to be willing to consider favourably the promotion of any linking-up and development scheme which is prepared by the supply authorities, who alone can have full knowledge of the local conditions to be catered for. In conclusion, particular note should be taken of the stress laid by several speakers on the excellent feature in the scheme that local autonomy would continue in regard to the supply of electricity. This is a statesmanlike feature which bids fair to secure the goodwill of the permanent officials of the authorities concerned, and we commend it to others who have similar projects in preparation.

PROBLEMS OF INDUSTRY.

We have received a reprint of the views on "Industrial Problems After the War" expressed in a contemporary by Mr. W. L. Hichens, the chairman of Messrs. Cammell, Laird and Co., Ltd. The opinions of Mr. Hichens, being those of a leader of industry, are well worthy of study, and they are the more so because of their timeliness. Of course, it is impossible for anybody to traverse such ground without saying some things that are already familiar to those who have made a close study of such matters during, say, the past two years. Recognising that things industrial can never be the same after the war as they were before, the writer holds that we shall only be able to avail ourselves of the opportunities for good that the new situation will present, and to steer amidst the difficult rocks that are bound to emerge, if all parties are imbued with the will to bring about a fair settlement of dangerous differences. He finds that the war has worked the miracle of producing that will, leaders of Labour and of Employers having now a firm determination to face and overcome the difficulties. He welcomes the important signs that public opinion, too, is not likely to allow matters to "drift." Indeed, in the interest that the Press and the public have been induced—shall we say compelled?—to take in the matter, there lies the chief hope that a solution will be found. It is admitted that there are enormous difficulties, and that the road "must wind up hill all the way, even to the very end, for the ever-changing values are of such infinite complexity as to render inevitable, possibilities of friction."

As we have repeatedly argued, so Mr. Hichens says, there must be a removal of the suspicion with which both sides still regard each other. The disposition of Labour to suspect Capital is seen in the fear held to-day that the latter will use National Service powers against the former, dragooning workers into the condition of Prussian slavery. On the other hand, employers are inclined to dwell upon the weaknesses that ill-contented Labour has exhibited for years, working adversely against the best interests of national industry, and to suspect that those weaknesses are not repented of. Each side will do better than this if it will honestly face its own shortcomings. Unless this is done, we may drift into the state that always befalls a house divided against itself. What, then, is the urgent need at this juncture? Mr. Hichens describes it as "statesmanship in industry"—both sides taking a wider view of the problems of industry instead of being immersed in their own immediate concerns. There have been many speeches to this effect, but it is doubtful if the disposition to develop, or even to "will," a fair settlement of differences is spreading through the rank and file on both sides as rapidly as one could wish. We have ourselves argued again and again that the best results are likely to follow if each side is effectively organised, so that there may be afforded proper facilities for dealing broadly with industrial questions. We find Mr. Hichens in agreement with us on this point. He instances the engineering industry as a conspicuous case of bad organisation. "Associations of all sorts and kinds exist . . . . but they appear to have been scattered from a pepper pot, for they have no ordered relation to each other or to the industry as a whole." "In fact, the engineering industry resembles a country that has not advanced beyond the tribal system, which makes it an easy prey to outside competition and a source of weakness at home." What he desires to see is one Employers' Federation for the entire industry, including shipbuilding, to deal with the broader aspects of the Labour problem in relation to the whole industry, separate committees dealing with different branches thereof. He believes that a Central Engineering Council is needed, which would be composed of representatives from the Employers' Labour Federation and the various trade associations dealing with special aspects of the engineering industry. This assuredly is what many others also have desired to see, but, so far, have been disappointed. Mr. Hichens views the Federation of British Industries as an organisation which has great possibilities, and he admires the foresight of those who initiated the movement, but he observes with anxiety and fear the tendency of this body to confound its functions as an inter-trade federation with those of an individual trade association, a tendency which he considers, if it is not checked, will lead to disaster. He regards this as the type of organisation that is needed on the employers' side, and wants to see a similar organisation established by Labour, with close relations established between them both. They would be able to hold regular meetings to discuss all questions of trade policy, and learn to understand each other's point of view, without waiting for disputes to arise for settlement. In this way there might be formulated a joint programme of industrial reform based on a practical experience that is denied as a rule to politicians—a constructive policy to which both sides can subscribe. The suggestion that Trade Union representatives should sit on boards of directors is not favoured, as such an arrangement is only likely to be satisfactory if those representatives are elected because of some special business qualification. It will be observed that so far Mr. Hichens does not mention the State. Later, he shows that, in his opinion, the State must hold a "watching brief," and be prepared to settle such differences as Labour and Capital cannot adjust for themselves. Its real function is to maintain the true balance between conflicting interests—and in the best of all possible worlds there will be conflict, our efforts being designed to keep it down to the minimum—not to follow slavishly the dictates of the majority.

Our readers will have observed that we have been writing along the foregoing lines for some time past. When a man in Mr. Hichens's position continues to appeal for the establishment of organisations suitable for dealing with the situation which will present itself immediately the end of the war is in sight, we are inclined to be impatient for the negotiations and conferences and efforts to that end to have a satisfactory issue. Good work has undoubtedly been done, but apparently the efforts are more or less scattered and incomplete. Are we not still needing something in the way of concentration or co-ordination of our efforts at organisation? Mr. Hodge, the Labour Minister, has delivered speeches suggesting that his Department is finding an improved atmosphere which augurs well for the future; there have been meetings in London, and meetings in Manchester, with an amalgamation of some existing organisations. Everything seems to point to some real progress being made, but the strong combined national organisation has apparently yet to emerge. Without suggesting that the slight falling back of the enemy in France, our successes at Kut, and the desperation of the enemy under the seas, mean that the war is near its conclusion, we may be allowed to express the opinion that the sooner our house is in organised order in readiness for facing industrial problems the better it will be for all.

Scientific Information.

The Committee on Engineering of the General Committee on Research of the American Association for the Advancement of Science has issued an appeal to the industrial research laboratories of the United States, pointing out that in the course of their work many data of great scientific interest must have been arrived at, which for a time, being the exclusive property of the firms concerned, were of commercial value to their owners. Often, however, owing to further progress, such data cease to be valuable to the holders, and are in danger of being lost to the world, and the Committee urges the industries to enrich scientific literature with such facts and data, remarking that some industries have incurred the reproach of absorbing an immense amount of useful information from scientific literature without giving any return in kind, a reproach which could be removed if they would from time to time make public scientific information which has ceased to be of commercial value.

There is undoubtedly a great deal of truth in the Committee's contention, and we cordially commend its suggestion to the notice of our own manufacturing firms, many of whom have accumulated a mass of information for which they no longer have any use, but which is as yet unknown to the world. By so doing, they would benefit our industries in general, and in many cases prevent the useless expenditure of time and money on researches which have been anticipated by themselves. In these anxious times we cannot afford waste in any compartment of our national life; the spirit of co-operation is in the air, and one of the functions of the great trade associations which are springing up ought to be to collect scientific information from their members and to distribute it. The British Association might with advantage follow the example of its American counterpart in this matter, as well as the engineering and other scientific institutions. We must all pull together to secure industrial triumph.

HIGH-PRESSURE CABLE JOINTS.

By S. G.

It is long ago that the stage was arrived at when cable joints (especially H.T. and E.H.T.) had to be made properly to ensure them not coming adrift and causing serious trouble; but although this is so, it is only quite recently that we are informed of a serious breakdown on a German H.T. cable.

Of course, the cause of this recent trouble is attributable to shoddy work, obviously done with a view to cheapness.

We are all apt to rush jobs, therefore British engineers should make a special note of this breakdown, with a view to keeping their reputation up.

Unforeseen accidents sometimes do present themselves, and in this respect it has been known for cables to give trouble due to the solder not having taken properly (the mixture not being correct), the sweated joints, of course, coming adrift.

The shifting of the ground is sometimes the cause of joints coming adrift, as well as being the cause of buckling; and in order to overcome these difficulties, which invariably cause very serious trouble and expense, those concerned should see that the joints are made in such a manner that they will stand up against every difficulty. It can be done; and the following comments may prove useful.

In the first place, the jointing of the copper conductors must be considered. Assuming that the joint is "three-core straight through," the usual method is to sweat the two ends of the conductor into a copper sleeve or ferrule. There is only one advantage in this method of making the joint, and that is simplicity and cheapness.

In order to make a thoroughly good job, the best method for conductors up to, say, 7/14s, is to make a "married" joint.

Now there are two kinds of "married" joints—viz., the real married joint, in which the strands of both cables are opened out, interleaved one with the other, one set of strands twisted "right hand," the other set twisted "left hand," and then the complete joint sweated together. It will readily be seen that a joint made after this fashion is not likely to come adrift. The other kind of so-called married joint is where one cable is merely twisted on to the other; but this is not recommended.

Where a small section "tee" or "branch" connection is taken off a large "main" cable, the strands of the "tee" cable should be divided equally, then one-half twisted around the "main" cable right hand, the other half twisted around left hand, then the complete joint sweated together.

It must be noted that the above comments are only for small cables.

For large cables, sometimes a "scarfed" joint, and sometimes a "butt" joint is adopted, the ends of the cables being sweated into a brass or copper sleeve. This kind of joint is not recommended.

In better-class work the "telescope" joint is preferable, and, if well made, is not likely to give trouble under ordinary working conditions. This type of joint must not be confused with the "married" joint, and the following is the method of making it:—

1. The two ends of the cables to be jointed are made to overlap 1 in., to, say, 3 in., according to the size of the strand.

2. On one of the cables cut a portion off the centre wire (the length depending upon the size of the strand), and the wires of each succeeding layer must be cut so that they are longer than the next layer beneath them.

3. On the other cable the corresponding wires are cut in the opposite manner, that is, the centre wire is long, and each succeeding layer is short, so that when the two sets of strands are brought together they resemble a "plug-and-socket" joint.

4. Bind the joint with 18 or 20 S.W.G. tinned copper binding-wire, then solder the joint thoroughly.

In dealing with this most important subject, it must not be overlooked that we are faced with a mechanical difficulty which has to be overcome. Certainly we all know that the soldering iron and the blow lamp are the jointer's main articles for making a cable joint, and we all recognise a good jointer as an asset. Now, supposing the job were given to a purely mechanical man with instructions that the joint had to be made so that it would not come adrift, you can depend upon it he would see that it was clamped by some means or other.

Purely electrically trained men are apt to forget (perhaps in many cases do not know) that mechanical engineering plays a very important part in electrical engineering; and with regard to the question under consideration, the writer's opinion is that the only sure method of making a good joint with medium and large size cables is by adopting a combined telescope and clamping joint.

The copper fitting for clamping the joint is composed of two halves, top and bottom (both alike); the hole for the cable is drilled to the diameter of the strand with a thin distance piece placed between the two halves, so that when the distance piece is removed the hole is slightly eccentric. The two halves are screwed together tightly on to the two ends of the strands, so that a good grip is ensured. The joint is then sweated. By sweated, I mean a thoroughly good job, not a few pieces of solder dropped on, which is sometimes the case.

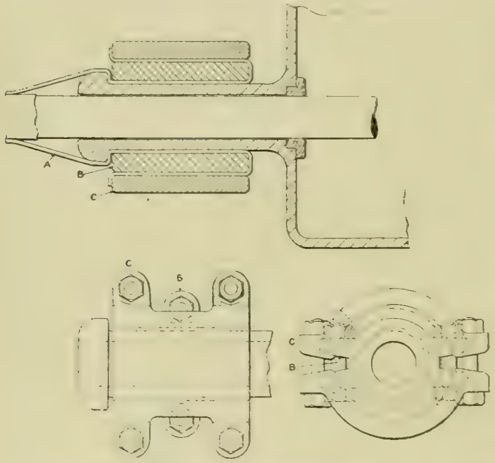

Fig. 1.—Armour Grip for Cable.

It will at once be realised that this combined joint makes a thoroughly efficient mechanical and electrical job, and one in which the possibility of its coming adrift is very remote.

Fittings should be so designed that all sharp corners are avoided.

I think a comment here regarding cables where there may be a likelihood of a pull will be useful, and that is, do not rely upon soldered joints, and do not make "twisted" joints unless it is absolutely necessary.

There are other parts of the joint which have to be taken into consideration; and in discussing this subject, the only joint which will be dealt with is "a straight-through h.t. three-core," the cable being paper insulated, lead covered, and wire or tape armoured.

A difficulty which presents itself when there is a pull on the cable is that the three joints are pulled together and short-circuited. In order to overcome this difficulty, the safest plan is to stagger the joints, tape them up, and insert spreaders or separators, which should be made of either ebonite or porcelain. Some engineers merely stagger the joints; some do not stagger them, but merely tape them up; some merely insert spreaders.

The usual design of spreader is made merely to prevent the joints touching one another. This gets over the trouble of short-circuiting the poles or phases when there is a pull on the cable: but when telescoping or buckling of the joint takes place, then the spreader should be so designed as to prevent the joints from pushing outwards on to the cast-iron box or lead sleeve.

It seems to be the general practice nowadays to reduce the size of the joint box to the very minimum, in order to save cast-iron and compound. This is all right up to a certain point, but the line must be drawn. On an expensive cable scheme the customer expects a box which, above everything else, will be reliable, and in order to make it reliable it must be large enough to accommodate the joint properly. There is still a lot of room in the earth to take joint boxes.

The joints should be staggered and placed a suitable distance from one another, according to the voltage, tightly taped with suitable (well compounded) tape to one and a-half times the thickness of the insulation on the cable, spreaders inserted, and then the whole of the joint enclosed in a lead sleeve of suitable size plumbed on to the end of the cable, then filled with compound, which must be suitable for the voltage at which the cable is working. The pouring holes in the lead sleeve can then be soldered up, after all air has been extracted.

As there is very little, if any, mechanical strain taken up on the lead sheathing (when the cable is armoured), it need only be electrically bonded to the cast-iron box by means of a thin strip of copper tape, soldered to the lead sheathing and screwed to the box.

We now come to the armouring. Sometimes single or double wires are employed, sometimes tape. Whichever is employed, it must be anchored to the box in a thoroughly mechanical manner, so that, whatever strain the cable is subjected to, the armouring will not leave the box. Of course, it cannot be expected that these conditions can be fulfilled without cost, and the writer suggests an armour grip designed somewhat as shown in the diagrams, fig. 1.

As will be seen, a very strong barrel extension or grip is cast on to the end of the box; A is the armouring on the cable; B is the inner clamp, made of malleable iron (in two halves); C is the outer clamp, made of malleable iron (in two halves).

The method of securing the armouring is as follows:—

1. Lay the armouring over the grip.
2. Clamp the armouring between the inner clamps.
3. Bend the armouring over the inner clamps.
4. Clamp the armouring between the outer clamps.

Although this method is a little more expensive and takes up more time than the usual methods employed, it will be found to have the desired effect.

Wire armouring is more easily manipulated than tape armouring, but with a strong hand, a willing heart, and a little patience a good job can be made with tape armouring.

There is a very important point which is often, if not always, overlooked, and that is the settling down of the armouring after it has been gripped for the first time. Although it may be that it is impossible to tighten the bolts and nuts even a fraction of a degree, it will be found that after a few hours the armouring will have settled down, and it will be possible to give the nuts a final tightening up.

PROSPECTS OF THE FRENCH ELECTRICAL INDUSTRY.

There have been, and probably still exist, many misconceptions concerning the development of the French electrical industry prior to the war. The excellence and variety of its products, its power of production, and its rôle in domestic and foreign markets—all have been under-estimated. Contrary to a widely-spread, but quite mistaken, opinion, French electrical manufacturers are capable of supplying a large foreign demand, over and above the domestic requirements of the country. A particularly significant fact, but one which has received little recognition in this country, is that French imports from Germany decreased regularly for years before the war, and were much lower than imports from the same source by most other countries of importance. Even before the war France exported more than she imported in five out of ten divisions into which French statistics divide electrical material, and there can be no doubt that the balance of export will be yet greater in future. In order, however, that development may be as rapid and as extensive as possible, co-operation between manufacturers and other interested parties must be adopted wherever practicable. "Voluntary union," says M. R. Legonez in the *Revue Generale d'Electricite*, "is the best adaptation to our national character, of the centralisation and co-ordination of individual effort, which have been one of the principal causes of the rapid industrial development of America and Germany."

The capital engaged in the French electrical industry was about £64,000,000 in 1911, and has since increased to £100,000,000 or so at the present day. Thanks to the "most favoured nations" clause inserted in the Treaty of Frankfort, German manufacturers were able to benefit by tariffs so low that it often cost less to import a finished machine than the materials entering into its composition. Yet, in spite of this extraordinary handicap, French manufacturers succeeded in reducing the imports of German electrical material, notwithstanding the increased demand occasioned by central-station development and the ever-extending industrial applications of electricity. In 1910, France stood tenth in the list of importers of German electrical material. In 1912, France occupied the twelfth place, but still imported more than Switzerland; but in 1913 (the last normal year before the war), France imported less than £500,000 worth (*i.e.*, 3.02 per cent. of the total exports) of German electrical material, as against £615,000 worth (3.74 per cent.) imported by Switzerland, and £1,800,000 worth (11 per cent.) imported by Great Britain and the Dominions. The great and growing strength of the French electrical industry before the war is a certain augury of its success in the coming economic struggle.

As regards trade with all countries, the total French imports of electrical material in the last complete year of peace were practically equal to the exports of similar materials. There was an excess of exports in the five classes: Wires and insulated cables, electrical carbon, accumulators, glass insulators, and arc lamps. On the other hand, there was an excess of imports in the five classes: Machines and transformers, electrical apparatus, incandescent lamps, scientific and measuring apparatus, and electrochemical porcelain. In the case of wires and insulated cable, the excess of exports over imports amounts to about £80,000 per annum. The cost of labour has little influence on the cost of the finished product, and the cost of copper, lead, and rubber is practically the same in every country, so that French success in this direction depends entirely on quality. There are several works in the country equipped with modern plant and capable of developing production and export. The electrical carbon industry is very prosperous in France, and covers the manufacture of furnace electrodes, arc lamp carbons, dynamo brushes, and carbon products for use in telephony. International dealings in accumulators are hindered by the fact that this apparatus is very heavy for its value, and is, moreover, relatively fragile.

The manufacture of glass insulators, now used so extensively in telegraphy, is essentially a French industry, and the value of exports (in normal times) is growing rapidly. French arc lamps have established a very high reputation on foreign markets, but, unfortunately for their manufacturers, this system of lighting is daily losing ground. Further advances in design and construction may, however, restore arc lamps to their former position. At the worst, there will hardly be more than a falling off in the rate of increase of their application.

Machines and transformers constitute the most important class of French electrical imports. The excess of imports over exports amounted to about £200,000 per annum before the war (principally from Switzerland and Germany). In respect of traction material France is self-sufficient; indeed, the superiority of French equipment was established by the single-phase loco trials held by the Cie. des chemins de fer du Midi. The best manufacturers of France, Germany, and Switzerland were all represented, but only the French locos passed the very severe tests imposed. After the war, manufacture of electrical machinery, and, indeed, every mechanical industry, will benefit from the modern equipment which has been installed on so extensive a scale for the production of munitions. War work has brought home to everyone the advantages of repetition manufacture and standardised types. Finally, a victorious peace will permit tariffs to be reformed. There is every reason to anticipate greatly increased and more economical production of electrical machinery in France, followed by more numerous and advantageous exports. Rapid progress has been accomplished in respect of electrical apparatus. In 1910 exports had less than 50 per cent. of the value of imports, but in 1913 the ratio had increased to 82 per cent., and will doubtless increase yet further. By force of necessity the manufacture of incandescent lamps, including sockets, caps, and bulbs, has been brought to a high state of development since the beginning of the war, and France will not again become dependent on foreign supplies of essentials in this branch of industry. French scientific and measuring instruments are second to none in design, workmanship, and accuracy, and it is simply a question of increasing production, and lowering prices by specialisation of works and standardisation of types. Similarly, the only reason why 5,000 quintals per annum of electrotechnical porcelain was purchased from Germany before the war was the inadequate production of French works. This deficiency has been made good, works being greatly extended and equipped with the latest machinery and extra-high-tension testing apparatus, so that a large balance of export is certain to be established.

The French electrical industry accomplished far more than is generally realised in meeting foreign competition prior to the war, and it can look with confidence to a period of great development and prosperity in the immediate future.

TRAIN CONTROL ON THE GREAT INDIAN PENINSULA RAILWAY.

In the *Railway Gazette*, Major Hepper gives some particulars of the system of train control used on the Great Indian Peninsula Railway, where it was first introduced in its present form in 1913. The main line between Igatpuri and Manmad was being relaid with the 100-lb. rail which necessitated the working of the traffic temporarily over sections of single line. It was realised that without the special advantages afforded by some system of control it would not be possible to cope with the heavy traffic on that part of the line and at the same time give the engineering department possession of the tracks for relaying. A form of control was therefore put into operation wherein were employed the magneto telephones, in groups of stations, then in use on this section of the Great Indian Peninsula system.

The experience gained on that occasion was so convincing as to the benefits to be derived from train control that the system of moving trains on orders from a central office was extended to other sections of the railway, and there are now 259 route miles of single-tracked, 248 route miles of double-tracked line, and 21 route miles of four-tracked line worked under train control by the magneto telephones.

The system of control by magneto telephones was, however, found to be subject to a strict limitation in regard to the number of stations that could be controlled. The selector telephone system of the Western Electric Co. has, therefore, been adopted, and is gradually being introduced. In this a 200-lb. return copper wire is used, and any station can be called up independently of the other stations.

The Western Electric system is already in use on the section between Bhusawal and Nandgaon, 15¾ miles north of Manmad, a distance of 98 miles, on which there are 31 connections and 58 trains a day, and its extension to Igatpuri has been provided for. Every officer in any way connected with the working of the trains is on the control.

As funds are available for the provision of selector instruments and copper wires it is proposed to concentrate the work, as at Manmad, in central offices.

Each control headquarters has a chief controller, two deputy controllers, three assistant controllers—one for each eight hours—and three recorders—one for each eight hours. In front of the assistant controller there is a diagram showing the siding accommodation at each station. On a table at the side is the train-register kept by the recorder and a tray of plugs for insertion in holes in the diagram to show the positions of trains. The controller has also a graphic chart upon which the working is shown, from which it can be at once seen how the section has been worked, and whether the best use has been made of the facilities available for passing traffic.

In front of the controller is a ringing key case, provided with one key for each point with which he wishes to communicate, each key being clearly labelled to indicate the name of the station it applies to. Inside the case is the selector, composed of a clockwork mechanism controlled by a silent governor, which, by means of a toothed wheel, makes and breaks an electrical contact. The number of teeth and, therefore, of electrical impulses, varies for each point of call. There is a corresponding toothed wheel in the instrument at each station, and when any key is operated all the wheels on that line are stepped forward in unison. The toothed wheel is operated by a stepping pawl operated by an electromagnet, the armature of which keeps step with the impulses sent out by the key. A second electro-magnet, arranged to act sluggishly, controls a retaining pawl which prevents the toothed wheel from flying back between the impulses. The magnet is energised immediately the key is operated, and remains energised until the station has been called, when it allows the selector to return to its normal position. The toothed wheel carries control arms, spaced at different positions to correspond with the number of impulses, which are closed in sequence as the selectors step round. The contact at the intervening stations is, however, so short that the trembling bell joined up by the contact has not time to operate. When the wheel reaches the limit set, the contact is closed, the bell at that station is rung, and this is indicated in the controller's office, as the interrupted current of the ringing bell will affect the controller's receiver and he can hear distinctly that the bell is actually ringing.

Should a station wish to speak to the controller, all that is necessary is for the speaker to lift the receiver from the hook and speak into the transmitter, as the telephone sets are all normally in bridge across the pair of telephone wires. In case the controller is not listening on the line, a generator is fitted at stations, and a magneto bell in the controller's office, whereby the controller may be called.

The telephones at the stations are of special construction in order to provide the high-impedance bridge necessary when so many stations may be simultaneously listening across one pair of lines. They are fitted with high-efficiency induction coils and high-impedance receivers. The instrument is, moreover, provided with a key by means of which, when in one position, the circuit is arranged to give the greatest speaking efficiency, and when in the other position the greatest receiving efficiency.

A battery of dry cells giving 260 volts operates the selectors. In order to avoid sparking at the key contacts the battery is connected to line by means of a telegraph relay. The keys are in a local circuit, including the relay coils, and a small battery; condensers are used to bridge the contacts to reduce the sparking, and retardation coils are inserted to prevent the sudden rush of current which would result from connecting the large battery to line, and which would cause unpleasant noises in the controller's telephone.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Small Municipal Electricity Undertakings and War-time Losses.

In view of the heavy deficits shown by numerous small municipal and urban council undertakings which are situated outside industrial centres, and which rely largely for revenue upon the sale of current for lighting purposes, I am wondering what steps are being taken by the generality of these undertakings in order to cope, or partly cope, with the melancholy prospect now before them.

Between the Scylla of declining output and the Charybdis of rising costs the small station engineer's lot is indeed anything but a happy one.

The larger undertakings are not suffering in the same way that the smaller ones are, as these big stations are sharing in the great industrial boom which the war has brought about, and it is no uncommon thing for some of these larger stations to increase their output for power by millions of units per annum. This, to a great extent, compensates them for loss of revenue due to restricted lighting, and, even apart from this, they are, in the majority of instances, fortunate in having substantial reserve funds from which they can draw to meet any temporary deficit.

The question before a good many small station engineers to-day is: How much of the estimated net loss upon the next 12 months' working ought to be directly provided for by the consumer, and what proportion (if any) by a call upon the local rate?

While, of course, it is only fair that the consumer in these days of abnormal prices should pay a fair price for his current, it is obvious that to ask him to provide for such extra revenue as would completely cover the estimated loss would in the long run do the undertaking far more harm than good.

The consumer himself asks—with a certain amount of truth, I must admit—why should he purchase the undertaking and present it to the town?

The ordinary ratepayer, as distinct from the electric lighting consumer, says: Why should I be called upon to make up losses upon a concern from which I am deriving no benefits? Another point which the ratepayer has in mind is that the great majority of central-station engineers lay it down almost as a law that when profits do accrue from an electrical undertaking they should be ear-marked for renewals and reserve funds, and not given to rate relief. From this he soon builds an argument to the effect that if he is not to benefit from electric lighting profits he ought not to have to make up electric lighting losses.

I am quite aware that in building up a reserve fund the electrical undertaking is providing for abnormal situations such as he is having to face to-day, but I am also aware that a number of these smaller undertakings have never been in a position to inaugurate a reserve fund, and some, indeed, have been for a good many years a regular old man of the sea upon the neck of "Sinbad ratepayer."

To me the question in some respects recalls the old problem of the hen and the egg. Should the consumer pay back to the ratepayer (where, in the past, electrical losses have been met by a call upon the rates) the amount "owing" before proceeding to build up a reserve fund, so that when next the undertaking is in difficulties the ratepayer would again be willing to come to the rescue, or should this very debateable debt be wiped off—leaving the ratepayer with a more or less legitimate grievance?

I realise that the arguments I have put forward, both pro and con, are very elementary ones, but we must not forget that both the consumer and the ratepayer, in a general way, argue in an elementary manner; therefore, it appears to me that a simple ruling on the above points would be preferable to both parties.

Quiz.

February 28th, 1917.

Curious Trouble with Lead-Sheathed Cables.

The trouble experienced by Mr. G. W. Partridge is evidently not electrolytic or chemical, but mechanical.

Without more exact information it is not possible to give a definite opinion, but the cause of the trouble is probably due to expansion and contraction.

The temperature rise of the cables is not stated, but if worked with heavy loading would probably be about 30 deg. F., and the corresponding lineal expansion in a cable 100 yd. long would be: Copper 1 in., lead 1⅝ in.

In small cables this expansion would be taken up in the space between the cables and their ducts; in larger and more rigid cables there is no doubt that the expansion pushes the increment of length into the manhole, and I have known movements to and fro of as much as ¾ in. on large lead-covered cables.

These movements are quite sufficient to throw a severe mechanical strain upon the plumbed joint, which is mechanically the weakest point of the lead sheathing. Again, the different rates of expansion of copper and lead for the same temperature rise do not improve matters, and will certainly cause further strains owing to larger increments of length of the lead over those of the copper and paper; in fact, the whole problem of protecting cables from expansion troubles has not received any adequate consideration so far as I know.

The trouble points to the advantage to be derived from an insulated pilot system just under the lead, giving warning of the failure of the lead sheathing.

Leeds, *February 27th*, 1917. **J. Shepherd.**

The Inspection of Munitions.

Judging from the letter in this week's REVIEW, referring to my short article on the above subject, and signed by "Albion," I am both ignorant and foolish. I am none the less rather amused, and not downhearted at the strictures of the writer. The cap fits, evidently. Now, I can easily ignore the abuse, and do not write this as an occasion for retaliation in the same kind. Also, the question of my experience and the "shop foreman" theory I leave to the Editors of the REVIEW, who saw fit to publish my article.

"Albion" complains that I have only two minor complaints to make. He might remember that wise people do not say all they know, and two small straws can show the direction of the wind. Will he contradict the truth of all or any of the following assertions?

1. Material has been rejected by Government inspectors, and, following manufacturers' protests, the rejections have been cancelled and the goods accepted.

2. Inspectors have been known to admit that they could not put a practical test on the goods they were sent to inspect.

3. Resident examiners have been sent from London to a works, scores of miles away, to stay on the works. In a few days they were ordered back, thus wasting money on railway and hotel expenses unnecessarily.

4. Scores of forms are being used as described in my article, in a manner which is wholly unnecessary, and which shows that the staff at headquarters do not know the nature of the material concerned.

5. Officers are using motors and petrol in a way which no business house would countenance on work which could be centralised.

If "Albion" can say "No" or "Yes" in a direct manner to these queries, your readers will be able to form their own conclusions as to who should be saddled with the word in question, a word which was used in a general manner in the original article, but which "Albion" very perfidiously ascribes to

March 3rd, 1917. **Commercial.**

Fuse Failures.

When I wrote my letter published, by your courtesy, in your issue of February 16th, I was not unmindful of the point raised by Mr. Baynes as to the advisability, or otherwise, of using concrete boxes in certain special cases for sealed house services. I desired to convey, however, that for commercial purposes the fuse referred to, of German origin, is under all conditions less satisfactory than the fuse of British origin, as designed, whether fixed upon an open switchboard, enclosed in earthenware, papier maché, concrete, or an earthed iron case. There is no wonderful secret or hidden mystery in either form of fuse; the success of both depends upon the fundamental necessity of excluding air from the fuse link. It is comforting to realise that the wily Teuton, with commercial penetration to achieve low "first cost," has adopted a narrow design, which necessarily limits the fuse capacity, and which is very dangerous when misused. The Britisher has beaten him from the start upon all points.

A brief summary of useful points given below may interest the student of fuse failures:—

1. Alternating current, and non-inductive direct-current, circuits present no fusing difficulties.

2. Millions of earthed iron cases are installed to-day, and when the Home Office recommendations have been followed, the chance of breakdown is negligible, if not non-existent.

3. All cartridge fuses should be so designed that in case of shortage, the length of break between the terminals should be such as to provide "ample clearances" under normal "open fuse" conditions. Standard minimum fuse lengths should be adopted for this purpose, then the risk of abuse is reduced to a minimum.

4. All iron cases should be so constructed that an open fuse under average normal conditions will clear itself without damage.

5. The personal element cannot be entirely eradicated, and the user should be educated to avoid the "abuse" of fuses.

In conclusion, I would like to say that I hope Mr. Baynes will join the members of the Panel engaged upon the standardisation of fuses. He would be sure of a hearty welcome.

Berry, Skinner & Co.
Herbert H. Berry.

London, W., *March 6th*, 1917.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Useful Compound Thermo-Element.

The accompanying illustration shows the construction of a useful compound thermo-element permitting temperature measurements to be made simultaneously at two points A and B. The couple terminating at A is composed of platinum and platinum-rhodium wires, and to the other ends of the latter there are connected respectively a silver wire and a constantan-silver thermo-couple. The three branches thus obtained are connected through terminals I, II, III, to two galvanometers A,' B'. Such a combination has many useful applications, the particular one in which it is described by Hilliger in the *Zeits. des Vereines deutscher Ingenieure* being to the measurement of flue gas temperatures at the front and back of a section of flame-tube filled with pieces of refractory material on the Bonecourt system. The compound thermo-element is cheaper and more compact than two separate couples, and for the above purpose the platinum couple was made 60 cm. (24 in.) long, and the silver-constantan couple was made 160 cm. (63 in.) long. The whole was mounted in a steel tube of 8 mm. internal and 12 mm. external diameter, which was so small as not to disturb appreciably gas flow in the flame-tube under observation. The high temperature end of the compound instrument was protected by a quartz sheathing. The couples being calibrated separately for a cold-junction temperature of, say, 20 deg. C., the reading of the galvanometer B', in conjunction with the calibration temperature, gives the temperature of B and, this being known, the reading of galvanometer A' (which measures the temperature difference between A and B), permits the temperature of A to be deduced. In the special application noted above, the couple A measured the temperature of flue gases at the entrance to a flame-tube, whilst B measured the temperature at the back of the refractory "filling" in the latter.

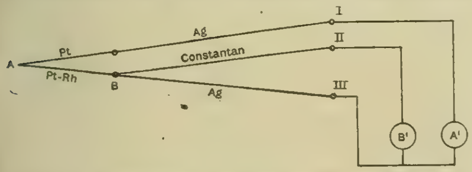

Fig. 1.—Arrangement of Compound Thermo-Element.

Plastic Solder.

We have received from Mr. A. P. Bevan, of Tavistock, a sample of "plastic solder" which he has invented. It is used like ordinary solder, but differs from it in that it passes from the solid to the liquid state through a plastic stage, in which condition it can be worked like putty. It becomes liquid at a dull red heat. We have used some of the sample, and find it quite handy and effective, and very easy to manage, as it does not tend to run off an inclined surface.

Marconi Vacuum Ampere Gauge.

In the *Wireless World* for February is given an account of a simple and ingenious instrument for measuring small currents, both D.C. and A.C. The instrument is designed primarily as a maximum-current gauge to indicate the condition of syntony in wireless circuits; it may also be employed as a substitute for a thermo-junction and galvanometer combination in the measurement of wave-lengths and decrement. The principle involved is that of the bifilar suspension, one pair of the filament ends being fixed, and the other pair attached to a pivoted arm, the rotation of which is controlled by a spring acting against the tension of the filaments. When a current passes through the filaments, heating them and causing them to elongate, the arm takes up a new position, and the angular displacement as indicated on the scale, is a measure of the current.

The movement is enclosed in a glass bulb exhausted of air. The sensitiveness is thus greatly increased, and the movement protected against damage and preserved from dust or corrosion.

The accompanying fig. 2 shows the construction of the device, which is made up after the fashion of an incandescent lamp, with either a bayonet socket or Edison screw, as preferred. Other forms are made with terminal caps at both ends. The variation in zero, which usually characterises thermal instruments, is said to be negligible in this type, and the movement is very dead-beat. The instrument may be used either as a low-reading voltmeter or ammeter, or as a shunted ammeter, having a normal resistance of about 12 ohms; a high-resistance pattern has a resistance of 30 ohms. These gauges have maximum readings of 0·11 and 0·035 ampere, 1·44 and 1·25 volts, respectively, and read down to 0·02 and 0·007 ampere; the cross-arm seen in the figure carries two pointers, for reading amperes and volts respectively.

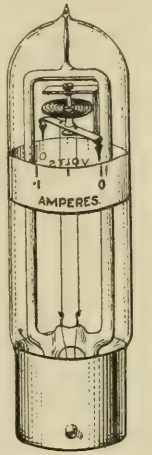

Fig. 2.—Marconi Vacuum Ampere Gauge.

With a wavemeter using the new vacuum gauge the wave-length of the primary circuit of a 1½-KW. set can quite easily be read when the wavemeter is held with the plane of its inductance coils parallel to that of the primary of the oscillation transformer at a distance of 2 or 3 ft. The noise of the spark, which often hinders the reading of a wavemeter by means of a crystal and telephones, in the case of the vacuum gauge gives no trouble, as the variable condenser has simply to be rotated until the pointer of the gauge gives the maximum reading. In this way circuits can be tuned rapidly as well as accurately.

In addition to the type of instrument described, a range of ammeters has been designed for all capacities between 50 and 500 amperes. These instruments, while following the general design of the smaller gauges already described, differ from them considerably in detail. In the large meters the suspension filaments carry no current.

A type of vacuum instrument for direct insertion in the aerial circuit is also being developed.

Pouring Acid from Carboys Without Spattering.

Serious damage is frequently caused by the spattering of acid when pouring acids from the carboys in which they are usually shipped. The contents of a carboy may be poured in a smooth, even stream if a bent glass tube is used as shown in the accompanying sketch, fig. 3. The tube should be ⅜ or ½ in. inside diameter, and may be bent by slowly warming a section about 6 in. long over a Bunsen gas flame; as soon as the glass has softened, the bend can be made. A hook made of stiff, rubber-insulated wire is bent around the tube to permit of hooking it over the mouth of the carboy, so that both hands are left free to tip the carboy carefully and to direct the stream into the jar that is to receive the acid.

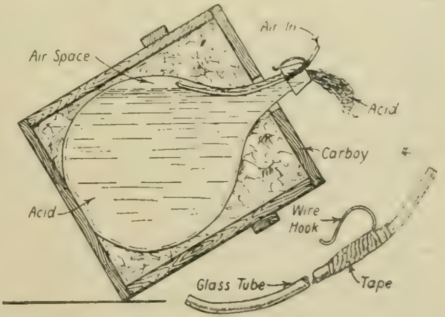

Fig. 3. Vent Tube for Pouring Acid from Carboys.

The tube lets air enter the carboy so as to replace the acid flowing out, and thus allows a uniform, steady stream to flow without spattering.

If a wire hook is made as shown, it must be thoroughly taped with rubber tape to prevent the acid from being contaminated by solution of the metal of the wire hook. A good inclinator should be used where carboys are to be handled frequently; it makes for safety, and also enables a single man to pour out their contents.—L. M. Dellinger, in the *Electrical Review and Western Electrician.*

WAR ITEMS.

Controlled Works.—The number of establishments controlled by the Ministry of Munitions is now 4,770.

Trading with the Enemy.—The "London Gazette" for March 2nd contains further lists of persons and bodies with whom trading is prohibited in various countries.

Entertaining the Wounded.—The "Times" states that the London staff of the Western Union Telegraph Cable System entertained 125 wounded soldiers from a number of hospitals on Saturday afternoon at the Savoy Hotel.

To be Wound Up.—The Board of Trade has ordered the following to be wound up:—

Mea Magneto Co., Ltd., 3, Stephen Street, London, W., dealers in magnetos, magneto parts, and accessories. Controller: C. R. Beeby, 66, Basinghall Street, E.C.

Women Electrical Workers.—It is announced in the daily Press that Messrs. Rawlings Bros., Ltd., of Gloucester Road, South Kensington, are prepared to give free instruction in electrical work to young women who wish to replace men for national service.

Imports from Neutral Countries.—The Board of Trade announces that on and after April 1st no goods of neutral manufacture of which more than 5 per cent. of the cost to the manufacturer is due to materials and labour of enemy origin, will be admitted into the United Kingdom except under licence.

Munitions and Trade.—According to announcements in the daily Press, Mr. Edgar Jones, M.P., has been appointed by the Minister of Munitions as Controller of the Priority Department. A new priority advisory committee, under the chairmanship of Mr. J. Wormald, consisting of Mr. Kenneth Chance, Mr. Alexander Walker, and Mr. Henry Woodall, has been appointed to advise the Controller and the Minister as to the effect of any restrictive Orders of the Ministry of Munitions upon trade, with a view to causing the minimum of hardship.

Paper Supplies and Catalogues.—Under an Order issued last week it is provided that as from to-morrow, March 10th, the sending to the public of any tradesman's catalogue, price list, or advertising circular, through the post or otherwise, is forbidden, unless a request has been made in writing for the delivery thereof. The sending of catalogues or price lists by traders to traders, for the purpose of their trade, or to persons abroad, is, however, to be permitted. Licences may be issued by the Board of Trade dispensing with the application of the Order to any person or thing, or any class of persons or things. Posters making announcements with respect to goods offered for sale by a retailer may only be displayed on the premises where they are so offered for sale. No paper poster may exceed 600 sq. in. superficial measurement.

Exemption Applications.—At Doncaster, the case of a switchboard attendant from the Mexborough & Swinton Tramways Co. was appealed against, both by the company and the Military Representative. Applicant had been exempted by a local tribunal until April 16th. He was 21 years of age, passed for general service, and earning 30s. a week. It was pleaded that it was necessary to keep a competent man at the main switchboard, but, in answer to the Military Representative, it was said that that work was now being done by women at sub-stations, but not at power stations. It would take 12 months to train a man for the power-station work. The Military Representative stated that the man was put back 10 groups 12 months ago, and he thought they had had sufficient time to find an efficient substitute. The Tribunal, however, dismissed both appeals.

Gillingham (Kent) Town Council appealed for C. W. Warby (28), fitter's assistant at the electric light works, passed in Class C 1. The electrical engineer (Mr. A. D. Chalmers) claimed that Warby was, through his occupation in a public utility department, in a reserved occupation. Coun. Freathy said that Class C 1 men were wanted as substitutes, and Warby could be replaced. With this object in view, the appeal was respited for a month.

At Stratford-on-Avon, an appeal was made by J. Clifford (27), in C 1, an electrical turbine worker engaged with the British Thomson-Houston Co., Ltd., at Rugby. It was urged that in view of his low category appellant should be allowed to remain at his present work rather than be taken to perform such military service as a C 1 man could do. The works manager of the B.T.H. Co. wrote suggesting that appellant would be doing a greater service to the nation by resuming duty at the works than he would by entering the Army. It transpired that appellant had been with the company from February 9th, 1915, until he received his calling-up papers on February 15th last, and that his badge was taken away a few weeks before he left. The Military Representative suggested that if the B.T.H. Co. could find a Class A man to be released then appellant might be allowed to remain; otherwise he ought to go into the Army. The Tribunal allowed two weeks for appellant to find work of national importance.

On the appeal of the Military, the conditional exemption granted to Mr C H. Fancy (26), managing engineer-in-charge for the Harold Wood Electric Supply Co., Ltd., has been withdrawn by the Romford Rural Tribunal, and a short period of temporary exemption substituted.

At Orsett (Essex), the Stepney Board of Guardians appealed for exemption for the electrical engineer at their Stafford Homes, who is 31, and was engaged in July, 1916, on the understanding that he was ineligible for military service. He was in Class B 2, and the only skilled mechanic at the institution. Mr. Brooks (Military Representative) expressed the opinion that time must be allowed for another man; clearly the institution could not be left without an electrical engineer of some sort. He would be useful to the Army, and he would not object to two months to enable a successor to be found. This term was conceded.

At Barnstaple, the Corporation electricity department appealed for the retention of M. Andrew (18), in Class B 1, a premium pupil in electrical engineering. The manager of the works, Mr. Hadfield, stated that they had become greatly understaffed, and the work was only being continued with difficulty. The Tribunal allowed exemption until September 1st, on Andrew undertaking a share of the night work, the Chairman intimating that they were impressed by the fact that all the brothers of Andrew, five in number, were serving.

Before the Hants. Appeal Court, Mr. Robson, tramways manager, Southampton, applied for exemption for 25 members of his staff. In each case three months were granted, with leave to appeal again.

Exemption held by E. Rothwell (32), electrical engineer at the Rochdale Board of Guardians' institution, in Class A, was opposed by the Military Representative. The Clerk to the Guardians, Mr. R. A. Leach, stated that they had received an urgent request to provide increased accommodation at the workhouse for wounded soldiers. Mr. Rothwell was an X-ray expert, and was occupied daily on that work. The appeal was refused, and the exemption confirmed.

At Bermondsey, Mr. W. J. Heenan, borough electrical engineer, applied for the exemption of a topman at the electricity and destructor works. He stated that it was impossible to obtain a man to replace him. A member of the Tribunal said they had been taking men from trades like this who could not be replaced, as there were no men left. He was granted three months' exemption.

At St. Annes'-on-the-Sea, the Tribunal heard the case of a man of 26, passed for general service, who is employed by a contractor in carting coal to the St. Anne's electricity works. The Clerk to the Council said they had endeavoured to get the coal carted by steam wagon, but were unsuccessful, and the Chairman said there were 24 wagons of coal waiting to be unloaded, and the delay was a serious matter. The case was suspended for a month, with a view to making other arrangements.

At the Shoreditch Tribunal, Messrs. Anselm Odling & Sons, Ltd., Crown Wharf, New North Road, marble merchants. appealed for W. Jefferies, aged 37, single, an electric crane driver, for the third time. Mr. Odling said this electric crane was up on a high scaffolding or carrier-way, which ran the crane out, and lifted the marble out of barges in the canal. First of all, an electrical crane wanted understanding, and then, again, it was most necessary to have a man of splendid nerve. Old men could not stand the height and the work, and had had to leave it. It was a 10-H.P. electrical crane, capable of lifting 10 tons. The Tribunal granted four months, conditional on joining the V.T.C.

Before the Chertsey Rural Tribunal, on February 24th, the Military again applied for the withdrawal of exemption granted to Mr. G. W. R. Howard (37), of Pyrford, inspecting engineer to the Tudor Accumulator Co., Ltd., and responsible for the proper maintenance of the firm's storage batteries at military camps, forts, hospital, and railway and munition works throughout the South of England. A further three months' exemption was allowed.

Before the Surrey Appeal Court, at Croydon, on February 24th, Mr. B. R. Pearce appealed for R. Anderson (34), in Class B 2. He said that he was manufacturing electric batteries formerly made by German firms, and Anderson had found out the secret of how they were made. Two months were conceded.

Nevada Transmission Storm Damage.—The *Journal of Electricity*, in a recent issue, illustrated the effects of sleet storms on transmission lines in the Sierra Nevada Mountains. In December last unprecedented storms of snow and sleet occurred: the sleet on the wires formed a frozen cylinder weighing 3 lb. or more per foot and as much as 6 in. in diameter, and the dead weight, together with a 50-mile wind, caused a number of towers to collapse. The towers carried two circuits with a 660-ft. span, and were designed with a factor of safety of 2, to withstand the weight of ½ in. ice coating and a wind of 75 miles an hour. No two towers failed in the same place; it is considered cheaper to repair the damage than to construct for such unusual strains.

Coal Advisory Board.—An Advisory Board has been appointed to assist the Controller of Coal Mines on general questions of policy; it comprises five representatives of coal owners and five of the miners.

ELECTRIC LIGHTING IN FRANCE.

As might be expected would be the case, the electric lighting companies in France which are dependent upon steam generating plant were very unfavourably placed during the year 1916, owing to the very high cost of coal and the difficulty of obtaining adequate supplies, and to the dearness of other raw materials. As a consequence, many companies were compelled to reduce their rate of dividend as compared with that of the preceding year, whilst no distribution whatever has been made in some cases. An exception to this state of affairs, however, is afforded by the Société d'Electricité de Paris, which is a bulk supply company, and furnishes energy to a small number of customers, particularly the Metropolitan Railway, the Nord Sud Railway, the Tramways de Paris, the Compagnie des Omnibus, and certain distributing companies, such as the Société d'Eclairage et de Force, &c.

The Société d'Electricité de Paris has an interesting form of contract with its customers. The price for energy is based upon the average price of coal in the current year for the time being, but as the latter cannot be definitely ascertained until after the end of December the price charged to customers is provisionally arranged on the coal price in the previous year, the final adjustment of accounts only being made in the following year. It thus happens that when the price of coal in any one year becomes enhanced, the supply company plays the part of banker to its customers, whereas the clients fulfil this part towards the company if the quotations for coal fall during the year. Under normal conditions the coal prices only vary within certain limits, as, for instance, from 3 fcs. to 4 fcs. per ton. As the company consumes 200,000 tons of coal per annum variations of these amounts only represent from £24,000 to £32,000, the cost of which can be defrayed out of floating capital. But when the price is advanced by 300 per cent., or £2 8s. per ton—as took place in 1916—the sum involved rises to £480,000, and no company with an ordinary share capital of £1,000,000 could have floating funds available to meet the requirements of the case. Under the circumstances, the company in question has endeavoured to make arrangements with its customers for payment in advance, but these efforts have only been partially successful, and the problem continues to be a heavy financial burden.

M. Daniel Berthelot, Chairman of the Société, drew attention to another aspect of the coal problem at the recent annual meeting of the shareholders. Apart from the fact that French coal prices have been fixed by the Government, permits have to be obtained by all companies or firms for the importation of English coal, and as this was fixed by the British Government at not exceeding 2,000,000 tons per month, a crisis has arisen in regard to supplies, and is preventing the formation of stocks at the electricity works, as in former years. Nevertheless, the company referred to has been able to increase its output, and to render assistance in recent months to other companies in Paris which are also working for the national defence. The total sales in 1915-16 amounted to 116,824,000 KW.-hours, as compared with 85,564,000 KW.-hours in 1914-15, and 145,300,000 KW.-hours in 1913-14, which was the year of maximum turnover. As showing the development in recent times, the Chairman mentioned that sales from July 1st to November 30th, 1916, reached 60,570,000 KW.-hours whereas in the corresponding period of 1915 they were 45,275,000 KW.-hours, and only 28,711,000 KW.-hours in the equivalent term in 1914. The dividend is at the rate of 8 per cent., as in 1914-15, and is the same as in the company's most prosperous years prior to the war. On the other hand, the average selling price realised per KW.-hour has declined of late years, owing to the competition of other and more recently established works, and the consequent necessity for accepting lower prices in connection with the renewal of old agreements or the conclusion of new contracts.

REFILLABLE FUSES.

THE subject of the design of fuses, which for some time has figured prominently in our pages, has recently attracted attention also in the United States, where the Bureau of Standards has been acting as referee between the Underwriters' Labaratories (Inc.), of Chicago, and the Economy Fuse and Manufacturing Co., of the same city. The question at issue was as follows:—"Has it been shown that the use of the fuses manufactured by the Economy Fuse and Manufacturing Co. results in no greater fire or accident-hazard than the use of other cartridge-enclosed fuses at present listed as standard by Underwriters' Laboratories (Inc.)?"

While the particular make of fuse whose merits were under investigation may have no intrinsic interest for us, the broad question at issue is one which appeals to all supply engineers and contractors—namely, whether the user of a fuse should be aided or hindered in renewing his fusible cut-outs by means of wire. A considerable amount of evidence was submitted to the Bureau by both parties, and by companies manufacturing "approved" cartridge fuses, and the Bureau also carried out a large number of tests under various conditions, to determine the relative performance on heavy overloads of new and refilled fuses, and the effect on such fuses of protracted service under normal conditions.

Apparently the performance of the Economy 250-volt fuses was generally satisfactory, and the real reason why the Underwriters' Laboratories withheld approval was that the Electrical Committee of the National Fire Protection Association held that fuses designed to be readily refilled by the user should not be approved, because of the greater probability of misuse than in the case of fuses difficult to refill. It may be noted, however, that the Economy Co. submitted samples of the latter for the purpose of demonstrating the *ease* with which they could be refilled by the user, in spite of the intentions of the designer; the Bureau, in its Report,* remarks that the point was quite clearly established, and that the investigations of its own inspectors show that replacement both with the proper fuse elements, and with improper elements, is actually done to a considerable extent.

It is unfortunate that no drawings are given showing the construction of the various fuses that were tested, but from the references in the text they all appear to have been cartridge-type fuses, with fibre casings, some at least having copper ends, and some kind of powder as a filler (an older type of the Economy fuse contained powdered filler, but not the type at present manufactured). Some or all of the patterns had indicators to show when they had been blown. Tests were made in the laboratories of the Bureau of Standards, under "very mild short-circuit conditions" (with currents limited to 800, 600, and 400 amperes, the fuses being rated at 30 amperes 250 volts), on the Economy fuses and six approved makes; further tests were made at one of the Boston Edison Co.'s power plants with limiting currents of 10,000 and 5,500 amperes, and various inductances in circuit, and at Chicago 600-volt fuses were tested under somewhat similar conditions. In some cases the Economy fuse was better, in others worse, than its rivals. Tests on "aged" fuses—*i.e.*, fuses which had carried their rated current for a considerable time—gave inconclusive results, but the deterioration was markedly greater with unfilled Economy fuses than in the case of fuses using powdered filler, which did not reach so high a temperature. Most of the tests were made on single fuses; when two fuses were used in series, the usual condition in practice, the operation of Economy fuses was entirely satisfactory, though the limiting current was 10,000 amperes. In the course of the investigation, experiments were made which showed that, under service conditions, short-circuit currents of 10,000 amperes or more could very frequently be obtained over a considerable area near a large modern power plant, and values ten times as great were observed. One make of fuse which had received approval was found to be decidedly below the standard set by the Underwriters' Laboratories.

In the course of the investigations, it was found that abuse of approved fuses took a great variety of forms, such as bridging with heavy wire or nails, filling the fuse cartridge with melted solder, &c. On one inspection trip an engineer of the Bureau found one in seven of 379 approved enclosed fuses to be improperly refilled, but on other occasions the tendency to abuse such fuses was found to be relatively small. Small shops make a regular business of refilling approved fuses, and often do it as badly as when the user attempts to do it himself. On the other hand, the evidence indicates that there is less tendency to abuse the Economy fuse than in the case of standard patterns, a fact which is attributed to the relative ease with which the former can be refilled with the proper elements; and while individual Economy fuses have failed in various ways, there is no evidence that the use of such fuses has increased the fire hazard. But the deterioration due to repeated blowing of the fuse elements in the same casing is regarded as an undesirable feature, and the Bureau considers that the approval of the present type of Economy fuse for unrestricted use would result in a lowering of the standard of fuse performance, and might introduce hazards of uncertain value. The actual finding of the Bureau, as referee, is somewhat hesitating and inconclusive; it recommends that the Economy fuses be not approved at present for general use on the same basis as fuses at present listed as standard, but that their use be permitted under conditions where their performance can be observed, until sufficient experience has been gained to justify an unqualified verdict.

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* Technologic Papers of the Bureau of Standards, No. 74.

It may be mentioned that this was the first instance in which the Bureau of Standards was invited to act as referee, and the Director, Dr. S. W. Stratton, in opening the proceedings, said that it marked an important period in the history of that Institution, indicating also a very important change that was going on all over the country—namely, to break away from costly and senseless legal fights, and to settle questions upon the basis of fact alone. The evidence is reported at great length, and contains much interesting matter; full particulars of the Bureau's tests are also given, together with numerous oscillograms showing the relations of current, voltage, and time. In the absence of details of the construction of the fuses, however, we think no advantage would be gained by reproducing these.

LEGAL.

The B.T.H. Trade Mark.

In the Chancery Division, on February 28th, Mr. Justice Astbury heard an appeal by the British Thomson-Houston Co., Ltd., from the decision of the Registrar of Trade Marks, refusing to register as a trade mark the letters "B.T.H." inside a circle with scrolls, which the company had used long and extensively to distinguish their goods. The Registrar's grounds for refusal were that initials were not capable of registration as a trade mark, and that a circle, even with scrolls, was too common to be distinctive of any particular class of goods with which it was desired to connect them.

The case was argued on behalf of the company by **Mr. J. Hunter Gray**, and the Registrar was represented by **Mr. Austen Cartmell**.

Giving judgment, his **Lordship** said that the company had used the mark continuously and extensively since 1905 as a trade mark, and they said it had become distinctive of their goods. The question was whether it was distinctive within the meaning of the Act; and he had no alternative but to hold that it was, in view of the evidence of long and extensive use. The applicants were, therefore, entitled to have the registration of the mark proceeded with, and he directed the Registrar so to do.

London United Tramways, Ltd., *v.* L.C.C.

In the King's Bench Division on Monday, before a Divisional Court composed of Justices Bray and Horridge, this arbitration case, which is a motion by the London County Council to set aside an award, was mentioned.

Mr. Morton, K.C., said that he wished to apply to their Lordships, with the consent of all parties, that the case should stand over for a fortnight. He said that there was a very large amount of money in dispute. The matter had been stated in the form of several special cases, and one particular item in the money involved was that relative to the Chiswick power house. The London County Council were asking that that part of the award should be set aside on the ground that there had been an excess of jurisdiction. There had been negotiations going on over a long period between the parties with a view to arriving at a settlement of the matters that were in dispute. Apart from the item that Counsel had referred to, there were other sums in dispute relating to the purchase of these tramways within the County of London, and if the adjournment was granted it was hoped that a complete settlement might be arrived at.

Their **Lordships** assented to the adjournment, the case not to come into the list before a fortnight from the date of the application.

Electrical Installation at a Theatre.

Alleged Breach of Contract.

Mr. Edward Pollock, High Courts Official Referee, on Thursday, March 1st, again resumed the hearing of this action, in which Vaughan & Co., Ltd., electrical engineers, of Cross Street, Islington, sought to recover from the Golder's Green Amusement and Development Co., of Duke Street, St. James', the balance of charges for putting in an electrical installation at the defendants' new theatre of varieties at Golder's Green. They also claimed damages for breach of contract.

Mr. Hewitt, consulting electrical engineer, gave further evidence in support of the plaintiffs' case

Cross-examined on the specification, Witness said that carbon lamps were sometimes used for coloured lights, but the advantage would be a very small percentage. The specification provided for cables which were in excess of those necessary for the work they had to do.

Supposing, instead of continuing to take the supply from the supply company, the theatre at any time had determined to put in its own supply, would you prefer the cables as required by the specification or the cables as put in?—Taking the installation as a whole, the cables as put in.

Re-examined by **Mr. Copping**: As to the sectional area of the cables and the cost of the extra cables, he said he had gone thoroughly through the specification, and, in his opinion, it was originally based on 100 volts and then altered to 240, and the wiring had to be altered to meet the change. It was carried out in accordance with the 240 volts.

This evidence closed the case for the plaintiffs.

Mr. Ernest Pollock, K.C., opening the case for the defence, said that the contract under which the claim was made was contained in two letters—a letter from the plaintiffs submitting a tender, and a reply from the defendants accepting it. The plaintiffs offered to fit up the installation at the defendants' theatre of varieties for the sum of £1,700. They said that they duly equipped the theatre and carried out extra work outside the contract. They admitted having received on account £1,650, and said that they had sold and delivered goods to the defendants to the amount of £367 2s. 9d. Defendants did not dispute the contract, but said that the plaintiffs had not done the work properly, and had not completed it. As to the extras, he said that a written order was a condition precedent to any extra work. The defendants further said that the payments made had not been paid on account, but that they had been made, upon the architect's certificate, in full. The plaintiffs, in their letter of September 15th, 1913, had undertaken to do the whole of the work for £1,700; but the plaintiffs now said that they (defendants) interfered with the consulting engineer (Mr. Mitchell), and that in consequence of that they were discharged from doing the work strictly in accordance with the specification. He (counsel) agreed, to a large extent, with the views of the other side as to the effect of the alterations. They could not supplant a person named in the contract by another person not named in the contract. So far, there had been a breach of the terms of the contract, and the plaintiffs could sue for *quantum meruit* or for the contract price, deducting what it would have cost to finish the work. The plaintiffs had elected to sue upon the contract, with a claim for extra work, and in suing upon the contract they were still liable to fulfil the conditions precedent and produce the orders for the extras, because there was no power to waive the conditions. In respect of a number of the items claimed for, no orders in writing had been produced. After the evidence that had been given, it was quite clear that the plaintiffs had put aside the specification altogether.

Evidence was called, when the case was continued on Friday, in support of the defendants' case, expert witnesses giving their opinion as to the manner in which the work had been carried out, and the cost of alteration where that work, as alleged, was not in accordance with the specifications. One of the witnesses stated that the cost of altering the work now would be much more than the amount of saving to the contractor had been. He estimated the total amount necessary to make good all the defects, and put the installation in a condition as required by the specification and contract, at about £1,169. He went into minute details of each item of the suggested necessary work, but admitted that he had based his estimates upon an examination made three months ago, after the whole installation had been in use for a period of three years, and he had heard of no mishap occurring during that time.

Mr. Ernest Pollock, K.C., counsel for the defendants, on the case being resumed on Monday, March 5th, urged that even though the defendants would not be in a position to sue the old company for their counterclaim, the figures should be determined.

Mr. Copping, addressing the Referee upon the plaintiffs' case, said that on Boxing Day, 1913, the plaintiffs had executed a considerable amount of work for the defendants, work which enabled them to have their theatre opened on that day with the light on. A fair price for the work and labour done on the defendants' premises, and goods supplied, amounted, according to the evidence, to £3,014 2s. 9d. In respect of that total the defendants had paid £1,650, leaving £1,364 2s. 9d. for work done and goods supplied, for which the plaintiffs had received no payment at all. On the contrary, it was suggested that the plaintiffs were indebted to the defendants in the sum of £632 2s. 3d. Although they had had the installation put in on the most favourable figures that could be put forward by any of the witnesses for the defence, there was an unpaid balance of over £800. The contract between the parties, he argued, was to carry out the installation to the satisfaction of the consulting engineer and architect mentioned in the contract. The throwing-over of the consulting engineer and architect was an abandonment of their contract, and the plaintiffs were entitled under the circumstances to recover on a *quantum meruit* for work done. But he still submitted that the work had been done in accordance with the contract.

The **Official Referee** reserved judgment, as there were points of law and of fact which it was necessary for him to consider.

British Thomson-Houston Co., Ltd., *v.* Duram, Ltd.

This case came before the Appeal Court on Tuesday, on the appeal of the plaintiffs from a judgment of Mr. Justice Astbury in favour of defendants. The case is proceeding.

Excess Profits Duty.—The Board of Referees has considered applications from the undermentioned companies for an increase of statutory percentage, with the results stated:—

Shanghai Electric Construction Co., Ltd., and Hankow Light and Power Co., Ltd.—Percentage increased to 9 per cent. in case of trade or business carried on or owned by a company or other corporate body, and to 10 per cent. in the case of any other trade or business.

TRADE STATISTICS OF SWITZERLAND.

IMPORTS.

The following figures of the imports of electrical and similar goods into Switzerland in the year 1915 are taken from the recently-issued trade statistics; the figures for 1914 are added for purposes of comparison, and notes of increases or decreases are given.

Electric cable not insulated.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
From Germany	19,000	2,000	–	17,000
,, France	1,000	—	–	1,000
,, Other countries ...	200	—	–	200
Total	20,200	2,000	–	18,200

Electric cable insulated with rubber or paper.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
From Germany	90,000	5,000	–	85,000
,, Great Britain ...	—	1,000	+	1,000
,, France	20,000	4,000	–	16,000
,, Other countries ...	3,000	142,000*	+	139,000
Total	113,000	152,000	+	39,000

* Italy.

Cable ditto covered with lead.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
From Germany	3,000	--	–	3,000

Cable ditto covered with lead and iron-armoured.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
From Germany	165,000	53,000	–	112,000
,, Great Britain ...	1,000	—	–	1,000
Total	166,000	53,000	–	113,000

Cable insulated with rubber or paper and covered with textiles.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
From Germany	171,000	6,000	–	165,000
,, Italy	9,000	184,000	+	175,000
,, Great Britain ...	16,000	27,000	+	11,000
,, Other countries ...	5,000	1,000	–	4,000
Total	201,000	218,000	+	17,000

Cable ditto covered with lead.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
From Germany	12,000	--	–	12,000
,, Austria	187,000	—	–	187,000
,, Other countries ...	1,000	3,000*	+	2,000
Total	200,000	3,000	–	197,000

* Italy

Dynamo-electric machines and electric transformers.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
From Germany	1,224,000	900,000	–	324,000
,, France	90,000	25,000	–	65,000
,, Italy	34,000	12,000	–	22,000
,, Great Britain ...	8,000	24,000	+	16,000
,, Other countries ...	19,000	4,000	–	15,000
Total	1,375,000	965,000	–	410,000

Accumulators, batteries, electrodes.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
From Germany	222,000	103,000	–	119,000
,, Austria	70,000	—	–	70,000
,, France	31,000	10,000	–	21,000
,, Other countries ...	8,000	32,000*	+	24,000
Total	331,000	145,000	–	186,000

* Italy 29,000 fcs.

Insulators, mounted.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
From Germany	78,000	33,000	–	45,000
,, France	2,000	1,000	–	1,000
,, Other countries ...	2,000	—	–	2,000
Total	82,000	34,000	–	48,000

Electric meters.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
From Germany	697,000	873,000	+	176,000
,, France	85,000	111,000	+	26,000
,, Italy	10,000	7,000	–	3,000
,, Great Britain ...	3,000	3,000		—
,, Other countries ...	7,000	4,000	–	3,000
Total	802,000	998,000	+	196,000

Telegraph and telephone apparatus.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
From Germany	474,000	191,000	–	283,000
,, Belgium	277,000	35,000	–	242,000
,, Great Britain ...	318,000	45,000	–	273,000
,, Sweden	90,000	58,000	–	32,000
,, Other countries ...	53,000	20,000	–	33,000
Total	1,212,000	349,000	–	863,000

EXPORTS.

The following figures show the exports of electrical and similar machinery from Switzerland in 1914 compared with 1915. The diversity of Switzerland's growing export trade is noteworthy:—

Dynamo-electric machines and electric transformers of all kinds.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
To Germany	2,257,000	2,998,000	+	741,000
,, Austria	525,000	893,000	+	368,000
,, France	3,002,000	3,523,000	+	521,000
,, Italy	1,158,000	1,089,000	–	69,000
,, Belgium	401,000	35,000	–	366,000
,, Great Britain	2,014,000	1,798,000	–	216,000
,, Russia	2,019,000	843,000	–	1,176,000
,, Spain	738,000	1,204,000	+	466,000
,, British India	30,000	201,000	+	171,000
,, Mexico	65,000	—		65,000
,, Brazil	308,000	102,000	–	206,000
,, Argentina	950,000	982,000	+	32,000
,, Other countries ...	2,111,000	1,578,000*	–	533,000
Total	15,578,000	15,246,000	–	332,000

* Netherlands 497,000 fcs., Norway 611,000 fcs.

Steam engines, cranes, pumps, turbines, &c.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
To Germany	941,000	1,515,000	+	574,000
,, France	673,000	755,000	+	82,000
,, Belgium	575,000	17,000	–	558,000
,, Russia	1,104,000	1,189,000	+	85,000
,, British India	49,000	131,000	+	82,000
,, Japan	97,000	21,000	–	76,000
,, Great Britain	577,000	648,000	+	71,000
,, Other countries ...	1,884,000	1,186,000*	–	638,000
Total	5,900,000	5,462,000	–	438,000

* Sweden 127,000 fcs., Spain 372,000 fcs., Chile 192,000 fcs.

Accumulators, batteries, electrodes.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
To Germany	7,000	21,000	+	14,000
,, France	47,000	539,000	+	492,000
,, Italy	7,000	140,000	+	133,000
,, Greece	—	25,000	+	25,000
,, Egypt	1,000	—	–	1,000
,, Other countries ...	24,000*	80,000	+	56,000
Total	86,000	818,000	+	732,000

* Brazil 8,000 fcs.

Electric meters.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
To Germany	437,000	803,000	+	366,000
,, Austria-Hungary ...	197,000	118,000	–	79,000
,, France	371,000	155,000	–	216,000
,, Italy	276,000	373,000	+	97,000
,, Great Britain	332,000	387,000	+	55,000
,, Russia	137,000	400,000	+	263,000
,, Other countries ...	287,000	668,000*	+	381,000
Total	2,037,000	2,904,000	+	867,000

* Includes Spain 150,000 fcs., Japan 153,000 fcs.

Steam, benzine, and electric locomotives.—*

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
To France	1,013,000	68,000	–	945,000
,, Algeria and Tunis ...	436,000	—	–	436,000
,, Dutch East Indies ...	247,000	385,000	+	138,000
,, Other countries ...	273,000	387,000†	+	114,000
Total	1,969,000	840,000	–	1,129,000

* Electric locos. in 1914, 146,000 fcs.; in 1915, 11,000 fcs.
† Includes Philippines 113,000 fcs.

Electric cable, not insulated.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
To Germany	6,000	1,000	–	5,000
,, France	5,000	—	–	5,000
,, Other countries ...	4,000	300	–	3,700
Total	15,000	1,300	–	13,700

Electric cable, insulated with rubber or paper.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
To Germany	28,000	135,000	+	107,000
,, France	89,000	4,000	–	85,000
,, Italy	7,000	—	–	7,000
,, Other countries ...	153,000*	20,000†	–	133,000
Total	277,000	159,000	–	118,000

* Norway 12,000 fcs., Turkey 11,000 fcs.
† Greece 8,000 fcs., Roumania 11,000 fcs.

Cable, ditto, covered with lead.—

	1914. Francs.	1915. Francs.		Inc. or dec. Francs.
To Germany	8,000	1,000	–	7,000
,, Great Britain	57,000	158,000	+	101,000
,, Other countries ...	3,000	--	–	3,000
Total	68,000	159,000	+	91,000

	Francs. 1914.	Francs. 1915.		Francs. Inc. or dec.
Cable, ditto, covered with lead, and iron armoured.—				
To Germany	44,000	23,000	–	21,000
,, Great Britain	156,000	12,000	–	144,000
,, France	3,000	—	–	3,000
,, Egypt	2,000	7,000	+	5,000
,, Other countries ...	105,000*	—	–	105,000
Total	310,000	42,000		268,000

* Roumania 5,000 fcs.

Cable, insulated with rubber or paper, and covered with textiles.—				
To Germany	—	69,000	+	69,000
,, France	9,000	—		9,000
,, Italy	56,000	—	–	56,000
,, Great Britain	124,000	8,000	–	116,000
,, Other countries ...	106,000	10,000*	–	96,000
Total	295,000	87,000	–	208,000

* Roumania.

Cable, ditto, covered with lead.—				
To Germany	3,000	2,000	–	1,000
, Other countries ...	6,000*	—	–	6,000
Total	9,000	2,000	–	7,000

* Roumania 5,000 fcs.

Note.—25 francs = £1.

REVIEWS.

Experimental Wireless Stations. By P. E. Edelman. Published by the author, Minneapolis, U.S.A. Price $1.50.

This work is now in its third edition, and has been brought up to date by a certain amount of general revision and by the addition of a 44-page supplement containing brief notes on various developments likely to interest the wireless experimenter, and capable of being tested or applied by him. A very useful list is given of United States patents on wireless telegraphy, telephony, and control, classified under various subject headings, and covering the period 1881 to January 1st, 1916. As regards the main portion of the book, which dates from 1912, and is probably known to many readers, the author has taken up the standpoint that the average "amateur" wireless worker is really an earnest student of the subject, and not far removed from the skill and opportunities of the professional operator or inventor. Keeping this principle before him, the author gives a clear and practical treatment of the theory, design, construction, and operation of experimental wireless stations. The amount of theory included is only such as is likely to be really useful to the reader, and no space is expended on historical or elementary matter, or on half-tone illustrations showing only the general appearance of apparatus. The book is very well illustrated by clear line diagrams. A point to which the author rightly attaches great importance is the necessity for working with sharply tuned wave lengths; unless this is done, experimental wireless stations, by their very number, become an intolerable nuisance to each other and to commercial stations.

Beginning with a general treatment of the nature and theory of wireless transmission, the author passes on to a description of types of aerial, and gives useful suggestions for their construction. Grounds and lightning protection are treated in similar manner, and the next two chapters are devoted to resonance and the general features of transmitters, and to the calculation of wave length, capacity, and other circuit calculations. It is due to lack of clear ideas and reliable basic data that the average experimenter is disappointed so frequently in the performance of his equipment. A good treatment is given of the use and construction of auxiliary equipment, transmitting condensers, inductances, spark gaps, and various measuring instruments. The chapter on continuous waves, wireless telephony, and so on might be extended with advantage. The final half-dozen chapters, on the receiving station and its equipment, are excellent, especially the sections dealing with detectors, and with tuning and the prevention of interference. The table of contents is peculiarly placed between the main body of the book and the supplement; the index comes at the end, but is meagre. The book should be very useful to anyone interested in experimental wireless work.

Engineering Applications of Higher Mathematics, Part V, Problems in Electrical Engineering. By V. Karapetoff. New York, U.S.A.: John Wiley & Sons. Price 3s. net.

This volume is very obviously in the nature of a mathematical addendum to the author's two treatises, "The Magnetic Circuit" and "The Electric Circuit." It deals with a few of the important problems in electrical engineering, and applies the calculus to their solution. The mathematics required is in no case of a very advanced character—a somewhat surprising fact in view of the title of the book. Some explanation of this is, perhaps, to be obtained from the preface, in which the author plainly indicates that there is still some uncertainty in American colleges as to the proper place of mathematics in an engineering course, and the proper method of teaching mathematics to engineers.

After referring to the influence of Prof. Perry on his ideas, the author proceeds: "In teaching analytics and calculus to engineering students, the instructor should limit himself at first to a comparatively small number of curves, functions, and transformations, but each of these must be explained and *made concrete* in a number of engineering problems." He then remarks that most engineers are not natural mathematicians, and consequently the correct method of training them in mathematics is to work from the concrete to the abstract: from the specific practical case to the general case. He concludes that "either our instructors in mathematics must come to understand the difference between their temperament and that of their students, or else mathematics in engineering colleges will have to be taught by engineers." Fortunately, we in England have long since recognised the importance of these facts, as witness the excellent text-books in practical mathematics now in use in our technical schools and colleges.

Prof. Karapetoff further suggests—apparently as a quite revolutionary change in American methods—that the teaching of mathematics should be carried through all the four or five undergraduate years, and outlines a "rational course in mathematics for engineering students" covering five years. It is interesting to note that this course follows exactly on the lines of the courses given in the best technical schools and colleges in this country, and it is very remarkable that a professor at Cornell University should regard such a course as anything beyond the ordinary and necessary nucleus of an engineer's college training.

All this casts an interesting sidelight on American methods of technical instruction, and incidentally explains the reason for the introduction of chapters on seemingly elementary, and almost irrelevant, mathematics into quite advanced American scientific and technical manuals, of which Karapetoff's treatise on "The Electric Circuit," reviewed in our issue of September 13th, 1912, is a striking example.

The six important problems studied in this book are as follows: Resistance of non-cylindrical conductors and magnetic paths; minimum weight of metal in a combination of conductors; most economical size of conductors; a leaky direct-current line; average and effective values of voltage and current; efficiency and losses in electrical machinery. Twenty or thirty examples are worked out in each section, and all the practical cases are included. Very neat proofs are given in many cases, notably in connection with efficiency and resistance calculations, and the practical and economical considerations which modify the answers obtained by mathematics are indicated in such cases as determining the cross-section of conductors. The section on average and effective values of voltages and currents is extremely well written and useful; there is also a useful appendix on maxima and minima.

A bibliography is given at the end of the book, and English electrical literature is represented by the works of Fleming, Lamb, Thomson, and Campbell. Altogether the book is a useful and satisfactory mathematical appendix to the author's larger treatises; it should give breadth and solidity to the knowledge of any engineering students who may use it.—P. H. S. K.

Alternating Current Work. By W. Perren Maycock. London: Whittaker & Co. Price 6s. net.

This book is a revised and extended edition of the author's former work, "The Alternating Current Circuit and Motor," but, as it now includes alternators and transformers, it has been given a new and more comprehensive title. A sub-title describes it as an introductory book for engineers and students, and its scope and objects are set out with considerable frankness by Mr. Maycock in the introductory paragraphs to Chapter I. Here he claims that "it is certain that the subject could not have been treated satisfactorily in a more elementary way," and, after stating that the calculus has not been allowed to show its "fearsome face," and that the very little trigonometry used has been fully explained, he proceeds to enter some interesting remarks concerning mathematics and the electrical engineering profession.

"Good mathematical knowledge is an accomplishment worthy of great respect, and is of decided advantage to an engineer, provided he does not neglect other aspects of his work. But those who—through lack of tuition or sheer mental inability—are unable to rise to such heights, may comfort themselves with the reflection that there is plenty of room for distinction in other ways. It is easy to imagine numerous cases . . . where the highly mathematical man would only be able to look on while the practical man was righting things. Then there is the indispensable 'commercial engineer,' who often does not possess very special knowledge of either theory or practice, but whose duties would be quite beyond some theorists and practicians."

Now, while we cordially agree with Mr. Maycock that there is room in the profession for both theorists and practicians, and that very few men can be expert in both capacities, yet we are disposed to doubt the "indispensability" of any electrical engineer to-day who does not possess any special knowledge of either theory or practice. The existence of such gentlemen is beyond dispute, but their desirability is open to question.

After encouraging the reader who may become overawed by the formulæ and vector diagrams by inciting him to "a little application," Chapter I proceeds to specify the nature and complication of the subject of electrical engineering, and to give reasons for the necessity for specialisation in one or more branches of the subject.

Chapter II occupies over 100 pages, and is in itself quite a little text-book of the theory of alternating currents. Following the recent suggestions of Dr. Drysdale, a number of remarkably sound mechanical and hydraulic analogies have been given, and the student's grasp of the effects of resistance, capacity, and inductance in a circuit ought to be materially strengthened by this method of treatment. The models used to obtain these analogies are well illustrated, and the corresponding effects in the A.C. circuit have been represented as far as possible by oscillograms. The method of representing A.C. conditions by means of vector diagrams has been dealt with in an equally unique manner, and the claim of the author to have devised the simplest and least objectionable method of treatment for the less mathematically minded is, in our opinion, well sustained. The vector diagram itself is first introduced with great subtlety, and its application is then insisted upon in a few well-chosen and fully worked out problems. Most of the examples at the end of this and subsequent chapters have been taken from the City Guilds and A.M.I.E.E. examination papers, and answers are given to all the numerical questions.

The next chapter deals with polyphase currents and power measurement, and here, again, the hydraulic analogy is employed with advantage, especially in the descriptions of the wattless current and the Y connection. A few fully worked out examples in the calculation of power in A.C. circuits also add to the usefulness of the chapter. Chapters IV, V, and VI deal in succession with alternators, transformers, and motors. In all cases the various types are classified, their windings are described, and numerous well-figured diagrams given of machines at various stages in course of construction. The synchronism and "regulation" of alternators are given considerable attention, and numerous calculations of transformer losses and efficiency are given.

The production of the rotating field by 2 and 3-phase currents is well described and illustrated, and its practical application to the running of motors is treated with equal thoroughness. Important sections of the chapter on motors are also devoted to single-phase induction and repulsion motors, and to motor calculations. This latter section, which has been largely extracted from the author's "Electric Circuit Theory and Calculations," is an exceptionally useful collection of typical motor problems worked out in full, the circle diagram being employed in many cases.

The book concludes with a short account of the uses of motors and the most recent applications of A.C. motors to railway, ship, and crane work. There can be no doubt that this book is, as it is claimed to be, an improvement on the author's former work, "The Alternating Current Circuit and Motor," for in these 400 pages Mr. Maycock has given a very thorough account of his subject. He has had two invaluable allies, to whom due credit is given in the preface—Mr. Hughes, who has collaborated throughout, and to whom are due the solutions to the numerical examples, and Mr. Bishop, who has succeeded admirably in the making of good diagrams. It is also noticeable that the photographs of machinery, &c., are unusually clear and helpful, and are *not* of the usual catalogue description, and that to this end a large number of the important engineering firms have been drawn upon for blocks.

Altogether the book is very sound and satisfactory, and the price is fair and reasonable.—P. H. S. K.

BUSINESS NOTES.

The Census of Production.—By a special Act of Parliament, it is to be arranged that a census of production shall not be taken in 1918, as the present year is a most unsuitable period to cover, and would afford no trustworthy index to the course of internal trade. It is proposed that the Board of Trade shall have power to settle when the next census shall be taken, and shall issue an order a year before the commencement of the year in which the census is to be taken.

Bankruptcy Proceedings.—OXLEY, H. H. (otherwise Oliver Huxley), Hanwell, lately of Ealing.—Second and final dividend 6¾d. in the £, payable March 7th, at 14, Bedford Row, W.C.

CUNNINGTON, J. G. S., and ALLISON, H. P. (Laing, Wharton and Cunnington), 7, Great Newport Street, London, electrical engineers and contractors. March 21st is the last day for receipt of proofs for dividend by Mr. E. L. Hough, the Official Receiver, at Bankruptcy Buildings, Carey Street, W.C.

Catalogues and Lists.—BRITISH THOMSON-HOUSTON CO., LTD., 77, Upper Thames Street, London, E.C.—Complete lamp catalogue, comprising eight sections, dealing with drawn tungsten filament lamps in various types, including standard (vacuum) lamps, half-watt type lamps, focusing or projector-pattern lamps of both vacuum and half-watt types, automobile and battery lamps, including half-watt models for motor-car headlights, lamps for medical, surgical, and scientific applications, B.T.H. carbon filament lamps for lighting and for radiator use, and carbon lamps for decorative purposes, the first section being devoted to useful tables and data relating to incandescent lamps in general and to B.T.H. lamps in particular. These sections are bound together in a stout tinted cover of attractive design. Every type of lamp (no fewer than 67 are illustrated) is priced, with its dimensions, wattage, form of cap, and output of light. The lighting values are expressed in terms of the lumen, which gives the total flow of light emitted irrespective of direction, shape of filament, or equipment of the lamp.

The company has also issued Incandescent Electric Lamp Handbook No. 3, of 64 pages, specially dealing with Mazda electric lamp bulbs for all makes of motor-car in use. Copies will be sent to electrical contractors, motor dealers, &c., on application.

ENTERPRISE MANUFACTURING CO., Gun Street Electrical Works, Bishopsgate, London.—Illustrated circular relating to their new type of fuseboard.

Trade Announcements.—THE L.P.S. ELECTRICAL CO. have moved their offices and stores to 14, Howick Place, Westminster, S.W. Telephone number: "Victoria 7346." Telegraphic address: "Engineyor, Sowest, London."

We understand that MESSRS. QUEAD, LTD., have appointed the Australian General Electric Co., of Melbourne, their agents for Australia, and the South African General Electric Co., for South Africa, for all their electric fires.

With reference to the notice under "Change of Address," last week, we are asked to state that only part of Queen Anne's Chambers, Westminster, has been taken over by the Government. MR. GEORGE ELLISON, whose London offices were in the building, announces that he has removed to 25, Victoria Street, Westminster, and that his telephonic and telegraphic addresses are unaltered. MESSRS. MOSSAY & CO., LTD., of Queen Anne's Chambers, S.W., have also changed their premises for the same reason to 7, Princes Street, Westminster, S.W.

The telephone numbers of the UNBREAKABLE PULLEY AND MILL GEARING CO., LTD., Cannon Street, E.C., have been altered to "6131 City" (two lines).

Vickers's Enterprise in Italy.—A further important development of British enterprise in Italy has recently been arranged. We learn that Sir Vincent Caillard and Mr. F. Barker, directors of Messrs. Vickers, have been elected directors of the Società per le Imprese Idrauliche ed Elettriche del Tirso and of the Società per le Forze Idrauliche della Sila, in which companies the Banca Commerciale Italiana and its industrial group are largely interested. The object of the two companies, to whom special concessions have been made by the Italian Government, is the development of hydro-electric power for industrial purposes, and also for agricultural irrigation in Sardinia and the southern provinces of Italy. Hydro-electric power stations will be erected to develop the power of the Rivers Tirso in Sardinia and Sila in Calabria. The two companies have already got to work on an ambitious programme, which, with the participation of British capital and enterprise, is expected to apply a great stimulus to industrial expansion in Southern Italy and Sardinia after the war. Incidentally, the arrangement may be regarded as the driving of another nail in the coffin of German commercial penetration in Italy.—*The Times.*

Book Notices.—"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXVI, No. 2. February, 1917. New York: The Institute.

"Annual Report of the Smithsonian Institution for 1915." Washington: Government Printing Office.

"Technologic Papers of the Bureau of Standards." No. 74. Investigation of Cartridge-Enclosed Fuses. Washington: Government Printing Office.

"Firm-Names Register." By G. W. Daines. London: Information Bureau. 3d.—This is a pamphlet reprint from the *Financial News*, dealing with the "Registration of Business Names Act" for the "man in the street."

Owing to the war, *Cheap Steam*, the interesting monthly issued by Messrs. E. Bennis & Co., Ltd., will be issued bi-monthly until times become more normal.

Liquidations.—JAEGER BROS., 9, Rathbone Place, Oxford Street, London, W.—The controller, Mr. Maurice Jenks, of 6, Old Jewry, E.C., has applied for his release.

SHIP CARBONS, LTD., 5, Chancery Lane, London, E.C.—The controller, Mr. W. Hancock, 90-91, Queen Street, E.C., has applied for his release.

Prices Advance.—THE STERLING TELEPHONE AND ELECTRIC CO., LTD., have issued a circular to the trade announcing increases in prices of switchboards and magneto telephones.

LIGHTING AND POWER NOTES.

Aberdeen.—The Electricity Committee reported the renewal of the agreement, for 12 months, for the supply of electricity to the Great North of Scotland Railway Co.

Argentina.—The Compania Alemana Transatlantica de Electricidad has petitioned the Chamber of Deputies asking that coal and petroleum may be exempted from the operation of the new law, which imposes a 5 per cent. import duty on goods hitherto imported free of duty. *Review of the River Plate.*

Australia.—The Sydney City Council's Electric Light Committee has considered the recommendation of the city electrical engineer to accept no new contracts for lighting excepting for places where artificial lighting is not already installed. Mr. Mackay, the city electrical engineer, said that it was impossible to obtain the necessary machinery, as British firms had received instructions to execute no work that was not required for the war. He had approached the Chief Commissioner for Railways (Mr. Fraser) to see if an arrangement could be made for the City Council to draw on the railway power house for a period of three years: he understood the Commissioners worked on a margin of 6,000 KW. at White Bay. Mr. Fraser said he would advise him in six months' time if an arrangement could be made, and he (Mr. Mackay) thought that some relief might be forthcoming from that direction when the six months elapsed. The recommendation was agreed to, with the addition that the city treasurer be instructed to ascertain what amount of money it was possible to borrow, and the rate of interest, for the purchase of additional plant, &c.

Birmingham.—Report on Electric Supply.—The report of Councillors Appleby and Beale on the causes of the recent interruptions of electricity supply in the city has now been published. It finds that such failures were due primarily to the abnormal demand for electric current, which came at a time when the Committee was least able to meet it, and that this situation arose from causes which were not beyond the control of the Committee. The chief engineer, Mr. Chattock, in 1910, reported that new plant would be required before a new station could be finished and proposed extensions at the Summer Lane station, which would defer for two years the necessity of a new station. In October, 1911, the purchase of the Nechells site and raising of £500,000 was agreed to, it being supposed that the station would be ready for 1915-16. The reporters consider that it is the failure to carry out this programme which is at the root of the trouble, and blame both the engineer and Committee for the delays which took place, pointing out that from December, 1912, onwards the former did not have the support of the whole of the Committee, although in the end the engineer's original recommendations were adopted. The report concludes with an expression of anxiety for the future. Although the temporary station will receive 6,000 KW. of additional plant this summer, it is doubted whether this will meet the case.

The members of the Electric Supply Committee who were members in 1911—viz., Ald. Jephcott, Ellaway, and Bird, also Councillors Burman, Hawker, Heath, and Marks, have replied to the above report, pointing out that prior to the war the plant appeared to be sufficient for the needs of the undertaking, and emphasising their opinion that the failures have been due to the abnormal demand for energy during the war. In reference to the delays, they state that if the Committee erred on the side of caution it should be remembered that economy and prudence in expenditure were regarded as superlatively important at that time. The reply further states, in reference to the future, that since the report was prepared negotiations have been practically completed whereby a further 10,000 KW. of plant will be available for the city's use, by arrangement with a local firm.

At the end of the present year the generating plant erected since August, 1914, ought to be 32,000 KW., which is 7,000 KW. more than the permanent station would have held had it been completed. The demand for energy is being overtaken, but the spare plant is admittedly meagre, and the Committee is very strongly of opinion that even now the permanent station should be proceeded with. Plans are now in preparation, and, in order to allay any anxiety which might be aroused by observations in the report, the Committee has asked Mr. C. P. Sparks (president, Institution of Electrical Engineers) to furnish a report on the extension scheme.

The chief engineer, Mr. Chattock, at the request of the Committee, presented a statement with reference to the report as it affected him personally, disagreeing with the suggestion made that the difficulties of foundations were not appreciated by himself and the Committee.

He points out that some months were taken up in 1913 in considering alternative schemes for ferro-concrete rafts and piles, and that no material delay arose from an alteration in size of the switch house. He concluded by pointing out the impossibility of obtaining the normal amount of steam with fuel of the character now used.

Both the reports were approved by the Council.

Canada.—The Imperial Trade Correspondent at Toronto reports that the Ontario Hydro-electric Commission will again be a large buyer of motors, copper wire, insulators, generators, and power plant during 1917. The Commission has now decided to carry out its own power plant construction, which will probably be commenced during the coming spring. The Commission will also require large quantities of electric railway plant in connection with the scheme of electric radial railways throughout the province. *Board of Trade Journal.*

Chippenham.—Workhouse Lighting.—The B. of G. has decided to enter into a contract with the Electricity Co. on agreed terms for the lighting of the workhouse.

Continental.—Portugal.—Owing to the shortage of coal caused by the German interference with neutral shipping, the gas and electricity works at Cadiz will close on March 12th if no solution of the difficulty can be found.—*Times.*

Dundalk.—The Council has taken steps to get a legal decision as to whether the L.G.B. has power to sanction a loan for working capital for the electricity undertaking. The Board has already held, on legal advice, that it has no such power, but it is felt that the matter is one that should be contested in a friendly way. The Courts are to be told, it is understood, that it would be of no service for the Council to borrow £50,000 for plant and buildings, if it had not money to work the plant until revenue had been brought in.

The Council has adopted a report by the Electricity Committee recommending, owing to increases in cost of fuel-oil, that, as from April 1st, the following further increases be made in the supply tariffs:—10 per cent. on existing power and heating tariffs, making a total increase of 20 per cent. on pre-war rates: the present contract rate for town lighting to be increased in the same proportion as the increase, dating from July 1st last, on private lighting:—viz., by one-sixth. It is probable that the work of adapting the two new engines to burn tar oil will not be completed for six months.

Enniscorthy (Co. Wexford).—Loan Sanction.—The L.G.B. has sanctioned an application of the Urban Council to borrow a loan of £6,000 in connection with the local electric lighting scheme.

Halifax.—Proposed Loan.—The Tramways and Electricity Committee has instructed the town clerk to make application to the L.G.B. for consent to the borrowing of £10,000 for the installation of a new boiler, economiser, &c., required at the electricity works.

Heston and Isleworth.—Price Increase.—The electrical engineer reported to the Council that the effect of Summer Time lighting last year, compared with the returns for the previous year, 1915, was a falling off in units sold from 38,315 to 27,640, and in revenue from £606 to £436. In public street lighting the units sold dropped from 27,168 to 1,025, with a drop in income from £500 to £351, a gross loss of income of £318. There were, moreover, 51 more consumers than in the previous year. He estimated the loss on the coming summer at £400, and he advised that there should be an increase in charges from April 1st by 12½ per cent. to all classes of consumers, making a total advance of 25 per cent. on pre-war prices, and also that a minimum charge of 6s. 8d. per quarter be enforced. The Electric Lighting Committee recommended that this increase be made, and this was agreed to.

Horsham.—Price Increase.—The U.D.C. has decided that, as from March 31st, the maximum demand rate for electricity supplied for power, heating and private lighting be discontinued, and that a flat rate of 6d. per unit be charged for private lighting (except for places of worship and the fire station, which would be supplied at the present rates, 5d. and 4d. per unit respectively), and for power and heating a uniform charge of 2d. per unit. It was estimated that the extra revenue to be obtained from these alterations would be £650 per annum.

Kendal.—For the year ending March 31st, 1917, it is estimated that there will be a net deficit of £978 on the working of the electricity department. For the month ended January 31st last, the units generated were 16,805, as against 18,863 in January, 1916.

Kilmallock (Co. Limerick).—Plans have been prepared for constructional work for the more efficient working of the scheme of the Kilmallock Electric Light and Power Co., Ltd.

Kingston-on-Thames.—Year's Working.—For the ensuing financial year there will be a deficit on the electricity undertaking of £1,700, which means the addition of 2d. in the £ to the rates. Councillor Kerrison, chairman of the Lighting Committee, explaining the deficit, said that in April last the two-cycle Diesel engine crankshaft was fractured, and they had not yet got the use of the engine again, while the cost of the new crankshaft would be £1,050. Then, on December 8th, the four-cycle Diesel engine broke down, and to the end of the financial year they were not allowed by the insurance company to work it more than 42 hours a week. Then they had to face a very heavy increase in the cost of coal. Councillor Waters objected to adding the £1,700 to the rates, and said the undertaking had been a failure and a muddle from the start. Councillor Kerrison, replying to the discussion by permission of the Council, said the Diesel engines were now insured, and they had received £200 for consequential damages, plus the cost of repairs to the four-cycle engine. He estimated that the increased charge for current would bring them in over £2,000. The daylight saving made a difference of 22 per cent. at night, when they got the best price for the current. A recommendation to add 2d. to the general district rate was agreed to. Later in the meeting, Councillor Kerrison moved, and it was agreed, that an addition of 20 per cent. be made to accounts for electricity after March 31st next. In reply to a criticism by Councillor Waters, he stated that they were going to see the few firms who had agreements running, and ask for a concession in view of the exceptional cost of production at the present time.

Leeds.—Loan Sanction.—The L.G.B. has sanctioned the borrowing by the Corporation of £17.128 for two boilers and other plant at the electricity works.

Liverpool.—At a recent meeting of the Mersey Docks and Harbour Board it was mentioned that experiments were being made with electrical stacking machines, such as were employed at the Manchester Docks.

London.—Woolwich.—The Highways Committee of the L.C.C. is proposing arrangements for additional power supply in the Woolwich district, at an estimated cost not exceeding £30,000.

Marylebone.—The Electric Supply Committee has authorised the special war purposes tariff of 1d. per unit (plus war advance of 20 per cent.) for current consumed at a garage in connection with the Red Cross House. The Committee has decided to discontinue the special rate for premises used for war purposes in cases where the Government is making a grant towards the expenses of the institution.

Deptford.—The Council is urging that, considering the brief period of darkness during the months of May, June, July, and August resulting from the adoption of the Daylight Saving scheme, it is desirable to dispense with street lighting during those months, thereby effecting a considerable saving of fuel and labour.

Rochdale.—A somewhat more reassuring statement as to the position at the Corporation electricity works was given by the chairman of the Committee at the monthly meeting of the T.C. last week. Councillor Walker said that at present matters were satisfactory, but the load they were grappling with was an exceptionally heavy one, and it was quite possible that interruptions might take place in the future, though things would be better than recently. In the year ending March, 1914, the output was 6,000,000 units, in 1915 it was 7,000,000, in 1916 12,000,000, and in the year ending this month the figure would be 16,500,000, and if they could have met all demands for electricity it would have exceeded 21,000,000 units.

Todmorden.—Plant Extension.—The Corporation proposes to spend £10,000 on new plant for the electricity works.

U.S.A.—Niagara Power.—According to the *Electrical World*, an additional block of 50,000 h.p. has been requisitioned by the Ontario Hydro-Electric Power Commission, not later than April 1st, which will lead to further curtailing of the power sent into New York State. The announcement of the new demand came as a complete surprise to the power companies and industries along the Canadian Niagara frontier. Although the additional 4,400 cb. ft. of water per sec. now allotted to American generating companies will relieve the situation, the cutting off of a further 50,000 h.p. will leave matters as before the extra water was granted. The temporary permit for the latter expires on July 1st, and unless extended, will shut down or lead to the removal to Canada, of many industries.

Wigan.—Price Increase.—The Electricity Committee has decided to increase the price of electricity for lighting purposes, as from April 1st next, by 7½ per cent. over and above the present prices, making the charges as follows: Churches and offices, 5⅝d. per unit; shops and dwelling houses, 4½d. per unit; public houses, restaurants, and theatres, 3⅜d. per unit.

York.—Price Increase.—The Electricity Committee has decided that the charges for electrical energy supplied to private consumers and users of power be increased by 10 per cent. as from April 1st.

TRAMWAY and RAILWAY NOTES.

Accrington.—The Tramways Committee, in reply to a request by the Amalgamated Association of Tramway Workers for payment of the 6s. 6d. war bonus to female conductors, &c., which was awarded to the men by the Committee on Production, has intimated that it cannot depart from the terms of the award.

Australia.—It has been decided by the Government to put in hand at once a section of the contract for the construction of the Sydney City Railway from Central Station to St. James Road, the reason being that the metropolitan tramway traffic has become so congested that relief is imperatively necessary: part of the scheme is to electrify the railway system, both suburban and country, for a certain distance out of Sydney.

A start is to be made immediately with the electrification, by converting the Hurstville and Bankstown lines; this will enable the trains from these suburbs to go right down to Circular Quay when the first section of the City Railway has been built.

The report on the working of the undertaking of the Adelaide Municipal Tramways Trust for the two years ended July 31st, 1916, shows that the Port Adelaide tramway system is now being electrified, while about 55 miles of route are already in operation by the Adelaide authorities, with 170 cars. We note that the Woods-Gilbert rail planer has been used with satisfactory results for removing corrugations, and some 97,000 ft. of running rail have been dealt with during 1915 and 1916. The total revenue from electrical working for the year ended July, 1916, was £322,759, as compared with £309,914 in the previous year; the total operating expenses were £193,964, as against £191,069; interest, sinking fund and reserve appropriations absorbed practically the whole of the balance, the total amount paid into sinking fund to date being £203,683, and into reserve £107,581, plus some £9,000 Third Party Accident reserve. The passengers carried exceeded 43 millions, 4,700,000 car-miles being worked. Roughly, 2 units per car-mile were required for traction and car lighting.

Belfast.—At the monthly meeting of the Corporation, attention was drawn to the unsatisfactory state of the tramway track and to the number of half-empty cars which ran constantly to Glengormley. In reply, it was stated that the city surveyor was fairly well satisfied as to the state of the track generally; and the Committee would consider the Glengormley service.

Blackpool.—The line between South Shore Station and the borough boundary at Squire's Gate, which is leased by the Corporation to the Blackpool, St. Annes, and Lytham Tramways Co., will be taken over by the Corporation on July 26th next when the lease expires. The company will have running powers only after that date, though its cars will be still allowed to run to Central Station and Manchester Square.

Mr. C. Furness, the tramway manager, has been authorised to commence the training of a number of women as drivers, so as to ensure a satisfactory service when more cars are required during the summer season.

Castleford.—Fire.—A serious fire, which broke out at the depôt of the Yorkshire (W.R.) Tramways Co., on Monday morning last, resulted in the destruction of eight cars, besides more than half of the roof of the shed. The whole of the repair shed was also burnt out. The damage is estimated at anything between £10.000 to £15,000. Eight cars (which were got out practically undamaged) are being used under the abnormal conditions to keep open the service of cars for the section from Normanton through Castleford to Pontefract. The power station adjoining the shed, fortunately, escaped injury.

Croydon.—Electric Tower Wagon.—The Tramways Committee recommended that an Edison electric tower wagon be purchased, at a cost, including charging gear, of £921, the amount to be defrayed out of the reserve and renewals fund. The annual cost of running the wagon is estimated at £21; the recommendation was agreed to by the Council.

Dublin.—The Chief Secretary for Ireland has intimated that he cannot recommend the Government to take control of the Dublin and Lucan Electric Railway owing to its being a line of a tramway character. The railway carries an average yearly of 421.000 passengers, and serves Chapelizod, Palmerston, and other districts along the Liffey Valley to within a mile or so of the famous Salmon Leap at Luxlip, Co. Kildare, and connects with the Dublin United Tramways service from O'Connell Bridge and Sackville Street.

East Ham.—Halfpenny Fares.—Although 51·392 per cent. of the total passengers carried on the Council's system are halfpenny fares, the income derived therefrom is only 32·35 per cent. of the total. Under the circumstances, the Tramways Committee has decided to abolish the issue of halfpenny tickets to adults.

Haslingden.—The T.C. is to receive a report on the proposed increase by Accrington of the through fare to Haslingden; also, on a further proposal by that Corporation to increase the charge for electricity supplied in bulk to Haslingden.

Northampton.—Revised Fares.—The Tramways Committee has decided that all fares other than the ordinary penny ticket, the ½d. early morning ticket, and children's tickets be abolished. The increased revenue from this and a revision of the parcels rate is estimated at £2,000 per annum.

TELEGRAPH and TELEPHONE NOTES.

France.—The Colonial Minister is having a wireless station installed at Guadeloupe.—*Journal Télégraphique.*

Holland.—A company has been formed at Amsterdam, by the great shipping companies, with the style Nederlandsche Telegraaf Maatschappij "Radio-Holland," for the installation and operation of wireless stations on board Dutch merchantmen. *Journal Télégraphique.*

Reception of Cable Telegrams by Sound.—The U.S. Minister for War has announced that, as the result of numerous experiments, a method of receiving cable telegrams by sound has been developed, and appears capable of replacing the processes at present in use. The improvement consists essentially in the use of a "ticker" and lamps of the "audion" type, like those used for the reception of wireless signals, in conjunction with an ordinary telephone receiver. The feeble incoming current, which is normally inaudible, is made intermittent by the ticker, and then amplified with the audion. It is stated that the sensitiveness of the apparatus is so great that less than $\frac{1}{30}$ of the voltage required to actuate the siphon recorder suffices to give comfortable reception.—*Journal Télégraphique.*

Telegram Rates.—The rates to Brazil have been fixed at 4s. 7d.—5s. 1d., and to Morocco at 5d. a word.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Adelaide.—March 28th. P.M.G.'s Department. Telephones, telephone parts, line and battery material, &c. Schedules 444 to 453. See "Official Notices" February 2nd. .

Belfast.—March 14th. Electricity and Tramways Committee. Six or twelve months' supply of stores, including several electrical items, for the Electricity Department. See "Official Notices" Feb. 23rd.

Burnley.—March 19th. Electrical goods, for the Board of Guardians. Mr. J. S. Horn, Clerk.

Canada.—March 28th. Toronto Electric Commissioners. Synchronous condensers, 5,000, 7,500 or 10,000 K.V.A. capacity. See "Official Notices" February 9th.

Glasgow.—April 5th. Corporation. Turbo-alternators (15,000 KW.), transformers, and condensing plant for the new generating station at Dalmarnock. Particulars from Mr. W. W. Lackie, Chief Engineer and Manager, 75, Waterloo Street, Glasgow.

London.—St. Pancras.—April 12th. B.C. Arc lamp carbons. See "Official Notices" to-day.

Londonderry.—March 17th. Corporation. Engine-room stores, carbons, electricity meters, cables, &c., for the Electricity Department. Town Clerk.

Macclesfield.—March 14th. Cheshire County Asylum. Electrical goods for one year. Mr. W. G. F. Tingay, Clerk to the Asylum, Parkside.

March 14th. Corporation. Nine 40-H.P., three-phase, slip-ring motors. See "Official Notices" February 23rd.

Merthyr Tydfil.—March 13th. Electrical accessories for six months, for the B. of G. Mr. F. T. James, Clerk, 134, High Street.

Redditch.—March 15th. 500 tons of D.S. nuts per month for six or twelve months. Mr. R. N. Mayne, Engineer and Manager, Electricity Works.

Rhondda.—March 21st. U.D.C. Twelve months' supply of house-service meters. See "Official Notices" March 2nd.

Salford.—Uniforms for Tramway Department. General Manager, Tramway Offices, 32, Blackfriars Street.

Stockton-on-Tees.—March 12th. Stores for the T.C. Electricity Department. See "Official Notices" February 23rd.

CLOSED.

Australia.—P.M.G.'s Department, Queensland :—

7,250 dry cells, £1,284.—Deamond Engineering & Trading Pty., Ltd.

Commonwealth Department of Works and Railways :—

14 D.C. motors, control equipment, and spares, for Port Augusta, £1,663.—Electric Construction Co., Ltd.

7 electric capstans and spares, for power house, Darwin, £3,060.—Gibson, Battle & Co., Ltd.

Victorian Public Works Department :—

Mechanical stoker at Kew Hospital, £139. J. O'Grady. *Tenders.*

Derby.—The T.C. Electricity Committee has accepted the following tenders :—

E. Morley & Sons. Power station extensions, £12,150.

J. A. Aiton, Ltd.—Steam piping, £424.

Hill Bros.—Purchase of 1,000-H.P. Ferranti plant at the power station, £1,050.

Derby Coal Co., Ltd.; Mr. T. Walker; G. J. Parr & Sons; and Brookhouse, Johnson, Ltd.—Coal.

London.—Marylebone.—B.C. Accepted tender :—

Pritchett & Gold.—Maintenance of the storage batteries at Aybrook Street and Rathbone Place sub-stations, £88.

Manchester.—The Tramways Committee has accepted a large number of tenders for accessories, parts, trolley poles, lamps and other lighting material, insulating material, carbon brushes, cables and wires, oils, and other requirements for the undertaking.

Nuneaton.—Corporation Electricity Committee :—

G. & J. Weir & Co.—Steam-driven feed pump, £110.

Griff Colliery Co.—1,000 tons of nutty slack, 12s. 2d. per ton at the pit.

Salford.—Tramways Committee. Accepted tenders for stores include the following :—

Car accessories (electrical).—British Westinghouse Co., £843; Manchester Armature Repairing Co., £888; L. Andrew & Co., £244; Western Electric Co., £125; Ward & Goldstone, £98; B.I. & Helsby Cables, £72; and other firms for smaller amounts.

Car accessories (mechanical).—Tandem Smelting Co., £342; British Westinghouse Co., £2,520; Hadfields, Ltd., £1,344; National Rail and Tramway Appliances Co., Ltd., £965; Brown, Bayley's Steel Works, £1,283; G. W. Allsop, £920; Anti-Attrition Metal Co., £134; and other firms for smaller amounts.

Special car accessories.—British Westinghouse Co., £188.

Ears, frogs, &c.—B.I. & Helsby Cables, £115; Britannia Lamp & Accessories Co., Ltd., £67.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, March 9th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Ordinary meeting.

Junior Institution of Engineers.—Friday, March 9th. At 8 p.m. At 39, Victoria Street, S.W. Lecture on "X-ray History," electrically illustrated, by Mr. C. Major.

Friday, March 16th. At 8 p.m. Paper on "Munition Work Abroad," by Mr. C. P. Barber.

Salford Technical and Engineering Association.—Saturday, March 10th. At 7 p.m. At the Royal Technical Institute, Peel Park. Paper on "Our Aerial Ocean," by Mr. J. Bacon.

Chief Technical Assistants' Association.—Saturday, March 10th. At 3 p.m. At the Tavistock Hotel, Covent Garden, W.C. Paper on "The Treatment of Water and the Removal of Scale," by Mr. J. H. Parker. Annual general meeting.

Institution of Civil Engineers.—Monday, March 12th. At 5.30 p.m. At Great George Street, Westminster, S.W. Lecture on "Foreign Trade and its relation to the Investment of Capital Abroad," by Mr. E. Crammond.

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, March 13th. At 7 p.m. At the Engineers' Club, 17, Albert Square. Paper on "Voltage Regulation of Rotary Converters," by Mr. G. A. Juhlin.

(**Newcastle Local Section**).—Monday, March 12th. At 6.45 p.m. At the Mining Institute. Paper on "The Principles involved in Computing the Depreciation of Plant," by Mr. F. Gill and Mr. W. W. Cook.

Belfast Association of Engineers.—Thursday, March 15th. At 7.45 p.m. At the Municipal Technical Institute, College Square. Paper on "An Anticipating Governor for Marine Engines," by Mr. A. Kerr.

Institution of Mechanical Engineers.—Friday, March 16th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Papers on "Heat Treatment of Large Forgings," by Sir Wm. Beardmore, Bart.; and "Heat Treatment of Steel Forgings," by Mr. H. Hashdown.

Electro-Harmonic Society.—Friday, March 16th. At 8 p.m. At the Holborn Restaurant, W.C. Smoking concert.

Association of Mining Electrical Engineers.—Saturday, March 17th. At 4.30 p.m. At the Royal Technical College, Glasgow. Paper on "Maintenance of Underground Plant," by Mr. M. Baird, jun.

NOTES.

Linking-up Electricity Works.—An important Conference of electric lighting authorities in Lancashire and Cheshire was held in the Manchester Town Hall, on Friday last, when the Lord Mayor, Ald. Smethurst, presided over a representative attendance. Mr. G. H. Roberts, M.P., Parliamentary Secretary to the Board of Trade, and other officials of the Board were present. Forty-two undertakings were represented.

Mr. Roberts said that a cheap and ample supply of electricity was absolutely essential to national development, and in May last a circular letter was sent to the various electric lighting undertakings throughout the country, pointing out the need for the strictest economy in view of the shortage of coal. The Board of Trade held a high opinion of the report, containing a scheme for the linking together of supply works, which had been issued by the Lancashire and Cheshire authorities, and they considered that it contained valuable suggestions. Electricity was playing a very great part in the development of our industries, and the Board of Trade realised the new importance of the problems to be considered. They believed that the policy pursued in the past had not been the right one, and the Board were prepared to give sympathetic consideration to the matter for which the Conference had been called. The nation had been caught unprepared for war, added Mr. Roberts, and it was for us to see that we were not caught unprepared for the problems which would confront us when the war was over.

Mr. S. L. Pearce, engineer to the Manchester Corporation electricity undertaking and chairman of the Interconnection Committee, said the scheme, as at present outlined, was in skeleton form, but he did not consider that the clothing of it would raise any insuperable difficulties. If the proposals for interconnection were carried through, there would be an annual saving of £82,000 in coal.

The Manchester Electricity Committee had considered the scheme, and had given it their unqualified approval, said Mr. Dagnall, the chairman; and Mr. L. C. Evans, town clerk of Salford, said they were prepared to join hands with other authorities in the matter. Several other local authorities also announced their support, and Councillor Russell Taylor, chairman of the Liverpool Corporation Committee, said the war had demonstrated the enormous amount of waste that had taken place.

Mr. Roberts said the next step would rest with the Interconnection Committee. They would have to work out details of the scheme, and then submit them to the Board of Trade. They all wanted the most economical form of production, he said, and unless they could secure that within the next few years, Great Britain would be deposed from her great position of commercial eminence. Electricity provided one of the greatest possibilities for the development of national industries, and the Board of Trade recognised its importance.

Whilst going to press we have received the official report of the proceedings, of which further particulars will appear in our next issue.

At a meeting of Torquay Town Council on Tuesday, the electrical engineer and manager reported attending a preliminary meeting of representatives from all interested concerns, held at Plymouth, to consider the linking-up of electricity supply works in Devon and Cornwall. The counties were divided into four areas. The general opinion was that the outlay could not be borne by the works themselves; the scheme must be State-aided. It was decided to go thoroughly into the matter and prepare a scheme with all necessary details. Torquay, Exeter, Plymouth, and Cornwall representatives are to collect all statistics in their respective areas and report progress to Mr. E. G. O'Kell, of Plymouth, chairman of the Committee.

Electrical Incubation of Eggs.—A recent article in the *Journal of Electricity* gives some particulars relating to the use of electrical incubators in Western America. The superiority of electricity for heating is said to be quite obvious to anybody familiar with the poultry business, and a vast field of enterprise is being opened up for manufacturers and electric suppliers in the areas concerned. In one small Californian town about 10,000,000 chickens are artificially hatched each year, and the hatching and brooding of these chicks by electricity would require about 3,000,000 KW.-hours per annum. A single-deck incubator is provided with an average of 75 watts heating capacity per 100 eggs; the average energy consumption is given as about 10 KW.-hours per 100 chicks hatched out, and such incubators are built for from 30 to 1,200 eggs. The incubators are doubled-walled, heat-insulated, and provided with wood or metal trays about 4 in. from the bottom. The heating elements are usually at the top, but in double-deck constructions may be top and bottom.

The single-decker is claimed to give more uniform heating, but the double-decker requires less energy per egg. The space below the tray forms the nursery for the newly-hatched chicken, into which the latter drop when they break through the shell, and it is maintained at about 95° F. The thermometers have to be high-grade instruments, as a slight error may considerably influence the success of the hatch. The thermostats used are very sensitive, and will maintain the temperature to ¼° or ½°.

In operation, the eggs are placed on the trays at an angle of about 45°, small ends down; the temperature is gradually raised to 102° F., and maintained so for four to six days, when a test for fertility is made by holding the trays of eggs up to the light. A similar test is made about the 14th day. After the first test the temperature is raised to 103° F., and continued until the hatch is off. After 72 hours the eggs are cooled daily, by removing the trays for from half to two hours, down to human body temperature, and are turned to a different angle. By the 18th day the air cell in the large end should be dried down to about 30 per cent. of the total volume of the shell; ventilation will hasten drying or the introduction of moisture delay it. After the 18th day the incubator is closed until the chicks emerge and fall below the tray, where they are left for 24 hours before removal to the brooders. The electric incubator has many obvious advantages over one depending on combustion, and turns out more vigorous broods and a higher percentage of chicks than other types. At 1d. per unit its approximate cost for energy is stated to be equal to oil at 10d. per gallon, but its greater efficiency in use offsets any slight extra cost for heat.

Under-Water Coal Storage.—A recent issue of the *Electrical World* described the concrete basin constructed by the Duquesne Light Co., of Pittsburg, in which 100,000 tons of coal will be stored under water. The basin is 791 ft. long, 25·5 ft. deep, and 153 ft. wide, and is made of 40 ft. × 50 ft. reinforced concrete slabs, laid so as to permit of expansion and contraction—the expansion joints being made waterproof with pitch and tar paper, and suported on concrete strips 4 ft. wide and 12 in. thick. Water is pumped in through a 14-in. pipe leading to four 12-in. outlet pipes at different points, which discharge at 6 ft. below the top of the tank. Four 18-in. pipes running from the bottom of the tank discharge the tank water to the adjoining river, and travelling cranes spanning the tank will handle the coal.

Volunteer Notes.—FIRST LONDON ENGINEER VOLUNTEERS.—Headquarters: Balderton Street, Oxford Street, W.

March 12th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30—8.

March 14th.—Instructional Class, 6.15. Platoon Drill, Platoon No. 2

March 15th.—Platoon Drill, Platoon Nos. 5 and 6. Ambulance Class by M.O., 6.30.

March 16th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No 9. Signalling Class. Recruits' Drill, 6.25—8.25.

March 17th.—Commandant's Parade, 2.45, Uniform, for Route March. Bugles and Drums to attend.

March 18th.—Special work at Bombing School. Parade Clapham Junction Station (City & S.L. Tube Ry.), 9.45 a.m.

(By order), MACLEOD YEARSLEY, *Adjutant.*

Registering Electrical Contractors in Mysore.—Some further particulars concerning the prompt steps taken by the Mysore Durbar to control the uses of their electric current in Bangalore and Mysore show that it is the intention of the Electricity Department in future to refuse to supply current to any lighting or power installation in those cities and in the civil and military station of Bangalore, unless such installations have been carried out by a licensed contractor. Public advertisements will shortly appear on the subject. Contractors who are not subjects of H.H. the Maharajah, will, therefore, be separately licensed for the station, and the names are given of the following contractor firms to whom it is intended to issue licences:—In Bangalore Station, the Anglo-American Electrical Stores, Campbell & Sons; in the city, G. L. Narnappa and the Empire Stores; and in Mysore City, Gajaraja Moodeliar. The fee to be paid upon securing licences is Re. 1, the object being not to secure revenue therefrom, but to make certain that electrical contractors have sufficient technical qualifications and financial resources to ensure that their work will be satisfactory, and, as far as possible, to prevent defective installations and personal injury. The draft licence recites that it is issued upon the understanding that the holder agrees to conform to the rules already in force and those which may hereafter be promulgated for regulating the supply of power for heating, lighting, and industrial purposes, and that it will be liable to be cancelled at the option of the chief electrical engineer for bad work or the violation of any of the rules.—*Indian Engineering.*

The Cost of Coal in U.S.A.—Discussing this subject at the American Mining Congress, Messrs. G. O. Smith and C. E. Lesher, of the U.S. Geological Survey, suggested that in the whole field of productive business, the coal industry seems to be the one most likely to be threatened with Government operation. Royalties add considerably to the cost of coal: in a recent lease by a large coalowner, a payment of 27 per cent. of the selling price is demanded. The average rate of royalty on anthracite is from 12 to 14 per cent. of the selling value at the mine; the minimum rate (about 10 per cent.) is found in some old leases, and the maximum (20 to 27 per cent.) in leases made during the last five years. The tendency is still upward. On one large estate, the gross return is over 2s. a ton: the value of anthracite lands, which in 1875 was £100 an acre, is now about £600 an acre. Large areas of land bearing bituminous coal, but without railway facilities, can be purchased at low prices, and the average royalty on bituminous coal is about 4 per cent. of the selling value at the mine, though in exceptional cases, where the coal is of special quality or favourably situated, royalties are much higher. The authors appear to regard with favour the principle of State control, not only of mining costs and transportation, but also of the prices charged by coal owners, in the shape of royalties.—*Electrical Review and Western Electrician.*

The Training of Disabled Men as Sub-Station Attendants. The Queen visited on February 21st the classes in progress at the Northampton Polytechnic Institute, Clerkenwell, E.C., for giving a preliminary training to disabled sailors and soldiers as electricity sub-station attendants. Her Majesty was received by Mr. L. B. Sebastian and Dr. R. M. Walmsley, respectively chairman and principal of the Institute, with whom, among others, were Mr. C. H. Wordingham (vice-president I.E.E.) and Mr. P. F. Rowell (secretary I.E.E.), representing the Institution of Electrical Engineers (in the unavoidable absence of the president, Mr. C. P. Sparks). Mr. F. M. Denton and Mr. S. D. Chalmers (heads of the Electrical Engineering and Optical Departments), and Mr. G. R. Buckley and Miss Collin (honorary secretaries of the Disabled Soldiers' Aid Committee). During the course of a prolonged inspection of the men, while under actual instruction in the power house of the Institute, Her Majesty showed the greatest interest in the work that was being done, and made personal inquiries from each man as to his disablement and the progress he was making in his training. Her Majesty also inspected the optical workshops of the Institute.

Electroculture at Hereford.—The Development Commissioners have, with the sanction of the Treasury, decided to undertake electrocultural experiments on a practical scale at Hereford. For this purpose some 50 acres are to be provided with suitable equipment, at the Huntington Court Farm. The work will be supervised by Prof. Blackman (of the Imperial College of Science and Technology) and Mr. Ingvar Jorgensen (who recently contributed an article on this subject to our pages); Mr. W. Duddell (Government Board of Inventions, &c.) will advise on electrical matters, and Mr. W. T. Kerr, the city electrical engineer of Hereford, is also giving practical assistance, the subject being one to which he has personally given much attention, as also to the general use of electricity in farming.

Official List of Vehicle-Charging Stations.—The Electric Vehicle Committee has issued an official list of charging stations, at which batteries of electrical vehicles can be charged. This contains, roughly, 180 names of places, together with a variety of other information in regard to charging facilities, tariffs, &c. The list is being published in full in the forthcoming second edition of the "Commercial Motor Users' Association Handbook of Approved Depôts"; it will also be published as a supplement to the June issue of *The Electric Vehicle.*

Fatality.—At the inquest into the death of a man killed at the Derby Corporation Electricity Works through scalding due to explosion of a boiler tube, Mr. T. P. Wilmshurst, the engineer, said that this was the first fatality at the works in the 24 years of its existence. The boiler in question was installed in September, 1914, and had been tested periodically by the insurance company, whose report of October, 1916, contained no reference to defects. The representative of the makers said that the tube which burst had probably been overheated, but a flange pipe engineer who also gave evidence did not think so. He said that the tube generally was ·175 in. thick, but at the point of fracture it was only ·125 in., which was too thin for the pressure. He thought it very unlikely that the fault would have been discovered by any examination or test. Verdict, "Accidental death."

The Electro-Harmonic Society.—The last smoking concert of the season will be held at the Holborn Restaurant, in the Venetian Chamber, on Friday, March 16th, commencing at 8 p.m. Mr. A. M. Sillar will be in the chair. Programme:—Mr. Gwylim Wigley, tenor; Mr. S. H. Beebe, baritone; Mr. Robert Howe, bass-baritone; Mr. Will Edwards, humorist; Mr. Walter Montague and Mr. Ben Osborne, humorous sketches; Mr Selwyn Driver, entertainer at the piano; Mr. Bernard Flanders, A.R.A.M., pianoforte solo and accompanist.

New Zealand.—A Christchurch agent, having considerable relations with the leading engineering firms in New Zealand, wants to get into touch with British manufacturers of electrical goods and general engineering supplies. Particulars can be obtained from the Board of Trade Department of Commercial Intelligence. Reference number 111

Automatic Train Control.—A system of automatic control of trains, by which the brakes are applied when an engine-driver passes a signal at danger, is strongly advocated by two Board of Trade Inspectors, Colonel Pringle and Lieut.-Colonel Druitt, in their reports on collisions which occurred on December 19th near Kirtlebridge, on the Caledonian Railway, and at Wigan, on the London and North-Western Railway. In both cases snow was falling. *The Times.*

German Professors in England.—The *Morning Post* states that on Tuesday the Birmingham City Council decided to withhold the annual grant of £13,000 to Birmingham University until the latter had decided not to retain the services of any pre-war unnaturalised German professor on its salaried staff. The mover urged that German professors were largely responsible for the policy of blood and iron. It was stated that the professor to whom the resolution related had been in this country for 20 years, but only became naturalised in September, 1914. An amendment by the Lord Mayor to reduce the grant by the amount of the professor's salary was rejected.

Tungsten from Cornwall.—Wolfram, the ore from which tungsten is derived, is being mined in Cornwall, near Tavistock, where it is found in conjunction with tin ore (cassiterite). Formerly the wolfram was carefully picked out by hand and rejected, whereas nowadays it is the miner's main quest, and the old wolfram dumps have proved rich sources of tungsten. According to a correspondent of the *Times*, a stamp mill on the river Tamar is being reorganised, and part of it is at work, the motive power being electrical. Magnetic separators are employed to separate the wolfram from the cassiterite, the former being slightly magnetic.

Summer Time.—The Committee appointed by the Home Secretary to inquire into the results of the Summer Time Act, 1916, has recommended its renewal "in 1917 and in subsequent years," and that it shall operate from the second Sunday in April to the third Sunday in September, the variation from normal time being one hour. Inquiries made by the Committee show that the moral and physical effects of the Act last year were good, and the opinion is expressed that nearly the whole trouble of those who found it irksome to get up in the early mornings last summer was their failure to go to bed at the same hour by the clock as at other times of the year. The great bulk of the working classes were favourable to summer time. The opinion of the very large majority was that the children benefited by summer time, though in certain districts children did lose sleep.

The opinions of agriculturists regarding the working of the Act were extremely conflicting, but the advantage of having an extra evening hour for carrying crops outweighed any inconvenience.

On many farms and in some entire districts—so far as the agricultural community was concerned—the Act was not observed at all. Farmers and others refused to alter their clocks. Therefore, in the same neighbourhood old time was observed on farms and summer time in schools, post offices, railway stations, and similar places. This caused confusion and friction. However, a very large majority of farmers are in favour of the renewal of the Act.

Artificial light had to be used in Lancashire weaving sheds in the early mornings during the second half of September, and the light raised the temperature in the sheds to such a degree that operatives refused to work in them. September of last year happened to be a cool month: in a warm September the difficulty would be increased. This difficulty would appear to be met by the recommendation that the date for reversion to normal time should be earlier than that adopted last year.

The Stock Exchange Committee drew the Committee's attention to a difficulty which in normal times might cause considerable inconvenience. Before the war, the last hour during which the London Exchange was open (3—4 p.m.) overlapped the first hour (10—11 a.m.) of the New York session and during this hour in normal times a vast amount of business was done, and was often continued in the street after the London Exchange had closed. At the present time, the London Exchange closes at 3 p.m., but after the war, when normal conditions are restored, the importance of coincident periods in the two sessions may possibly be still greater than in former times. The Committee believes that this difficulty is capable of adjustment between the London and New York Exchanges without serious inconvenience to members and clerks.

With regard to the current daily work of the Meteorological Office, the director, Sir Napier Shaw, reported that the inconveniences were, as far as possible, overcome. A great deal of confusion arose with the observers, and the continuity of many series of observations had been interrupted. "My impression is," says Sir Napier Shaw, "that there is now no possibility of placing beyond dispute the exact time of any event, except those dealt with by telegraph, which occurred between May 21st and September 30th."

Taking the evidence as a whole, the Committee says that the vast preponderance of opinion throughout Great Britain is enthusiastically in favour of summer time, and of its renewal as a permanent institution. Further, the Committee believes that what opposition still remains will completely disappear in a few years.

American Electric Vehicle Trial.—The new model of an electric passenger vehicle, manufactured in Detroit, in a recent run from New York City to New Haven, Conn., made a highly commendable record. The Electric Vehicle Section, N.E.L.A., has been advised that three passengers were carried, and the distance of 88·2 miles from Columbus Circle, New York City, to the Hotel Taft, New Haven, Conn., over an extremely hilly, although smoothly constructed road, was accomplished in 3 hours and 45 minutes, including all stops, traffic delays, and reduction of speed through thickly populated centres, and on a single charge of the battery. While an average speed of 23·4 miles per hour over a distance of 88·2 miles may not arouse the interest of the speed fiend, yet when it is remembered that this is kept up over average roads, the speed is about as great as can be maintained by either a petrol or electric car with comfort to the riders, and with safety to pedestrians.

This new model is furnished with a control system which provides for the safety of the driver and other occupants. It consists of an automatic device which, by the pressure of the foot on a pedal, even though the car is travelling at full speed, instantly cuts off the current and applies both brakes, regardless of the position of the control lever. It is impossible to start the car again until the control lever has been returned to the neutral position.

This run is an evidence of the "electric's" ability to make an average long run, covering the ground at a comfortable speed, with the fear of possible breakdowns practically eliminated. A series of runs have recently demonstrated the fact that an electric automobile can be very satisfactorily used for interurban travel. These runs averaged distances of about 90 miles per trip, and were conducted with absolutely no trouble of any sort. One of the longer runs was from Chicago to Milwaukee, a distance of 101 miles.

Prohibited Exports.—The Supplement to the *Board of Trade Journal* of March 8th contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported from Norway, Portugal, Russia, Spain, Sweden, and Switzerland. The Supplement also contains the United Kingdom Contraband List in its present form.

Institution and Lecture Notes.—**Institution of Electrical Engineers.**—The members of the DUBLIN LOCAL SECTION recently attended a gas furnace and industrial heating exhibition, organised by the Alliance and Dublin Gas Co., and listened to an address on "Industrial Heating," by Mr. H. F. Cotton, the company's distribution engineer.

The Society of Engineers (Inc.).—Since reinforced concrete was introduced into this country, it has been customary to employ plain round mild steel bars, but Mr. A. W. C. Shelf, in a paper on "High Tensile *versus* Mild Steel for Reinforced Concrete," read before the Society on Monday last, endeavours to prove that greater efficiency and economy is obtained by physically developing mild steel bars, for the purpose of taking out the first yield in the steel, which is useless, and has a detrimental effect in concrete. When this first yield or stretch is taken out, a higher yield point is obtained without any injury to the steel, so that it is safer to employ a stress of 20,000 lb. per sq. in. (which results in a saving of 20 per cent. in the weight of steel required) than it was to employ a stress of 16,000 lb. per sq. in. before the steel was physically developed.

Junior Institution of Engineers.—A lecturette was given by Mr. C. G. D. Burdett on February 23rd, entitled "Random Notes on Structural Design." The author dealt with such details as uniform pressure upon footings, the load over lintels, roof trusses, bridge girders, &c. The question of wind pressure was also discussed.

The Employment Exchanges.—The Minister of Labour has appointed a Committee to advise and assist the Employment Department of the Ministry upon matters affecting workmen in the building trades in connection with the working of employment exchanges. Mr. J. Kinniburgh is to represent the electricians.

It is proposed, in due course, to take steps with a view to forming a corresponding Committee of employers' representatives in the building trades.

Bankruptcy Proceedings.—Canadian interests in electric lighting and power and in pulp and paper mills were the principal features in the estate of Mr. A. B. Craig, woollen merchant, trading at 8, Well Street, Cripplegate, E C., under the style of John Craig & Sons. The debtor failed in the London Bankruptcy Court in November, 1915, and on the 7th inst. he applied to Mr. Registrar Hope for an order of discharge. In the opinion of the Official Receiver, the debtor's estimate of the realisable value of his Canadian interests was excessive and unwarranted; they were very involved, and nothing could be done towards their realisation until after the war. Up to the present time the trustee had only received £1,082 in respect of the assets. The hearing was adjourned.

CHARLES BENJAMIN OGILVIE, electrical engineer, 43, Dudley Road, Whalley Range.—The adjourned public examination of this debtor was held on March 6th at Salford, when the debtor attributed his failure to lack of capital and the non-success of a partnership business. The deficiency in the matter was just over £140. After his apprenticeship he started for himself on a small scale as an electrical and mechanical engineer at Dudley Road. He had no capital, but managed to make a living until he was joined by three friends, with a view to undertaking work for the Government. A small sum was subscribed and certain orders were executed, but owing to lack of capital the partnership was not a success, though there were no outstanding liabilities in respect of it. The examination was concluded.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The Halifax Tramways and Electricity Committee has resolved to increase the salaries of the electrical engineer (from £700 to £800), the traffic manager (£400 to £425), and the tramway engineers (£300 to £325).

The L.C.C. on Tuesday approved the appointment of Mr. J. K. Bruce, deputy chief officer of the tramways, as traffic manager under the new scheme.

The wages of the shift engineers of the Batley electricity department have been increased to £2 2s. per week of 56 hours.

Increases of salary have been granted by the Dewsbury Council to Mr. R. H. Campion, electrical engineer, from £400 to £425, and to the assistant engineer, Mr. R. W. Grubb, from £200 to £250 per annum.

Consequent on Mr. W. J. Carter, chief assistant engineer (Batley electricity department), having resigned, Mr. Percy Marsh Maxwell, shift engineer, was appointed mains superintendent at a salary of £130 per annum; and Mr. Albert Russling, shift engineer, was appointed station superintendent, at £125 per annum.

The Manchester Corporation Electricity Committee has recommended that the salaries of the undermentioned officials be advanced:—

Mr. H. C. Lamb, resident engineer at Stuart Street generating station, first year £500, second year £550, third year £600.

Mr. F. T. Guildford, chief works clerk, Dickinson Street, at £200, to be appointed engineer's secretary, at £250.

Mr. F. A. Fothergill, foreman fitter, Stuart Street, at £200, to be appointed mechanical engineer at £250.

Mr. T. Baxendale, assistant resident and constructional engineer, Stuart Street, from £300 to £350.

Mr. J. R. Davidson, boiler-house engineer, Stuart Street, from £225 to £275.

Mr. H. W. Smyth, engineer-in-charge, Stuart Street, from £225 to £245.

Mr. W. H. Simpson, engineer-in-charge, Stuart Street, from £220 to £240.

Mr. W. H. Woods, engineer-in-charge, Stuart Street, from £220 to £240.

Mr. A. L. Lunn, engineer-in-charge, Stuart Street, from £200 to £240.

Mr. J. G. Thomson, boiler superintendent, Stuart Street, from £200 to £225.

Mr. W. Baxter, foreman of electrical repairs, Stuart Street, from £175 to £200.

Mr. J. Grey, clerk of the works, Stuart Street, from £163 16s. to £175.

Mr. W. Dundas, resident engineer, Dickinson Street and Bloom Street stations, from £325 to £375.

Mr. A. Williams, Mr. A. E. Hinde, Mr. F. P. Seager, and Mr. J. A. Vice, engineers-in-charge, Dickinson Street and Bloom Street stations, from £200 to £220.

Mr. J. A. E. Hilton, relief engineer-in-charge, Dickinson Street and Bloom Street stations, from £156 to £175.

Mr. T. H. Wray, foreman fitter, Dickinson Street and Bloom Street stations, from £190 to £200.

Mr. H. W. Sanders, chief draughtsman, Dickinson Street, from £260 to £275.

Mr. W. Kidd, assistant constructional engineer, Dickinson Street, from £200 to £225.

Mr. A. Lee, senior draughtsman, Dickinson Street, from £163 16s. to £185.

Mr. R. F. Paiton, technical assistant engineer, Dickinson Street, from £163 16s. to £175.

Mr. J. Clark, assistant mains engineer (low-tension), from £275 to £300.

Mr. H. Hawkins, assistant mains engineer (high-tension), from £275 to £300.

Mr. P. T. Fowler, fault assistant engineer, from £210 to £230.

Mr. A. J. Lovell, district assistant engineer, from £200 to £220.

Mr. E. Bolton, sub-stations engineer, from £200 to £225.

Mr. W. H. Hanstock and Mr. W. Hutchinson, sub-stations superintendents, from £175 to £200.

Mr. R. Swettenham and Mr. J. H. Whiteley, sub-stations inspectors, from £163 16s. to £175.

Mr. H. A. Ratcliff, general superintendent of testing, standardising and scientific department, from £350 to £400.

Mr. O. Howarth, senior assistant in testing, &c., department, from £163 16s. to £185.

Mr. G. Fry, superintendent, motor section, from £163 16s. to £185.

Mr. J. A. Cookson, mains surveyor, from £425 to £450.

Mr. C. H. Rayner, assistant mains surveyor, from £205 to £225.

Mr. L. H. Marlor, installation inspector, from £245 to £270.

Mr. G. A. Proctor, technical assistant to mains surveyor, from £163 16s. to £180.

The Islington Lighting Committee recommends that the salary of Mr. A. P. MacAlister, deputy electrical engineer, be advanced from £350 to £400; and that the salary of Mr. C. S. A. Munro, constructional and repairs engineer, be increased from £3 9s. to £4 per week.

The Islington B.C. Special Salaries Committee has considered a petition by six members of the electricity works technical engineering staff, pointing out that, as single men, they are excluded from participating in the war bonus scheme, notwithstanding that during the war their duties have increased nearly two-fold, mainly owing to the increased station output, and they are not in receipt of any pay for overtime or extra duties. The officers concerned had applied for permission to join the Forces, but they had been informed that they were best serving the national interests by remaining in their present positions. The Committee is satisfied that the men are engaged on very important work, and it has decided that the war bonus scheme should be applied in their case.

Mr. F. E. A. Rea, engineer-in-charge at the Rawtenstall electricity works, was presented with a case of cutlery by the staff on the occasion of his marriage.

General.—Coun. Richard Holt has been appointed chairman of Blackpool Electricity Committee, in succession to the late Ald. J. Brodie.

Mr. I. J. Gowen, A.M.I.E.E., late of Stoke-on-Trent Borough electricity department, and formerly chief assistant engineer to the Rangoon Tramways & Supply Co., has been appointed chief engineer to Messrs. Portals.

Roll of Honour.—Private J. Kenyon, Loyal North Lancashire Regiment, who has been killed in Mesopotamia, aged 27, was employed by Messrs. Dick, Kerr & Co., Ltd., at Preston.

Private J. F. Neal, Royal Marine Light Infantry, who was with Messrs. Johnson & Phillips, Ltd., of Charlton, has died of wounds.

Private J. Dunn, Machine Gun Corps, who was for five years on the staff of Messrs. Willans & Robinson, Rugby, has died in hospital after having his leg amputated.

Private L. J. Hopkins, who was at Rugby with the British Thomson-Houston Co., Ltd., has fallen in action.

Lieutenant W. R. Carse, R.F.C., who has been killed whilst flying, was on the test department staff of the B.T.H. Co., Ltd., at Rugby.

Sergeant J. E. Wolstencroft, King's Own Yorkshire Light Infantry, formerly on the Hull Corporation tramway staff, has been recommended for a commission, and is now in the Officers' Training Corps.

Obituary.—Mr. James Forrest.—We regret to record the death, which occurred on Friday last, at the age of 91 years, of Mr. James Forrest, the honorary secretary of the Institution of Civil Engineers, with which he had been connected for 75 years, and to the interests of which he had unreservedly devoted by far the greater part of his life. Mr. Forrest, who was a Londoner by birth, received his engineering training under Messrs. E. & J. Manby, to whom he was articled, and later under Mr. Charles Manby, the then secretary of the Institution. Some years of practical railway construction experience in Yorkshire followed. Mr. Forrest returned to London in 1848, and was with Mr. Manby assisting him in the work of the Institution, but receiving no remuneration excepting an honorarium of £50 for compiling a library catalogue. In 1856 Mr. Manby retired from the active secretaryship, but he retained the title for three years from that date. The full title and responsibility fell to Mr. Forrest in 1859, and from that date onwards he devoted himself entirely to the Institution's interests until ill-health compelled him to retire from active work in 1896. At that date he was made honorary secretary. It was due to his efforts that the Council was induced to abandon the former rigid exclusiveness of the body, which had so limited its membership that it could not recognise as a civil engineer a man who was occupied in the design and construction of machinery. One of the effects of this exclusiveness was seen in the formation of the Institution of Mechanical Engineers. Mr. Forrest's ambition was for the "Civils" to become the representative body of the entire engineering profession of the British Empire. The realisation of such an ambition under the circumstances could not be secured without patience, tact, and hard work, and it was not until the year 1886 that he could claim to have thoroughly established the new reputation. When the deceased gentleman was first appointed secretary, there was a membership of only 835 in all classes; to-day, including students, it is 8,600. The "James Forrest" Lecture, of course named after him, was established by the Institution out of a fund subscribed by members in his honour, and presented by him for that purpose. Sir J. Wolfe Barry is shortly to deliver the 25th of these lectures. A service in memory of Mr. Forrest was held at St. Margaret's Church, Westminster, on Wednesday.

Mr. E. M. Murphy.—Mr. Edward Martin Murphy, who has passed away in his 35th year, was the fourth son of Mr. W. M. Murphy, chairman of the Dublin United (Electric) Tramways Co. He spent his early years at the General Electric Works, Schenectady, where he received his training in electrical engineering. Of late years, deceased had been managing director of the *Independent* Newspapers, Ltd., Dublin, of which his father is chief proprietor. Mr. Murphy had been in bad health for a considerable time, and his death was not unexpected.

Sir Benjamin Brown.—We regret to record the death of Sir Benjamin Brown, who had been for the whole of his life so prominently associated with engineering industry in the Newcastle district. Sir Benjamin, who was 78 years of age, retired from the chairmanship of Messrs. R. & W. Hawthorn, Leslie & Co. only last year. He was a director of the Newcastle & District Electric Lighting Co., Ltd. As our readers are aware, he was very keenly interested in industrial labour problems and the relations of Capital and Labour. He was a writer on this matter almost to the last. We read that Sir Benjamin did not hesitate to ascribe much of his success in industry to the timely advice and support of a banker of last century, who, at the age of 30, influenced his mind and activities in the direction of the business side of engineering.

NEW COMPANIES REGISTERED.

Tingey & Co., Ltd. (146,292).—Private company. This company was registered on March 1st, with a capital of £1,000 in £1 shares, to take over the business of engineers carried on by L. I. Robinson and W. H. Tingey, at Eyre Street, Clerkenwell, and at 3, Staple Inn, E.C., as Tingey & Co., and to carry on the business of mechanical, electrical, experimental, and scientific engineers. The subscribers (each with one share) are: L. I. Robinson, 3, Staple Inn, W.C., electrical engineer; W. H. Tingey, 63, Chancery Lane, W.C., engineer. The first directors are L. I. Robinson and W. H. Tingey. Registered office: 3, Staple Inn, Holborn, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Walter's Electrical Manufacturing Co., Ltd.—A memorandum of satisfaction in full on January 1st, 1917, of charge dated September 29th, 1916, securing an undefined amount.

Phillips Magnetos, Ltd.—Particulars of £3,000 debentures created October 2nd, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Sterling Telephone & Electric Co., Ltd.—Memoranda of satisfaction in full (*a*) of mortgage dated February 8th, 1915, securing £10,000, and further advances, and (*b*) mortgage dated November 11th, 1915, securing £48,253 17s. 1d. and further advances (notice filed February 22nd, 1917), have been filed.

Horrabridge & District Electric Supply Co., Ltd.—Particulars of £400 debentures created January 29th, 1917, filed pursuant of Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

CITY NOTES.

Liverpool Overhead Railway Co. At the annual meeting on February 27th, Mr. H. C. Woodward said that the railway was still controlled by the Railway Executive Committee. The receipts shown (£105,526) did not represent the traffic actually carried, but that was the sum they received after the surplus over their 1913 revenue had been paid to the Government. The traffic continued to expand. The total expenditure on the railway and tramways amounted to £73,394, an increase of £13,359. This was due to the higher prices of coal, and stores and materials of every description, and additional war bonus. The upkeep of the railway and tramway had been maintained in as efficient a condition and state of repair as was possible under existing circumstances, but certain arrears would have to be made up immediately opportunity again offered, for which they expected to be recompensed by the Government. They carried last year 3,500,000 more passengers than in 1913, with about the same train mileage, and this larger traffic had considerably taxed the accommodation of their rolling stock, particularly at certain times of the day. They ran a three-minutes' service in the busiest hours, which was as much as they could do with their present staff; but, even then, there was much congestion, which the directors had endeavoured to meet by purchasing some additional coaches, so as to give more third-class accommodation. In common with other railways, they had, on the instructions of the Government, increased their ordinary fares by 50 per cent., which increase came into operation on January 1st last. The directors communicated with the Board of Trade, asking that the increase should not apply to their system, as, being worked by electricity, they had no locomotives to hand over nor rails to spare, like other railways. The Liverpool Chamber of Commerce joined in this appeal, but the reply, in both cases, was that no distinction could be made, and that the increase should operate on all railways under their control. When the war was over, and the present Government control and guarantee terminated, they would undoubtedly find themselves faced with a largely increased working expenditure, and although he should be very glad to see their fares again on a lower level, and traffic thus encouraged, he doubted their being able to return in all cases to the extremely low rates in vogue during the pre-war period. The chairman congratulated the general manager, Mr. Neachell, his principal assistants, and the staff as a whole, on the successful carrying on of the undertaking, with a much increased traffic, amounting, as compared with 1913, to an increase of about 26 per cent., and with so many comparatively new hands to train and instruct in their duties.

Westminster Electric Supply Corpn., Ltd. Mr. J. Browne Martin presided at the annual meeting on February 28th. He said that the receipts were £15,000 larger than for 1915, owing to the increased charges to consumers and large expansion in power and heating current sold. The use of radiators and electric fires was constantly increasing. They had sold 187,000 units less for lighting than in 1915, and still less would have been used but for the fogs and dark weather. Power and heating units sold increased by 1,200,000, and the total for these purposes very nearly approached those sold for lighting. In regard to expenses, coal had cost 1s. 6d. per ton more than in 1915, and the cost of public lighting was up by £927, owing to carbons and wages. For the first time they had a material reduction in the amount paid for rates. They had lent to the Treasury securities to the amount of over £70,000, and held £90,000 of War Loan Exchequer Bonds and Treasury Bills. They had also subscribed £25,000 to the new loan. The Daylight Saving Bill appreciably reduced their lighting sales. They were making no further increase in the charge for electricity for lighting purposes beyond the 10 per cent. of October, 1915, but they were slightly raising the price for that supplied for power and heating, which was still appreciably below that charged in many other districts. The price of coal and its delivery formed a chief factor in the business, and those contingencies must be borne in mind.

Tramways, Light & Power Co., Ltd. Viscount Chilston presided at the annual meeting on February 28th. He said that their income from the various power, lighting, and tramway undertakings was £35,272, an increase of £4,780. Administration expenses were approximately the same as in 1915, but debenture and loan interest absorbed £1,200 more. £100,000 of 5 per cent. debenture stock was issued during the year, the proceeds of the issue being applied in repaying loans from bankers and providing for the current needs of the company. All the properties showed an improvement except the electric lighting portion of the Leamington and Warwick Co., and the electric lighting undertaking in Leamington. The decline in profit was purely temporary. The position of the company now justified them in paying dividends half-yearly on September 1st and March 1st each year, and they therefore proposed to pay the preference dividend on these dates in future, unless the company was faced with any set-back which could not be foreseen at present. Out of the balance of £36,769 available, £12,214 was required for debenture and loan interest, 6 per cent. was paid on the preference shares, £5,000 transferred to reserve, and £4,073 is to be carried forward. Considering the great difficulties of the times, the report was extremely satisfactory.

Newcastle and District Electric Lighting Co., Ltd. At the annual meeting, on March 2nd, Mr. Arthur Scholefield, the chairman, referred to the great loss that the company and the whole of the Tyneside district had sustained through the death of Sir Benjamin C. Browne. Sir Benjamin joined the company 28 years ago, when it was formed. The directors proposed to place £10,000 out of the year's profits to the reserve fund, making £20,777. The capital expenditure had been increased by £9,793. The gross receipts for energy, &c., showed an increase of £15,051, or about 19 per cent., which was very good; the receipts had been affected by the lighting restrictions. On the termination of the war the loss due to the restriction of lighting would be recovered, and with a reduction of working costs the directors looked forward with confidence to the results of the future. There had been an increase of 23 per cent. in the number of units sold during the year. The net profit for the year, £20,816, was an increase of £4,851. They proposed to pay a dividend of 2½ per cent., for the directors, in view of the continued high price of coal and the unsettled conditions prevailing at the present time, did not think it would be wise to distribute more than the dividend now recommended.

Kensington and Knightsbridge Electric Lighting Co., Ltd. During 1916 connections to the system increased by 59 to 5,070, and the energy-consuming devices by 11,390 (30 watts) to 522,175. Lighting restrictions were more stringent than in 1915, and the Summer Time Act caused a reduction of 8 per cent. in the units sold during the period it was in operation. The net profit was £11,574, plus £432 brought forward. After paying the preference dividends, and a final dividend at the rate of 7 per cent. for the last half-year on the ordinary, making 6 per cent. for the year, £205 is to be carried forward. The balance of the renewal and reserve fund account, after writing off the capital account £6,981 for old plant sold, now stands at £135,925. Mr. G. H. Hopkinson has retired from the board after 23 years. The vacancy is not to be filled at present. Annual meeting: March 15th.

Metropolitan Electric Supply Co., Ltd. The capital expenditure during 1916 was £34,493, making the total £2,293,094. The gross revenue was £277,909, an increase of £48,708; the working expenses were £161,009, an increase of £33,859. £40,000 has been put to depreciation and reserve (now standing at £377,359), and £76,900 is carried to the credit of net revenue account. The balance brought forward, together with interest and dividends on investments, &c., brings the total up to £90,195, and after deducting interest on debenture stocks and loans, dividend on preference shares and sundry items written off, the balance is £34,757. A further dividend of 2s. per share (at the rate of 4 per cent. per annum), making a total for the year of 3s. per share, or 3 per cent. for the year, is recommended, leaving £4,757 to carry forward. The new connections during the year were equal to 119,880 25-c.p. lamps, making the total connected 1,317,643. Annual meeting: March 13th.

County of London Electric Supply Co., Ltd. The capital expended during 1916 was £31,409, making £2,189,064. The revenue for the year, after deducting all costs and charges, was £156,894, plus £14,499 brought forward. Debenture and loan interest absorbed £42,528, and there is put to reserve for depreciation £45,000, leaving for distribution £83,865. After paying the preference dividend, and dividends of 5 per cent. and 9 per cent., less income-tax, for the first and second half-years respectively on the ordinary shares, £18,378 remains to be carried forward. Applications for 4,516 kw. received during the year bring up the total to 64,581 kw. The total units sold were 35,029,862, an increase of 4,467,817. The number of consumers increased from 25,913 to 26,994. The results are regarded as satisfactory. Cost of coal and other material further increased; lighting restrictions more vigorously enforced. The Bournemouth & Poole Co. has paid 6 per cent. for the year. Coatbridge & Airdrie Co. increased its units sold from 6,134,986 units to 8,414,823. Annual meeting: March 12th.

South Metropolitan Electric Light & Power Co., Ltd.

Mr. H. St. J. Winkworth, presiding at the annual meeting, said that the number of new consumers was only 204, as cable extension had been kept to a minimum in residential and shopping districts. New business and extensions, and additional bulk supply had increased the revenue by £15,130, the largest increase they had had. The total units sold were 41 per cent. better than 1915, and 94 per cent. better than 1914. Sales for heating and domestic power were 356,755 units, as against 212,154 in 1915. Sales in the showrooms and the wiring and installation work carried out amounted to £12,800, with 4,804 transactions (4,479 in 1915). Coal cost £26,673, or £12,420 more, partly due to increased output and partly to higher cost, higher freights, and inferior quality, although owing to more efficient working the quantity used per unit generated was the lowest on record. Rates charged to consumers had been revised in some cases to meet in part the increased cost. The West Kent Electric Co., Ltd., had paid a dividend of 10 per cent., and the expansion of business was continuing, and the outlook was favourable. The prospects as to output of the South Metropolitan Co. for the coming year were good, but it was difficult to forecast what the effect of the prevailing conditions might be upon economical working. For many weeks past the increased output has approximated 35 per cent. to 45 per cent. over that of 1916. Mr. H. W. Bowden, the engineer-in-chief, in seconding the adoption of the report, made his usual technical statement. Among other things, he said that the results of their experiments with coke breeze were distinctly encouraging, but they had to abandon the trials owing to the heavy demands made upon the boiler plant. It was their intention to resume the trials as soon as there was sufficient boiler plant available for the purpose.

St. James' and Pall Mall Electric Light Co., Ltd.

Mr. Walter Leaf, presiding at the annual meeting, said that by appointing Sir Alex. Kennedy to succeed the late Mr. Dobson (chief engineer) they were able to draw still closer their alliance with the Westminster Co. During the year the business had recovered from the shock of war, and resumed its normal steady progress. The output of units had grown by 600,000, almost entirely in the second half of the year, and that rate of increase was being maintained. If the present rate continued to be maintained, 1917 should easily surpass any year before the war. Their revenue also showed a good increase, chiefly owing to increased output, but partly to increased charges made to consumers. The increased cost of coal showed itself in the increased cost of electricity purchased, amounting to £7,600 more than last year. The increase would have been much larger but for the efficiency of the new plant installed by the Central Co. They had obtained a re-valuation for rating, with the result that their payments for rates were reduced by £1,398. The Central Co. had paid no dividend, so receipts from investments had fallen by £1,711. The net result was that they were enabled to pay the same dividend as last year, but it was all paid out of profits, whereas last year they had to take £4,500 from the contingency fund.

Waste Heat and Gas Electrical Generating Stations, Ltd.

Profit for year ended January, 1917, after deducting administration expenses, £40,080, against £39,819 last year; transferred to reserve, £11,500, balance brought forward, £17.430. Available profit £45,511, against £43,030 for 1915. The dividend is to be 8 per cent., as before, leaving £19,911 to carry forward. The new generating plant at Weardale power station has been delivered, and will be completed at an early date. With this plant the coke oven gas will be utilised in an internal-combustion engine, instead of under boilers as at present. The Grangetown power station extensions are now in operation. Capital expended during 1916, £37,738. The revenue from units generated at the different power stations has been satisfactorily maintained, the amount of waste heat and gas having been approximately as in 1915, but the amount is still below the average obtained prior to the war. Arrangements have been made, in conjunction with the Cleveland and Durham Power Co., under which a power station will be erected at Horden for the utilisation of waste heat and gas from coke ovens being constructed by the Horden Collieries, Ltd., and plant of 3,000 H.P. capacity will be installed.

Charing Cross, West End and City Electricity Supply Co., Ltd.

The directors report that during 1916 the West End undertakings increased their gross earnings from £138,964 to £150,473, and the expenses, excluding depreciation, rose from £70,068 to £78,831. The net earnings advanced from £68,895 to £71,642. Including balance brought forward, £18,044, and interest accrued for 1916, £3,234, the available sum is £92,920. There is absorbed by debenture interest £17,829, £22,000 is put to depreciation, the preference dividend is paid, also 5 per cent. on the ordinary shares, leaving £15,090 to be carried forward. The equivalent of 30-watt lamps connected to the West End mains is 724,418 (457,185 lighting, 42,798 heating, 224,435 (9,025 H.P.) motive power). The City undertaking increased its gross earnings from £158,357 to £176,464, and the expenses advanced from £94,590 to £110,909; the net earnings advanced from £63,767 to £65,555. After adding £18,000 brought forward, providing for debenture and loan interest, &c., and paying the preference dividend, £17,739 is carried to general reserve (income) account, and £18,000 is to be carried forward. The equivalent of 30-watt lamps on the City mains is 748,623 (319,160 lighting, 69,640 heating, 359,823 (11,470 H.P.) motive power).

West End.—Units generated, 4,152,539; bought, 11,972,745. Total sold, 11,775,521. Used on works, &c., 4,349,763. Total accounted for, 16,125,284.

City.—Units generated, 34,654,576; bought, 153,715; sold, 28,397,463. Used on works, &c., 6,410,828. Total accounted for, 34,808,291.

Northampton Electric Light & Power Co., Ltd.—During 1916 the connections were 19,596 (32-watt), making 242,853. Motors increased by 476 H.P., making 5,144 H.P., of which 3,580 H.P. is on hire. The units sold totalled 5,526,482, an increase of 9.3 per cent. Owing to the importance of extensions, the capital was increased by £50.000 in £1 shares, and the shareholders and the general public had responded entirely satisfactorily to the offer of the shares. £5,500 has been added to depreciation, and a further £925 has been written off hired motors. The reserve fund is increased by £1,000. After paying 5 per cent. on the preference shares, and 6½ per cent. for the year on the ordinary, £2,010 is to be carried forward. Mr. Brook Sampson has retired from the board, and Mr. A. H. Geldart will take his seat.

Cambridge Electric Supply Co., Ltd.—Mr. D. Munsey told the annual meeting, on February 28th, that the severe outside lighting restrictions had affected them adversely, but the increase in current used for power had compensated them somewhat, though the income therefrom was less. Coal cost £800 more than in 1915. Rates and taxes increased by £160. He thought that if they could pay 5 per cent. the shareholders would be satisfied. What 1917 would bring forth he could not tell. Mr. A. A. C. Swinton, in moving the reelection of Sir C. Parsons as a director, said that Sir Charles could not be present as he was sitting as chairman of a meeting of the Board of Trade Committee on the Electrical Trades, which was concluding its report, and he could not get away. The Committee had sat weekly for many months.

Chloride Electrical Storage Co., Ltd.—According to the *Financial Times*, an extraordinary meeting is to be held on 8th inst. to consider the following resolutions: (1) That the capital be increased from £135,350 to £300,000 by the creation of 164,750 £1 shares, of which 73,250 will be ordinary shares and the remaining 91,500 may be issued with such rights as the company in meeting may determine; (2) that £73,250 of the reserve fund be distributed in the form of fully-paid ordinary shares as a bonus to holders of ordinary shares.

Tyneside Tramways & Tramroads Co.—At the half-yearly meeting, Dr. J. T. Merz said that their receipts had been considerably more than they were in the corresponding half-year of 1915, and they were, therefore, able to make up the deficiency in the last half-year, and bring up the dividend to 3 per cent., as it had been before. Their revenue had increased £687 on the half-year, they had been working on a smaller mileage, and had gained ½d. per car mile, but the costs had gone up 0.6d. per car mile.

Jarrow & District Electric Traction Co., Ltd.—Total revenue for 1916 £8,755, a decrease of £100. After deducting expenses, debenture and loan interest, and £800 for renewals, the surplus is £2,213, plus £1,040 brought forward. £900 is placed to reserve, 3 per cent. is paid on the ordinary shares, and £855 carried forward.

Shropshire, Worcestershire & Staffordshire Electric Power Co.—An extraordinary meeting is called for March 19th, at the Electrical Federation Offices, to authorise the board to issue 50,000 of the 150,000 cum. pref. shares of £1 each created in May, 1915, as redeemable 7 per cent. cum. pref. shares of £1 each.

Stock Exchange Notice.—The Committee has ordered the undermentioned to be quoted in the Official List:—

India-Rubber, Gutta-Percha & Telegraph Works, Co., Ltd.—£400,000 5 per cent. debentures of £100 each, Nos. 1 to 4,000.

Northallerton Electric Light & Power Co., Ltd.—Mr. J. Hutton informed the annual meeting that, owing to the war, the net profit for 1916 was only £232, against £496 for 1915.

Automatic Telephone Manufacturing Co., Ltd.—Dividend, 5 per cent. on ordinary shares; £16,000 is written off, and £14,774 is to be carried forward.

Tyneside Electrical Development Co., Ltd.—Dividend, 6 per cent. per annum on the preferred ordinary, and 10 per cent. on the deferred ordinary, carrying forward £933.

Alldays & Onions Pneumatic Engineering Co., Ltd.—Interim dividend, 5 per cent. per annum, less tax, on the ordinary shares for the half year.

South London Electric Supply Corporation, Ltd.—Dividend on ordinary shares, 5 per cent. for 1916, carrying forward £3,053 Units sold 6,698,357, an increase of 380,217.

Rushden & District Electric Supply Co., Ltd.—The number of consumers increased from 123 to 151 during 1916. Motors increased from 292½ to 459 H.P., of which 393 is let out on hire. Units sold increased by 86 per cent. to 464,713, and revenue from £1,699 to £3,060. A dividend of 5 per cent. is to be paid, and £470 is being written off for depreciation, £164 off preliminary expenses, and £95 is to be carried forward.

Melton Mowbray Electric Light Co., Ltd.—Dividend for the year, 2 per cent., placing £800 to plant renewals reserve and carrying £395 forward. Mr. W. J. New, the chairman, said that the report was satisfactory under the circumstances, though the dividend had fallen off. No reduction in the cost of coal could be expected, and a further increase in charges to consumers at an early date must be anticipated.

Bruce Peebles & Co., Ltd.—Total profit for 1916, £24,469. Net profit £11,930, subject the Excess Profits Duty for 1915 and 1916. The debit at December, 1915, was £10,687, so that in the balance sheet the profit and loss account now shows a credit of £1,243. Meeting: March 16th.

British Insulated & Helsby Cables, Ltd.—Dividend, 10s. per share, plus a bonus of 5 per cent., making 20 per cent. £128,500 is put to reserve and depreciation, and £163,000 is to be carried forward.

Birmingham District Power & Traction Co., Ltd.—A petition for reducing the capital from £1,050,000 to £700,000 is to be heard by Mr. Justice Astbury on March 23rd.

Calcutta Electric Supply Corporation, Ltd.—The units sold to consumers during the four weeks ended January 26th, 1917, were 1,750,156, compared with 1,354,635 last year.

Globe Telegraph & Trust Co., Ltd.—Dividend, 2s. per share, less tax, on the ordinary shares for the past quarter.

New York Telephone Co.—The total net earnings for 1916 were $23,364,706, an increase of $3,854,166.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets are firmer. There is more inquiry than stock in the case of many first-class investment securities. Sharp rises in Consols, both the War Loans, and the 6 per cent. Exchequer Bonds, have attracted renewed attention to the gilt-edged markets. Already there is much demand for high-grade stocks, despite the fact that the subscription lists for the 5 per cent. War Loan closed less than three weeks ago. Business remains quiet, but the tone is decidedly more healthy, and prices, generally speaking, are on the rise. National service work of a temporary character has been provided this week for the Stock Exchange and its House Clerks; before long, something more permanent will be offered.

So far, the rise in the investment markets has not got round to Home Railway stocks in the Underground group. Some of those in the Steam lines are better, but the recent speech of Lord George Hamilton at the meeting of the District Co. was not encouraging, though his remarks apply equally to steam and electric transport. The London General Omnibus Co. has notified that it has a very large claim against the Government, though this had no effect upon the prices of the various stocks in the Underground Electric Railways Co. The Income bonds of the holding company are lower at 82, the dividend disappointment still rankling.

Those interested in academics will find a nice point in considering what is the yield on these bonds at the present time. They have just been paid a dividend at the rate of 4 per cent. per annum, while in the previous half-year 6 per cent. was distributed. The question is, whether they can be regarded as a 5 per cent. investment or not. We work out the yield on the former basis in our tables. The £10 shares are a shade harder, and those of the shilling variety are steady at 5s. 6d.

Although prices of the Mexican industrials are unchanged on the week, the sentiment in regard to the companies is a little less cheerless. Buying has lifted the prices of two or three of the Mexican railway stocks; this served to infuse hope into the industrials. That Carranza did not comply with the blandishments of the astute German who tried to embroil him in so characteristic a plot is read as an indication of more friendliness on the part of the Mexican President than he had been thought to possess.

Moreover, one or two of the Mexican oil companies have just reported excellent progress; and although their sphere of operations is well removed from the danger zone, the mere fact of their being able to secure progressive profits in Mexico during the chaos is considered to hold a glint of hope for the others. A slender enough sunbeam, it is true, but something, at all events, to go on with.

Other foreign issues are disposed to be dullish. The Argentine Tramways stocks are heavy, in sympathy with the acute depression that has befallen Argentine railway stocks, although the reasons which contribute to the latter have but an indirect bearing upon the former. Brazilian Tractions fell to 45½, and recovered a point later, this being in keeping with the trend of other securities connected with the Republic, which fell upon flatness upon the prohibition of Brazilian coffee imports into this country, but have since partially rallied. Rio Tramway bonds of both classes continue dull, failing to recover, so far, the point or two falls that occurred last week.

The Kensington & Knightsbridge Electric Lighting Co. has reduced its dividend from 7 per cent. to 6 per cent., a result which was anticipated, as we ourselves have shown several times here. The net profit of £21,500 is about £1,000 less than this time last year, but a smaller amount came into the accounts. The price of the shares has not altered, and the market as a whole is a good one. Counties rose to 10¼, and West End shares are in some demand. St. James' & Pall Mall have gained 5s. The County Co. improved its gross receipts by nearly £45,000, but the net profit of £69,400 is £6,000 less than that of a year ago. The sum of £11,000 for repairs and renewals is charged this time to revenue instead of reserve, and depreciation receives £45,000, instead of £40,000.

The Metropolitan's gross receipts rose £48,000 to £286,000, but net profit is £1,400 down at £46,900. The company maintains its dividend at 3 per cent.

Prices in the manufacturing group are good. General Electric ordinary and preference both gained 5s. British Insulated added a further 5s. to their big rise of last week. India-Rubber improved by a similar amount. Of the lower-priced descriptions, British Westinghouse preference are again being bought. On the other hand, British Aluminium have been slightly reactionary. The cable market is so quiet as to call for no special comment. Marconis have quieted down, though the market remains steady. The rubber market remains the most active in the Stock Exchange, prices being good throughout, with persistent buying of all the best-class shares.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Mar. 6, 1917.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary	5	5	3⅜	—	7 8 2
do. do. do. 4½ Pref.	4½	4½	8$\frac{3}{16}$	—	7 1 2
Chelsea	5	4	3	—	6 13 4
City of London	9	8	11	—	7 5 5
do. do. 6 per cent. Pref.	6	6	9⅞	—	6 1 6
County of London	7	7	10¼	+ ⅛	6 16 7
do. 6 per cent. Pref.	6	6	9⅝	—	6 6 4
Kensington Ordinary	9	7	5⅜	—	5 11 7
London Electric	4	3	1	—	Nil
do. do. 6 per cent. Pref.	6	6	8¾	—	5 6 8
Metropolitan	8½	8	2¼	—	6 13 4
do. 4½ per cent. Pref.	4½	4½	9⅛	—	7 4 0
St. James' and Pall Mall	10	8	6¼	+ ¼	6 8 0
South London	5	6	2⅞	—	6 19 0
South Metropolitan Pref.	7	7	1$\frac{3}{32}$	—	6 7 8
Westminster Ordinary	9	7	5¾	+ ⅛	6 1 9
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	94	—	6 7 8
do. Def.	30/-	33/6	22	—	6 16 4
Chile Telephone	8	8	6$\frac{15}{16}$	—	5 15 3
Cuba Sub. Ord.	5	5	7¾	—	6 8 6
Eastern Extension	7	8	13¾	—	*5 16 4
Eastern Tel. Ord.	7	8	137	+ ½	*5 16 10
Globe Tel. and T. Ord.	6	7	11½	—	*5 19 2
do. Pref.	6	6	9¾	—	6 3 1
Great Northern Tel.	22	22	34½	—	6 7 5
Indo-European	13	13	46½	—	6 19 9
Marconi	10	10	2$\frac{13}{16}$	—	3 11 2
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord.	10	10	2⅛	—	4 14 1
United R. Plate Tel.	8	8	6⅜	—	*6 6 6
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13¾	—	*5 16 4
Home Rails.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1½	1	23	—	4 7 0
do. District	Nil	Nil	16	+1	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A"	Nil	Nil	5/6	—	Nil
do. do. Income	6	6	82	—3	*6 2 0
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4$\frac{15}{16}$	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	2⅞	—	9 11 4
do. 2nd Pref.	5½	5½	2⅝	—	—
do. 5 Deb.	5	5	64½	—	7 15 0
Brazil Tractions	4	4	46½	—	8 12 0
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	60	—1	8 6 8
do. do. Preferred	—	Nil	43	—	Nil
do. do. Deferred	—	Nil	37½	—	Nil
do. do. Deb.	4½	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	25	—	Nil
do. 6 per cent. Bonds	—	Nil	22½	—	Nil
Mexican Light Common	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	14½	—	Nil
do. 1st Bonds	Nil	Nil	27½	—	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	2¾	—	5 9 1
British Aluminium Ord.	5	7	27/6	—6d.	5 8 0
British Insulated Ord.	15	17½	12¾	+ ¼	6 17 3
British Westinghouse Pref.	7½	7½	2$\frac{5}{16}$	+ $\frac{1}{32}$	6 9 10
Callenders	15	20	12¼	—	8 4 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	3⅜	—	6 10 8
Edison & Swan, £3 paid	Nil	—	⅜	—	Nil
do. do. fully paid	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	61½	—	6 10 1
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9½	+ ¼	6 6 4
do. Ord.	10	10	14	+ ¼	7 2 10
Henley	20	25	15	—	8 6 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11¾	+ ¼	*8 10 2
Telegraph Con.	20	20	37	—	*6 15 2

* Dividends paid free of income-tax.

FIGHTING HAIL AND STORM BY "ELECTRIC NIAGARAS."

The damage done to agriculture by hail is sufficiently serious in this country, but it is vastly greater in many other lands. In France, for instance, the loss by hail is estimated at £4,000,000 per annum, a sum so large that there is every encouragement to tackle seriously the problem of eliminating or controlling hailstorms, instead of merely distributing inadequate sums from public funds in compensation for the damage done. Hail cannon, rockets, bombs, explosive balloons, siren kites, and such like devices are more or less effective in "softening" hailstorms in their immediate vicinity, and even in reducing the storm to rain, but little can be done against violent cyclonic storms by these means, and well-organised "firing" on a large scale is necessary to deal at all certainly with slowly-moving storms.

From ordinary experience, one is quite prepared to admit the probability of hailstorms being governed (or, at any rate, affected) by the electrical conditions of the atmosphere. This probability is supported by authentic records of serious hailstorms all over the world; such storms are generally "thunderstorms," and it is generally easy to trace cause and effect in lightning discharges and the increased violence of hail which follows. The firing of hail cannon, &c., may achieve its purpose, but there is reason to suppose that it does so by changing the electric potential of the lower layers of air and clouds, and, by suppressing lightning, prevents the formation of hail. Many theories have been evolved to account for the connection between electricity and hail. Thus Volta considered the formation of hailstones to be due to the combined effect of cold produced by evaporation and of electrostatic attraction and repulsion of ice-particles. Another theory is that the shock caused by a flash of lightning, or the vacuum formed temporarily along its path, leads to local rarefaction of air and such evaporation of moisture as cools surrounding particles to freezing point. The difficulty is to explain how one or a few flashes can control the hail-fall over an area of hundreds of acres, if in reality they do so.

There seems not the slightest doubt that, in France at any rate, disastrous falls of hail are always preceded by violent lightning, generally from cloud to cloud. Also, in districts much subject to storms, the latter tend always to follow the same route. Storm charts show remarkable regularity in the lines representing the course of storm clouds, and also show the constant influence of mountain peaks. In Western Europe, and particularly in France, the prevailing direction of storms is from the West towards the North-East and East.

Lightning Conductors and Hail.—Granted that there is a close association between atmospheric electricity and hailstorms, it is obviously better to attempt some direct control over atmospheric electricity than to use weapons which can only be operative by secondary effects. Experiments conducted in France during the course of several years past have shown that a carefully-arranged system of lightning conductors is very effective in warding off hailstorms, and a detailed statement of the ways and means employed is given by Jean Escard in *La Lumière Electrique*, whence these notes are derived. The idea of using vertical conductors to fight storms and hail is a very old one. During the second half of the 18th century hail rods (*paragrêles* or *paragrandines*), consisting of long masts terminating in a copper point connected to ground, were tried in France and Italy. About that time, Franklin suggested the use of numbers of lightning conductors to diminish the frequency of storms, as well as to protect buildings; and in 1783 Abbé Berthelon devised his *électro-végétomètre* to collect atmospheric electricity by a multiple-pointed lightning conductor. The primary object of this device was to stimulate growing crops, and it has formed the basis of many later systems of "electroculture," as well as of most of the protective arrangements since proposed for use against hail. Following successful trials with wooden posts, the brass-pointed tops of which were connected to earth by a conductor of hemp and straw, more than a million hail rods were installed in France, Switzerland, Italy, Bavaria, and on the banks of the Rhine by the year 1825. A generation later Beckensteiner patented a system for "combining increased crops with freedom from destructive atmospheric conditions" by using a *large number* of hail rods *particularly on heights*, each rod consisting of a painted resinous pole about 65 ft. high, and fitted with a copper finial (with four or five branches) and a galvanised iron conductor to earth. Practically the same equipment was used by Frestier and Chabert in successful electroculture and protective investigations between 1885 and 1895. Convincing testimony as to the efficacy of such equipment is afforded by the great reduction in storm damage in the neighbourhood of the Pic-du-Midi Observatory. Since 14 lightning conductors were fitted to the building in the 'nineties, the claims in respect of hail and lightning damage have been very few.

In 1901, Dr. Clément (Lyons) published several notes emphasising the importance of using many hail rods, and of placing them on all high ground. The rods should not be placed simply in the area to be protected, but should be arranged to form a sort of "storm wall," or barrage, at a little distance away, and in the direction from which storms usually arrive. There is, of course, no objection to making the protection more complete, but the "outposts" are the first essential. Clément recommended that the hail-rod should consist of a long metal strip reaching well above surrounding objects, and terminating at each end in a large sphere or disk. The whole of this system should be insulated from earth, and a short distance above ground there should be a metal "exciter," consisting of a bowl near the lower sphere and connected to earth. Such a system would discharge intermittently and carry off large quantities of electricity from a storm cloud. Naturally, it would be very dangerous to approach the "exciter," which should, therefore, be effectively screened.

Electric "Niagaras."—The electric "Niagaras" of Négrier and Beauchamp, so called because they discharge large quantities of electricity into the earth, consist of rectilinear batteries of large lightning conductors carried by lofty lattice masts and terminating in branched finials. It has long been recognised that natural obstacles (forests in particular) form barrages, giving a great deal of protection against hail; indeed, many districts are almost perfectly protected by large woods surrounding them. The genuineness of such protection is well authenticated. The natural barrage is analogous to regiments of lightning conductors, or to enormous condensers preventing storms from breaking and preventing the formation of hail-clouds.

When there is "no electricity in the atmosphere" there is no hail, and even when the atmosphere is highly charged electrically there is no hail if the air be saturated with moisture. A dry and highly-charged atmosphere is very favourable to the formation of hail. As it is impracticable to increase the humidity of the atmosphere by artificial means, all that we can do to reduce the hail risk is to dissipate the electrical charge of the atmosphere as much as possible. In order to do this it is only necessary to know how atmospheric electricity behaves, and how it acts on the atmosphere. Thereon depends the whole science of protection by electric "niagaras." The function of "niagaras" is rather to drain away atmospheric electricity (in the form of a steady brush discharge to the conductor, and so to earth) than to cause or encourage actual flashes of lightning, because hail is generally precipitated by the latter.

The potential difference between the earth and the upper layers of the atmosphere is enormous,* and normally increases with altitude (the air being charged positively). In other words, at higher altitudes one approaches more and more to an ideal source of electricity—a reservoir of enormous capacity. The charges of atmospheric electricity are being renewed continuously (by air movements, &c.), and it is quite impracticable to establish permanent conductors between the upper atmosphere and earth in sufficient numbers to keep the atmosphere "drained" of electricity. All that we can do is to suppress more or less effectually the sudden discharges which cause storms. This may be accomplished by lofty fixed conductors which "drain" passing clouds of their electrical charge, and so safeguard adjacent territory which it is desired to protect.

The first "electric niagara" to be erected in France (in 1899) consisted of a large metallic pylon terminating in a radiating sheaf of pointed copper bands, connected electrically to a water course. This equipment was erected at St. Julien l'Ars, which used to suffer more frequently than any other place in Poitou from hail and storms. The protection afforded proved to be so effective that several other towns soon voted funds for similar equipments, subsidies were obtained from local authorities, and Senators and Deputies have raised the matter in Parliament with a view to protecting the whole of France against hail and storm. When hail does fall in the neighbourhood of electric niagaras, it is in the form of "soft hail"—friable and practically harmless, little more than snow.

Before the St. Julien "niagara" was erected, damage by hail was frequent and severe, and the value of the crops destroyed increased as the vineyards were extended. Directly the "niagara" was installed there was an unmistakeable decrease in the storm damage. For 13 years past no damage has been caused by lightning, and hail has done no appreciable damage, such as has fallen being quite soft. *In all the neighbouring communes the damage done by storms has remained as serious as ever.*

(*To be concluded.*)

Conductivity of Air and of Mica.—M. Branly, at a recent meeting of the Paris Academy of Sciences, reported that he had had occasion to investigate the resistance of piles formed of a large number of thin sheets of white mica; and, observing certain anomalies, was led to believe that the conductivity was appreciably increased by the existence in these sheets of very fine circular holes. Experiments, still in progress, have been made with a simple circuit comprising (1) a source of electric supply, (2) two metal plates between which is inserted a fine sheet of mica, either plain or perforated, (3) a galvanometer. It appears that the gaseous layers imprisoned between the sheets are liable to become gradually and freely conductive.

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* Tests at Glossop Observatory showed a potential higher than 100,000 volts at 400 metres above ground.

SOME POINTS IN CONNECTION WITH ENGINEERING SPECIFICATIONS.

By J. SHEPHERD, M.I.E.E.

(*Paper read before the* Institution of Electrical Engineers *at Leeds.*)

(*Concluded from page* 249.)

Laying Cable Conduits.

In a large underground electrical distribution system the cables are either drawn in or laid solid, and both systems have their advantages.

For a large town with expensive surface reinstatement, the solid system is unsuitable; whilst for an urban district the draw-in system is too costly.

The work of laying cable ducts is very similar in character to that of laying gas or water pipes. The method adopted by one of the Government Departments was to pay a fixed rate per lineal yard of work actually carried out, the contractor taking the risk of difficult work, and having to stand the loss of work partially completed but abandoned owing to obstructions encountered later.

Such a method of contracting is open to many objections, as the work becomes too speculative, the unknown quantities being too great. Either the contractor loses a lot of money or else he provides large amounts for contingencies which may or may not arise.

For work of a similar character which the author has carried out, the specifications for the work, though more elaborate, were found to be fair to both parties in so far as difficult work is paid for if met with, at tendered rates set out in the bill of quantities, and, if difficult work is not met with, the contingencies provided for do not require to be met.

The general body of the specification contains but little novelty, the chief interest being in the bill of quantities, which is divided into three sections, as follows:—

(A) *Duct-laying* of various numbers of cable ducts laid in every kind of roadway or pathway construction. The rates tendered per yard run. Cover excavation to normal depths and widths, removal of useless obstructions, lighting, watching, fencing, &c., carting away surplus material, levelling the bottom of the trench, laying conduits or pipes in cement, concrete, and mortar, filling in the trench, ramming and permanently reinstating the surface, testing each cable-duct line, including the cartage of the ducts from the nearest depôt.

The rates tendered cover work laid both at normal depths and in trenches of normal width. If, when carrying out the duct-laying, deeper trenches or wider excavation be found necessary, adjustment in rates are made, as afterwards described.

(B) *Construction of Manholes.*—The manholes for drawing in the cables are spaced about 100 yd. apart, and are of two types and various sizes, to suit the bank of ducts.

The work of constructing the manholes is divided into the following sections:—

(*a*) Excavation of the ground.
(*b*) The foundation upon which the box is built.
(*c*) The brickwork of the box.
(*d*) The construction of the top or cover of the box.
(*e*) The permanent reinstatement of the surface, whether road or footway.

If the manholes are of standard size, the rates tendered directly apply. If they are of necessity greater in depth or width, the new prices can be immediately built up from other rates, given in the next section.

(C) *Miscellaneous works* of all characters which may be required, such as excavation for extra depths or for extra widths, extra bricklaying at various depths, rates for concrete laid at various depths, timbering left in trenches, steel or cast-iron piping, paving, and surface reinstatement of every kind, &c.

In practice it has been found to be comparatively simple with a specification of this character, and with a comprehensive schedule of prices, to adjust at once, and to price up all work of usual difficulties. When, however, the work becomes of extraordinary difficulty, involving excavation in water, running sand, or the like, provision is made in the specification for the contractor to carry out the work on a prime cost basis, plus 15 per cent., but in only one case during 11 years was it found necessary to resort to this method.

Work to the value of £250,000 has been carried out to specifications of this character with but one dispute, where a particular class of work had been incorrectly priced and the estimated quantities of that class of work were largely exceeded.

Sub-station Switchgear.

Having no less than 23 sub-stations containing rotating machinery of from 2,000-kw. to 6,000-kw. capacity, the problem of purchasing switchgear became one of importance.

Two methods were adopted. At the commencement general requirements to be met were stated, leaving the maker to supply his standard apparatus to meet the conditions laid down. Three sub-stations were equipped in this way by two contractors; one for the high-tension apparatus, and the other for the continuous-current feeder panels. The result was not satisfactory. One contractor supplied his panels of marble, the other insisted on slate; and the two classes of panels had varying widths and heights. These difficulties, however, were minor matters compared with other troubles met with.

Within six months the low-tension panels had practically to be rebuilt, and within six years the high-tension panels had to be scrapped to suit Home Office regulations.

For all later sub-stations the second method was adopted, viz., to issue working drawings of all the panels and apparatus and to loan to the contractor parts for interchangeable manufacture.

The method was entirely satisfactory to the purchaser; competitive tenders on equal footing were obtained, and sound and interchangeable switchgear was purchased, requiring a minimum quantity of spare parts.

It became a simple matter to interchange panels from sub-station to sub-station as conditions of load required.

All high-tension switchgear was contained in brick cubicles, and but two accidents occurred during 10 years' working. In each case the damage was confined to the one cell where the short-circuit occurred.

There are, of course, drawbacks to such a system of purchasing. It is not adapted for purchases on a small scale, and it becomes difficult with standard designs to introduce modifications from time to time, which otherwise in a smaller system would be adopted. On the other hand, the maintenance of such switchgear was particularly good, amounting to practically nothing on the high-tension side, and it was generally confined to renewals of circuit-breaker contacts on the low-tension side.

It became possible to standardise such details as all porcelain insulators, and a sheet of standard porcelain was loaned to each contractor in turn.

Reconstruction of Motor-Generators.

After working continuously night and day, several of the earlier motor-generators began to fail from various causes, such as soft cores, broken core teeth, brittle insulation on the armatures and stators, charred insulation on the shunt windings, &c.

After careful consideration it was decided to provide a renewals fund on the basis of reconstruction every 10 years, and the first year's programme included the reconstruction of 17 motor-generators of 300-kw. and three motor-generators of 500-kw. capacity. An estimate of the cost of the work was furnished to the financial authorities, and the makers of the plant were approached for prices. As the results were by no means comparable, a specification was drafted, working drawings were got out, and tenders invited by advertisement, the prices tendered being:—

(A)	£7,987 10s
(B)	£8,330
(C)	£14,100
(D)	£20,321
Engineers' estimate	£11,500

The lowest tender was that of a firm practically unknown, but a visit to their shops proving satisfactory, the contract was let to them at the price tendered, and the result was in every way satisfactory.

Owing to improved methods of winding with "hairpin" formed coils, a much sounder construction resulted, giving an increase in output of 25 per cent. on the original rating, and a renewal of life to certainly another 10/15 years.

The machines were originally constructed in 1902 and 1903, and the frames were then liberally proportioned.

The contractors who carried out the work took on further contracts at substantially the same rates.

General.

Having described in brief outline a few specifications covering various branches of engineering, the author would by no means dogmatise, or even go so far as to say that the only way to buy engineering plant is by specification. It is, however, the only way he knows of by which one can purchase plant on the conditions laid down. A free agent can purchase on different lines if he is free to select his tender, no matter what the price may be; but, even so, a clear specification as to what is offered is necessary both to limit the supplier's responsibility and to define his liability. The basis of all contracts depends upon much besides the wording of a specification, and implies fair and reasonable dealing on the part of both supplier and purchaser, without haggling on the part of the supplier or needless complaints or meddling by the customer's engineer. In conclusion, the author would remark that, to specifications such as those described, over £2,500,000 worth of work has been purchased, and of that large sum not more than £1,500 was spent abroad, and that for articles which were not manufactured in this country. In the past a large amount of foreign purchasing has taken place, resulting in the foreign manufacturer frequently escaping rigid inspection, burdensome general conditions, exacting wage rates, and other labour conditions. This condition of affairs is not, however, likely to be repeated during the next 10 years, nor, it is to be hoped, for a much longer period.

ECONOMIC RECUPERATION AFTER WAR.*

By PROF. W. R. SCOTT, D.Phil., Litt.D., LL.D., F.B.A.

(*Concluded from page* 230.)

So far as the argument has been developed, grounds have been adduced to indicate that industry can be restarted after the war upon an adequate scale. Still, the approximate magnitude of that scale is of vital importance. Here the labour supply—both as to quantity and quality—must be considered. No one can yet estimate with precision the probable total of the killed. In addition, there will be all those wholly or partially disabled by wounds and disease. Therefore an initial survey of the position, as regards labour, shows a large deficit in the supply as it existed before the war. And so, upon a hasty inspection of the situation, it might be concluded that, not only was capital likely to be deficient after the war, but, still more, industry would be cramped for a number of years by a very material reduction of labour. But this estimate only considers the quantity of the labour in employment immediately before the war. There is, first, the extension of that quantity. The war has revealed in most of the combatant countries unanticipated reserves of labour. Men past the prime of life, and also women, have discharged many functions in industry which were new to them. Naturally, this new supply of labour is to some extent an emergency one, but its existence shows that after the peace a large augmentation of the quantity of labour is possible. There is still the question of efficiency. The progress of hostilities has proved that several countries have been working on too narrow a margin of skilled labour. In order to carry on the industry of the country, it has been necessary to train large numbers of new workers; and, after the war, the skill of these will remain as a potential national asset. It is true that in some cases agreements have been made with the Trade Unions that the employment of workers, unskilled before the war, in specified skilled trades during the war, is to be purely temporary. While this arrangement will be loyally observed, scope will no doubt be found for these lately trained workers in new industries which will, no doubt, be rendered possible by the progress of inventions, while it may be that a much better organisation of industry may be arranged, so that industries may be reconstituted that neither employers nor employed would desire to return to the pre-war conditions. A great and just war such as this has been the means of a quickening of the national spirit, partly through the awakening it has experienced, partly under the spur of necessity. Invention will be greatly extended, and new discoveries will play their part in the restoration of prosperity at a later date. Then the consequences of the Napoleonic wars may be repeated; and, as they were followed by the great Victorian era of invention and industrial progress, so the war of the twentieth century will be succeeded by a similar period. And that epoch will follow the war more closely than the developments of the nineteenth century; for war has now become so mechanical that it has evoked the best energies of thousands of inventors. Some of these discoveries will be capable of adaptation to the uses of peace; while, in other instances, the augmented capacity of the inventors will be available, and will be more efficient than if it had not been evoked by the present tragic circumstances. Besides, this principle of substitution will be at work, and further introduction of labour-saving machinery will take place in cases where its efficiency can be demonstrated. Indeed, even during the war, there have been instances in which already such machines have been devised and used upon a comparatively extended scale. In fact, just as the watchword of the first years of peace in the provision of capital will be the continuance of economy, so in the case of labour, economy in its use will also be necessary. Moreover, it is to be hoped that the nations of Western Europe will respond to Nature's demand for population; and that in this case, as in that of previous wars, there will be an improvement in the birth-rate. Thus the terrible waste of humanity may be repaired—in the first instance by continuing to use so far as necessary the reserve of labour called up by the war, and later by a larger proportion of births and a reduction of infantile mortality.

Some considerable friction in the readjustment of the *post bellum* supply of labour to the demand for it is inevitable. Exclusively war industries, which, during hostilities, have been incessant in their call for labour will begin almost at once to reduce their staffs. Conversely, other trades which were suspended, or whose operations were seriously contracted, will be anxious to make a fresh start after peace. Moreover, demobilisation will return men from the Colours to the avocations of peace time. In this process it would appear that confusion, with resulting temporary unemployment, would be inevitable. No doubt this would follow if demobilisation were as sudden as many of the mobilisations have been. But various conclusions indicate that demobilisation will take place by stages, and, therefore, industry will have a better chance of reabsorbing the labour which was displaced in order to undertake military service. Any radical change in tariffs would increase the difficulties in the reabsorption of labour. It is possible that after the war the scale of operations of many industries will be considerably changed. An important alteration in tariffs would cause a great reduction in some trades and an increase in others. Thus important bodies of skilled workers upon their return might conceivably find the demand for their labour very largely reduced, and it would be small immediate compensation to them to learn that there was a wide field for workers in another trade which had increased. Further, if, as seems to be necessary and unavoidable, the first years of peace will witness a continuance of war economy, though to a modified extent, then the luxury trades must suffer, except to such extent as some of them can add to their otherwise reduced output by producing for export in order to replace some part of the lost home consumption. But the consuming power of that part of the world, which is at present neutral, would not suffice to absorb that portion of the production of these trades which is likely to be displaced from the home market. Accordingly, it is to be anticipated that in this, as well as in other directions, important variations in demand are to be anticipated. Still, too much stress need not be laid upon the inevitable dislocation of industry upon the return of peace. One of the discoveries of the war has been (as I have endeavoured to point out in my presidential address to the Economic Section of the British Association in 1915) the great extent to which specialised labour and capital have been able to adapt themselves, soon after the outbreak of hostilities, to meet new and unexpected demands. In this respect, at least, it may be anticipated that the converse movement, when the war is over, will be less, rather than more difficult.

What, then, is to be the general conclusion? Speaking from the data at present available, and with due reserve for the absence of information concerning some of the belligerent countries, and in view of all the circumstances as to how long the waste of war is to continue, I may perhaps describe my general results as those of a conditional optimist as regards the state of Europe during the first decade after peace has been made. Dangerous as similes are in economic reasoning, one may afford some light upon the situation which is likely to result. As regards those nations in Europe which are at present combatants, let us imagine an owner of land who is at the same time engaged in some productive occupation, and who has become involved in a serious law suit which menaces both his vital interests and his property. The time spent on preparing his case, as well as the anxiety, lessens his income from his occupation, and he finds himself compelled to disburse great sums unexpectedly in legal costs. He is forced to mortgage his property, and when the contest in the law courts is ended, he must pay the interest on the debt, and as soon as possible begin to repay the principal. This will mean that many improvements on his property which he had planned may require to be postponed, and certainly he will need to curtail his luxuries, it may be even many of his comforts. Further, the magnitude of his expenses will be the measure of the period of his sacrifices. He is, in fact, exchanging as against one huge, immediate, unproductive expenditure, the future unproductive expenditure of many years to come. The duration of his privations may be contracted by extra efforts in augmenting his production, either by increase of efficiency or by additional work. Here a nation has an advantage over the imaginary individual of our illustration. In a sense, it is always young. A time of privation forces new activities, and it enables progress to be hastened. In a measure the population of a country, just recovering from the losses of war, resembles the individual bondsman of the early English plantations in North America, where the man, who was in earnest, worked at high pressure to liquidate the debt and to attain his economic freedom as soon as possible.

To continue the parable, just as the losses of war will fall with varying incidence on different countries, so a detailed examination of the position of various litigants in the circumstances indicated will reveal interesting individual differences. One may have been forced to pledge his property very deeply, and at burdensome rates of interest. Should he lose his case and be mulcted in damages, then his affairs are likely to suffer serious embarrassment for a long time afterwards. The whole business of another may be seriously disarranged; yet, even though for a few years his estate may yield him little if any return, a successful issue will enable him in time to re-establish his fortunes. In the case of a third, it may happen that relief will come through the cessation of a state of relations with his neighbour which gravely impaired the development of his property and the pursuit of his legitimate activities.

Such seems to be the future position, symbolically represented. Can we see it more perfectly as it will be in its essentials? That at present is scarcely possible. Some of the important factors are unknown, or only partially known; it may even be that others have not yet revealed themselves. But one thing may be expected—namely, that the general burden will be very considerable. Combatant nations cannot anticipate the unproductive expenditure of future years and transform it into present unproductive expenditure in war without experiencing the pinch of a certain amount of want for a considerable period in the future. In the words of the proverb: "One cannot eat one's cake and have it too." We in 1916-17 are, so to speak, eating the cakes of 1917 to, let us say, 1927, or even later. In the intense national preoccupations upon national existence (as each nation conceives it), and in the grief of so many families for the fallen, the burden is not fully realised. Consciousness of it will come when, after the peace, life endeavours to return again to its former courses. Then the burden of present unproductive consumption in war will be felt, and in preparation for that time it is the duty of Governments to endeavour in advance to adjust that burden to the capacity of those who have to bear it. Equitable adjustment of taxation and improved organisation of commerce and industry will do much to make the people more capable of sustaining the load they will have to carry. In particular, should we not learn something from what may be described as one of the paradoxes of the war—namely, that while there never has been a war in which material appliances have been so important, at the same time it is no less true that, conversely, there never was one in which immaterial wealth, or even moral ideals, were so supreme? And towards repairing the waste of war, an important function will belong to the immaterial. Activity of mind and flexibility of intelligence to seize the opportunities of the new peace (which may differ from that peace which was shattered by the war); inventiveness to advance man's conquest of Nature (which in reality is man's co-operation with Nature), economy in the employment of the resources (both human and material)—all these will shorten that period during which the sacrifices, which the present demands of the future, must be endured.

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* Read at the Institution of Engineers and Shipbuilders in Scotland, February 20th, 1917.

THE PARALLEL OPERATION OF ELECTRIC POWER STATIONS.

The paper by Mr. J. S. Peck, on the above subject, was read and discussed at the meeting of the Western Local Section of the Institution of Electrical Engineers, at Bristol, on February 5th.

Mr. W. A. Chamen (engineer and general manager, South Wales Electrical Power & Distribution Co.), in opening the discussion, said that some considerations regarding the question of changing the periodicity of one system to suit that of another might be useful. It was obvious that such a course was always desirable in the interest of simplicity and of the highest efficiency, and in many cases no doubt it was quite possible and a proper course to adopt, but in the case of a supply concern having a considerable number of large consumers, many of which were collieries, the problem was exceedingly difficult, if not impossible, and the cost prohibitive. New plant in the power station would require to be put down before the original plant could be thrown out of action. So far as the plant was concerned it might be possible to change it over piecemeal, and it might even be possible to follow the same course with regard to the main switchboard, which was usually duplicated as regards the bus-bars, so that the new plant could deliver to one set of bus-bars while the old plant could deliver separately to the other. But the real difficulty would arise in dealing with feeders upon which perhaps several large consumers might be grouped together. The periodicity of supply to all these consumers must obviously be changed at one and the same time, which meant that the consumers must be dealt with simultaneously. Coming now to the consumers' installations, the worst difficulty of all arose. Most of the new periodicity plant would require to be provided in readiness for the change, and in many cases it would be impossible to get the motors delivered below ground and transmitted to their various destinations at the same time that the old motors were being taken out except by arranging for periods of "shut-down" of such duration as no colliery would be likely to be able to bear. It would involve practically the construction of duplicate engine houses or pump houses underground, so that the new plant could be ready when the periodicity was changed. The time taken to carry out such operations and the cost of them would clearly be prohibitive. The transmission of motors and other heavy machinery along the underground roads must all be arranged and carried out in such a way as not to interfere with the ordinary working of the mine, and this in itself would be the cause of very serious delay. It might be taken, therefore, that changing over the periodicity of an extensive system of supply was, practically speaking, quite impossible. It followed that in the cases of the linking-up of power stations running at different periodicities we should be often driven to the use of frequency changers. He knew of one instance of linking-up of power stations of different frequencies where energy was sometimes transmitted in one direction and sometimes in the other, in which it had been thought desirable to construct the frequency changers with motor ends of the induction type and with generator ends of the synchronous type, coupling one in the one direction and the other in the opposite direction, so that the induction end should always be the motor in one or other of the sets, according to the direction in which the load was being transmitted. He gathered from Mr. Peck's reply to the discussion that this was not really necessary and that frequency changers with synchronous machines at both ends could be used with safety. The fear expressed in regard to this arrangement was apparently that one station might tend through overload to drop its speed slightly and that the synchronous machines, allowing of no slip, would be liable to destruction by being called upon suddenly to transmit loads altogether beyond their capacity. This, however, seemed simply to point to the necessity for having the frequency changers of ample capacity to deal with any situation which might be likely to arise in practice, and for the use of reactances, automatic overload circuit breakers, or other protective devices to prevent injury to the machines in case of abnormal conditions arising. Surely, after all, this question could not be really different from that of linking-up two power stations of the same frequency, because the same question of the carrying capacity of the inter-connecting cable and of the necessity for protecting it against excessive and abnormal loads must obviously arise there.

Mr. C. G. Morley New (deputy engineer and manager, Cardiff Tramways) agreed that stations could be operated in parallel without difficulty, and for that reason could not understand the emphasis the author laid on speed regulation. Interconnector voltage would have to be carefully considered, as it was probable in many instances that the linking-up system of to-day would be the transmission system of the future, and extensions to generating stations would only be carried out in the most suitable places. He saw no reason why reliable automatic devices could not be installed for the purpose of earthing a system, in the event of the interconnector opening. He was interested in the Scott system of transformation in dealing with single-phase load from a three-phase supply, and was not at all satisfied as to the effect on, say, phase "A" during a severe overload such as a fault on phase "B," seeing that the neutral point on the three-phase side was not fixed. In the author's fig. 3 the neutral point was shown earthed, which was contrary to the Board of Trade regulations, if the system was already earthed at the generating station. He would like to know if there was any objection to dealing with one-phase load from a three-phase system by ordinary transformer connections, three-phase mesh connected to three-phase 4-wire, the neutral point forming an earthed outer to the single-phase system. In many cases it was not more difficult to balance three circuits than two. Having had experience with all types of sub-station converting machines, he could say that the induction machine was the most stable, as the synchronous plant as often as not shut down when faults occurred outside.

Mr. A. T. Kinsey (Bristol Post Office Telephones) said that telegraph circuits still used the earth as a return conductor, and as the current employed on them was measured in milliamperes it could readily be seen which circuit was likely to suffer if powerful currents traversed the earth. Since the introduction of electric tramways telegraph engineers had constant differences of potential between any two earths irrespective of distance, and in general not much notice was taken of them at the present time so long as they did not exceed 2 volts, as their effect could be eliminated. In telephony, owing to the extreme sensitiveness of the apparatus, the use of the earth as a return conductor had long been discarded and all public circuits were now metallic. Moreover, the tendency was to terminate such metallic circuits on transformers, so that the transmission circuit proper would be quite independent of the earth. There were, however, large quantities of apparatus used in signalling and in supervision which were auxiliary to the transmission circuit, and they relied upon the use of the earth. It could therefore be seen that telephone engineers as well as telegraph engineers would view with great concern any transference of load from one power station to another if it meant that large alternating currents of high frequency would pass through the earth.

Mr. T. J. Nelson (Port Talbot), in a communication, said that the paper provided a strong argument for the standardisation of frequencies, as the difficulties that arose with the parallel working of power stations appeared to be in connection with frequency changers. The parallel working of two power stations having different frequencies had been successfully carried out in South Wales at the "New Markham Pits" of the Tredegar Iron & Coal Co. These new pits had a supply from two existing stations belonging to the company situated at Tredegar and Oakdale, which had different frequencies, Tredegar being 40 cycles and Oakdale 50 cycles, and frequency-changers were used to interlink the two stations. Two motor-generators were installed, one with an induction machine on the 40-cycle side, and the other with an induction machine of the 50-cycle side, thus enabling the two sets to float on both systems without loading either supply with wattless current. The synchronous machine could be excited to such a degree as to give wattless current equal to, or exceeding, that taken by the induction machine connected to the same bus-bars. The first set consisted of a 750-B.H.P., 600-R.P.M., 3-phase, 50-cycle, 6,600-volt induction slip-ring motor rigidly coupled to one 500-KW., 0.8 power factor, 3-phase, 40-cycle, 6,600-volt synchronous generator. The second set was of similar output. Two liquid starters were provided for starting the induction motors, and two sets of resistance grids were permanently connected in series with the rotors of the induction motors to give approximately 1½ per cent. additional slip at full load. The provision of slip-ring motors with adjustable permanent slip resistance provided, as it were, a flexible coupling between the two stations so connected. It was not necessary that the two stations should run in exact synchronism. The frequency of one station might vary approximately 2½ per cent. in either direction without overloading the frequency-changer set. Suppose that the Tredegar station kept exactly a frequency of 40 cycles, if the machines at Oakdale were overloaded, the speed of the prime movers would have a tendency to drop, but in the same measure as its frequency dropped below 50 cycles, one of the frequency changers would transmit power from Tredegar. If the drop were approximately 2½ per cent., then 500 KW. would be transmitted in that direction, with one frequency-changer running, and 1,000 KW. if both were in service. On the other hand, if the prime movers in Oakdale had a light load, their speed would rise over the normal frequency, and power would be transmitted from Oakdale to Tredegar. The condition for the smooth working of the plant was that the governors of the prime movers in both stations should cause a few per cent. speed drop from no-load to full-load. This condition applied in general to prime movers driving alternators for parallel operation. The outside adjustable slip-ring resistance allowed the slip of the frequency-changer to be brought into line with the regulation of the governors in both stations. This would not be possible with squirrel-cage motors. The provision of slip-ring motors with starting resistances also simplified the synchronising of the sets. When two stations were running in parallel only one neutral point should be earthed, or if it were required to earth the two neutrals, it might be done by inserting transformers in the interconnecting line, as suggested by the author. He had known this method to give entire satisfaction, but if the transformers were not required for any other purpose, it was not necessary to go to the expense of installing them. He did not agree that reactance or resistances should be placed in the earth connection to limit the earth current to a negligible value, as it was important that the earth resistance should be low enough to allow sufficient current to flow through it, to open any feeder on the system.

Prof. **David Robertson** said that the figures which Mr. Peck gave as to the size of frequency changer necessary for connecting two systems made one wonder whether it would not be better to change over the smaller system in every case in which it was at all possible to do so. Since the changer set involved both a motor and generator, if it had to be rated as high as 20 per cent. of the capacity of the smaller system it would cost somewhere about 40 per cent. of the electrical equipment of the station, and would thus go quite a long way towards paying the station part of the cost of changing over to the standard frequency. Of course, there would be the consumers' motors to change as well, which, as Mr. Chamen pointed out, would be quite impracticable in some districts. With the object of illustrating Mr. Peck's statements and calculations about the operation of machines in parallel, he gave some locus vector diagrams based on the same approximate theory as Mr. Peck's equations and explained them in detail.

Mr. **J. S. Peck**, in reply, agreed with Mr. Chamen as to the great difficulties involved in changing over a large generating station from one frequency to another. Where a station was isolated from other stations in the same district, due to a different frequency, it was worth considering when laying down new plant whether to couple two generators to one turbine, one generator to be wound for the frequency of the station, and the other for the frequency of the district. The advantage of a set with two generators was that it could be driven by the turbine and supply current at either or both frequencies, or it could be used as a frequency changer to take energy from either system and supply it to the other. If the installation referred to by Mr. Chamen and Mr. Nelson were being installed to-day, the two sets would probably be replaced by a single double-synchronous set. Where two or more very large stations were connected together by short lengths of cable, it would be highly desirable to install reactance coils in the interconnecting lines, otherwise a short-circuit on any part of the system might produce serious disturbances, and perhaps shut down all the generating stations. He did not think earthing devices were usually very reliable, and believed it was much better to earth the neutral point through a resistance, especially where balanced protective gear was used. The Scott system of connection for changing from three-phase to single-phase would not give a balanced load on the three-phase circuit unless the two single-phase circuits were equally balanced. This then became, in effect, a two-phase system. With Prof. Robertson's remarks he was in general agreement.

ELECTRIC SHIP PROPULSION.*

By W. L. R. EMMET.

The writer has for many years actively advocated electric drive for the larger vessels of the navy, and as a result of a long campaign of designing, experimentation, and educational activity this method has been adopted on a large scale by the Navy Department. Electric propelling machinery has been ordered for the last seven battleships which have been authorised, and is specified for the four new battle cruisers which form part of the present naval programme. These battleships are very large and important vessels, requiring 33,000 H.P. each, and the battle cruisers present the most stupendous propulsion problem ever brought forth, since they require no less than 180,000 H.P. each. Only two or three of our cities use as much electricity as will be generated on one of these ships at 35-knot speed.

Electric propulsion has from the first had many opponents, and it is still being very actively opposed by nearly all the shipbuilders of the country, by Sir Charles Parsons, Charles G. Curtis, and others who have had important influence in marine engineering. Most of this opposition is undoubtedly sincere, but is not altogether disinterested, since shipbuilders want to use machinery which they know how to build, and since turbine inventors have in the past received large royalties from turbine-driven ships which are cut off by the advent of electric drive. Although the power still comes from turbines, the electric drive is, by licence agreements, free from royalty charges.

The case of the new battle cruisers may be considered as the extreme case where advantages are most important and in which the disadvantages of increased weight are most serious.

Four of these vessels are authorised in the Navy Bill of 1916. They are designed to make 35 knots each, requiring 180,000 H.P. delivered to four shafts turning at full speed about 250 R.P.M. These are the fastest and most highly powered vessels ever built. The electrical installation proposed in each of them far exceeds in extent any single installation ever made for any purpose.

It is proposed to install in these ships four high-speed turbine-driven generating units of the best type, similar in most respects to those used in power stations on shore. Upon each of the four propeller shafts will be mounted two independent induction motors. Cable connections and switching arrangements will be provided by which any combination of motors and generators can be immediately obtained, and by which all the changes of connections for operation, reversal, &c., can be instantly made under all running conditions; they are quite simple—in fact, much simpler than in most electrical installations. The electric supply is produced for the one purpose of propulsion, and is varied or discontinued according to need. Connections are changed only on dead circuit, even in the ordinary operations of stopping, starting, and reversing, and automatic means are provided by which any diversion of current from any cause produces an unbalancing which instantly breaks the field circuit and de-energises the system.

The aggregate weight of this equipment with cables, switches, instruments, and controlling apparatus is 1,865 tons.

If such a vessel were gear driven, a plurality of ahead turbines would be connected through helical gearing to each propeller shaft, one or more backing turbines would also be connected through the same gearing, and if good cruising economy was sought, it would be necessary to provide also cruising turbines connected through separate systems of gearing and arranged with couplings so that they could be detached during high-speed operation.

Without further description or discussion of either type of apparatus, we are in a position to make a comparison which constitutes one of the most important advantages of the electric drive. In the geared equipment, each shaft has a system of turbines, gears, bearings, thrust balancing devices, and lubricating systems all mechanically locked together. With high-speed machinery any kind of trouble with any of these parts will almost certainly necessitate the immediate stoppage of the whole system. To keep a high-speed turbine running out of balance or with bearing trouble is impossible, and the gearing part would present almost equal difficulty. In the event of mechanical trouble of such character a ship would have to be stopped until the wreck could be cleared. The work necessary to uncouple and disconnect any part of such very heavy apparatus would be a serious matter involving much time, including that required to stop the ship. After the disconnection was made, the idle propeller would act as a very serious drag on a fast vessel.

In the electrically-driven ship there is no mechanical connection of the shaft to anything but the rotors of the motors. These are self-contained, ironclad structures, and cannot by any possibility be subject to mechanical interference. The shafts are subject to the same possibilities of bearing or thrust trouble as shafts in other ships, but the presence of the motors does not increase this danger, and the speed being low it is remote in any case. With this equipment any motor, generator, or turbine, if in any kind of trouble, can be instantly disconnected without stopping the ship, and with only a small loss from the highest speed capacity.

Such interchangeability as this power of disconnection gives constitutes one of the most important advantages of electric drive in such a ship. With one motor out of eight in trouble, only one-eighth of the maximum capacity is lost, and the ship's maximum speed is impaired by only about one knot. If a generator or turbine is in trouble the maximum speed is reduced only about two knots. With two generating units and four motors out the ship can make 26 knots, and with three generators and four motors out she can make 19 knots. If parts give trouble they are simply cut out and repaired at leisure or as opportunity offers. The value of this interchangeability is a warship can hardly be over-estimated; it largely overcomes the military danger incident to accidents to the driving power, a danger which has always been of primary importance.

In turbine-driven ships, not electric, it is necessary to provide backing turbines which must run idle in the reverse direction when the ship is going ahead. These backing turbines involve complications which are very objectionable, and if these are reduced to a desirable minimum the backing power will be greatly inferior to that easily provided with electric drive. Experiment has shown that a turbine forced in an opposite direction involves about seven times as much friction loss as when driven in its normal direction. This loss is very appreciable in the backing turbines of ships, and causes heating which must be dissipated by circulating steam, which causes further loss and waste. There are also serious difficulties and dangers in high-speed apparatus incidental to the abrupt and wide changes of temperature where steam is suddenly admitted to a cold reversing turbine. Steam which expands without doing work has a high temperature, and if work is done upon it by a reversed turbine the heat is considerably increased. With superheat these temperatures may be extreme, and they affect the main turbine as well as the other, since it also must be used for reversal of direction, and since the two often occupy the same casing. The mechanical effect of such abrupt change of steam temperature upon fragile structures presenting very extended surfaces is a matter which has been little considered, but which has caused much serious trouble. With electric drive the turbine never need be stopped when the ship is under way, and its operation is easier than in a power station, because the load is steadier. With modern high-speed turbines superheat affords large gains in fuel economy, and the ability to use safely high degrees of superheat may constitute one of the important reasons for adopting the electric drive.

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* From the *Electrical World*. Abstract.

Various statements and estimates have been published concerning losses in high-speed gearing for which the authority is not known by the writer. Tests at Schenectady have shown losses about double those generally estimated, with rapid diminution of efficiency as the load falls. These tests were of a most accurate character with large smooth running gears, and by the motor-generator method, where losses alone were measured, the same power being transmitted with and without the gearing.

With the electric drive in these battle cruisers, the losses from turbines to propeller shaft at full speed will amount to 7 per cent., and by adjustment of voltage the transmission efficiency can be kept equally good at all speeds. Considering gearing losses, reversing turbine losses, losses incident to necessary sub-divisions of the turbine and additional packings, it is believed that the actual transmission from turbine blades to shaft at full speed cannot be made more than 2 per cent. better in the geared equipment than it is in the electric. At reduced loads the geared equipment will be much less efficient. The normal cruising speed of these ships will require less than one-tenth of full load, and the drag of gearings, bearings, reversing turbines, and idle parts of main turbines will be very serious.

With the electric design, the number of motors and turbines used can be adapted to the demand for power, while with the other all parts must be kept running. This gives very important gains in economy at all speeds below the maximum. At 19 knots only one turbine is required to drive the ship, and electrical arrangements are may by which it can be run at full speed instead of running at half speed, as it would if the ratio was fixed as by gearing. Thus the steam efficiency at 19 knots, a desirable cruising speed, is equal to the best attainable at any speed. Assertions which have been made by shipbuilders and others that equal cruising results can be obtained by the use of cruising turbines are obviously absurd. The cruising turbines themselves would be greatly inferior to the single main turbine so used, and they would be burdened with all the drags which are mentioned above. Cruising economy gives increased cruising radius without renewal of fuel supply. This has always been considered a matter of the greatest importance in warships; it is a feature in respect of which the electric drive can have no rival.

Enough has been said to give an idea of the reasons for the use of electricity in such ships, but, in addition, it should be considered that everything used in such an electric installation is a matter of exact knowledge and wide experience, while methods of gearing on such a scale are backed by little and brief experience, and are the subject of wide difference of opinion as to methods of design and proportions.

The writer believes that the differences of weight and cost which have been predicted by shipbuilders and others are not based upon just comparisons, but that even if they are true they are not sufficient to balance the practical merits of electric drive for such vessels.

For these reasons, it is believed that when prejudices are overcome electricity will develop an extensive use in large high-power warships. In such light vessels as scouts and destroyers, for reasons of weight and space, it is relatively much less desirable, but even in such cases with the lightest and most compact designs, and with very high pressure and superheat, it might in the future develop a legitimate application. In merchant ships also it may afford great advantages. With electricity, turbine units can be installed in duplicate, either in single or twin-screw ships. Machinery can be installed where convenient with motors near propellers and turbines near boilers, auxiliaries can be driven electrically from the main units. The highest superheat can be used without danger or complication, and main units can be applied to other power uses, such as cargo pumping or handling. These advantages have led to the preference of electric drive at a higher price in certain large freighters recently ordered, and will doubtless lead to many other applications in ships of various types.

The advantages here mentioned have been developed with a wonderful skill and foresight by the Swedish engineer Ljungström in the 900-H.P. ship *Mjolner*, which has been in successful operation for about two years. This vessel has shown a fuel economy decidedly superior to anything produced elsewhere in a steamship, and has maintained this high standard throughout her period of service. Such a result with such small power is very remarkable and significant The *Mjolner* uses an extremely high degree of superheat.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, Londno, W.C., and at Liverpool and Bradford.

2,439. "Temperature compensators for electrical control devices." British Thomson-Houston Co. & General Electric Co. February 19th.

2,475. "Electric switches." T. McLeod. February 20th.

2,487. "Electro-magnetically-operated contact makers or switches." F. C. Hibberd, W. King and G. D. Peters & Co. February 20th.

2,488. "Electric motor-control systems." British Thomson-Houston Co. and General Electric Co. February 20th.

2,494. "Manufacture of armature driving spindles." F. R. Simms and Simms Motor Units, Ltd. February 20th.

2,505. "Operation of electric or magnetic apparatus." F. J. Moffett. February 20th.

2,507. "Wireless telegraphy and telephony." I. Hortik. February 20th.

2,525. "Electromagnetic levitating and transmitting apparatus." T. P. C. Smith. February 21st.

2,564. "Terminal or gripping devices for electric conductors." Benjamin Electric, Ltd., & E. Fowler. February 21st.

2,570. "Automatic control of electric generating sets for emergency or stand-by purposes for ships, buildings, &c." G. C. Pillinger & L. Sunderland. February 21st.

2,574. "Interrupter cams for operating ignition in internal-combustion engines." H. de la Valette. February 21st. (France, February 25th, 1916.)

2,582. "Electrical oscillating apparatus." G. C. Evans & Submarine Signal Co. February 21st.

2,591. "Electrical driving gear for motor-cars, &c." H. Crochat. February 21st. (France, December 15th, 1916.)

2,600. "Means for rendering liquids radio-active." O. A. Elias. February 22nd.

2,601. "Artificial cooling of electric motors and generators." G. E. Preece & P. J. Williams. February 22nd.

2,617. "Protective devices for alternating-current electric systems." A. E. McColl. February 22nd.

2,621. "Electrical massage generators and appliances." E. Peckham. February 22nd.

2,623. "Tank for oil-break switches." A. Reyrolle & Co. and R. W. Gregory. February 22nd.

2,624. "Oil-break switches." Electrical Improvements, Ltd., & R. W. Gregory. February 22nd.

2,639. "Electric signalling or indicating apparatus for signalling orders or numerical data, &c." E. A. Graham. February 22nd.

2,650. "Combined electric generating and self-starting mechanism for motor vehicles." E. Aron & E. Hill. February 22nd.

2,656. "Receiving apparatus for wireless telegraphy." G. A. Beauvais and L. N. Brillouin. February 22nd. (France, March 27th, 1916.)

2,657. "Telephone installations for wireless telegraphy, &c." G. A. Beauvais & L. N. Brillouin. February 22nd. (France, November 7th, 1916.)

2,674. "Fittings or supporting combinations for electric lighting, &c." J. S. Foreman. February 23rd.

2,691. "Controllers for electric circuits." British Thomson-Houston Co. and General Electric Co. February 23rd.

2,701. "Process of treating ores of copper and nickel by electrolysis." M. V. Garin (*née* Bailly). February 23rd. (France, February 29th, 1916.)

2,707. "System of signalling in coal mines, &c." P. Holmes. February 23rd.

2,718. "Pocket electric torches or flash lamps, &c." C. Allaun. February 24th.

2,740. "Electrostatic machines." D. K. Morris. February 24th.

2,741. "Electrostatic generators." D. K. Morris. February 24th.

PUBLISHED SPECIFICATIONS.

1916.

The numbers in brackets are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

1,540. Electric Impulse Senders. Relay Automatic Telephone Co. & H. J. Herink. February 1st, 1916. [103,683.]

1,862. Thermic Telephones. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. February 13th, 1915. [100,084.]

2,491. Electrical Fuses or Cut-outs. H. W. Cox. February 19th, 1916. [103,712.]

2,864. Integrating Mechanism for Measuring Instruments. British Thomson-Houston Co. (General Electric Co., U.S.A.). February 25th, 1916. [103,714.]

3,298. Electric Switches. A. H. Midgley and C. A. Vandervell & Co. March 4th, 1916. [103,719.]

4,347. Telephone Systems. T. Pettigrew. March 23rd, 1916. [103,738.]

4,606. Ship Propulsion. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 29th, 1916. [103,733.]

9,232. Dynamo-electric Machinery. W. Marden. June 30th, 1916. [103,766.]

10,558. Duplex and Multiplex Telegraphy. G. O. Squier & L. A. Cohen. July 26th, 1916. [103,771.]

11,435. Rotors of Electrical Machines. Allgemeine Elektricitats Ges. August 6th, 1915. [101,158.]

13,905. Cooling and Ventilating System for Electric Storage Batteries in Submarines. M. F. Hay. September 30th, 1916. [103,792.]

1,410. Signalling Appliances. W. A. Heyes, L. O. Heyes & A. V. Heyes. January 26th, 1916. [103,676.]

5,733. Day and Night Compasses. G. Leigh. April 19th, 1916. [103,748.]

13,338. Tramway and Railway Rails. C. Spreckley. September 29th, 1916. [103,786.]

THE

ELECTRICAL REVIEW.

VOL. LXXX. MARCH 16, 1917. No. 2,051.

ELECTRICAL REVIEW.

Vol. LXXX.] **CONTENTS**: March 16, 1917. [No. 2,051.

	Page
Cheaper Electricity Supply	281
Industrial Federation	282
Catalogues: Notice to Manufacturers	282
Some Long-Distance Wireless Stations (*illus.*)	233
The Controller Drum, by P. H. Jackson (*illus.*)	285
Interconnection of Lancashire and Cheshire Electricity Supply Systems	286
British Capital and Foreign Trade	288
Bare Wire Signalling in Mines	289
War Items	289
Legal	290
Business Notes	291
Notes	295
Reviews	297
City Notes	299
Stocks and Shares	301
Market Quotations	302
Fighting Hail and Storm by "Electric Niagaras" (*illus.*) (*concluded*)	303
The Voltage Regulation of Rotary Converters, by G. A. Juhlin (*illus.*)	304
Correspondence—	
Re "Alternating Current Work"	307
Electric Radiators	307
Improvements in Radiators	307
The Inspection of Munitions	307
The Röntgen Society	307
Foreign and Colonial Tariffs on Electrical Goods	308
New Patents Applied for, 1917	308
Abstracts of Published Specifications	308
Contractors' Column	Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE 1—4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 8s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.

AUCKLAND N.Z.: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.

BRISBANE: Gordon & Gotch, Queen St.

CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.

DUNEDIN, N Z.: Gordon & Gotch, Princes Street.

JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c.: Central News Agency, Ltd.

LAUNCESTON: Gordon & Gotch, Cimitiere Street.

MELBOURNE: The Mining & Engineering Review, 90, William Street; Gordon & Gotch, Queen Street.

MILAN: Fratelli Treves.

NEW YORK: D. Van Nostrand, 25, Park Place.

PARIS: Boyveau & Chevillet, 22, Rue de la Banque.

PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Loescher & Co., Corso Umberto 1° 307.

SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.

TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE "ELECTRICAL REVIEW'S"

ELECTRICAL & ALLIED TRADES DIRECTORY

(THE RED BOOK),

1917 EDITION

IN THE PRESS.

H. ALABASTER, GATEHOUSE & KEMPE,

4, Ludgate Hill, London, E.C. 4.

CHEAPER ELECTRICITY SUPPLY.

LAST week we commented at some length upon the very successful conference which was recently held in Manchester under the ægis of the Board of Trade; in view of the importance of this event, and the fact that we publish elsewhere in this issue a lengthy report of the proceedings, we may be excused for making a further reference to it, as we wish to emphasise the remarkable unanimity which prevailed throughout the meeting, and which, we think, offers a good augury for the future. Not only at Manchester, but also at other centres where meetings of supply authorities have been held to consider the question of linking-up, the consensus of opinion has been entirely in favour of the movement, which is gathering impetus, and may now be said to be certain of accomplishment.

That the attitude of company officials would be favourable to it might readily have been foretold; but what is the cause of the enthusiasm of the representatives of municipal authorities? It seems to us to be due mainly to one thing: our municipalities have at last discovered electricity as a motive power. The position was very ably put by the Town Clerk of Blackburn, who, as he said, had practically grown up with electricity supply. He pointed out that, in the early days, electricity was looked upon merely as a means of lighting shops and the houses of the well-to-do. Now it was realised that it was the motive power *par excellence*, and that a cheap and reliable supply of electricity was absolutely indispensable to the prosperity of our industries. There is the answer in a nutshell. Of course, no electrical engineer needed to be told that that was so; the great thing is that it is now becoming understood by the laymen, and for this we have to thank the world-war, which in so many ways is opening the eyes of our fellow-countrymen to facts to which they had been blind. And therein lies the guarantee that the movement towards cheapening and extending the supply of electricity will attain fruition.

Now, we wish to point out that linking-up is not the beginning and end of the matter. It involves wider issues, which ought not to be neglected at a time when they are likely to be accorded favourable consideration. One of the most important of these is the perennial question of wayleaves. So long as owners of land, both private and public, are permitted to hamper and delay the development of supply networks, in opposition to the common welfare, so long will it be impossible to attain that degree of efficiency and economy which is imperatively necessary in the interests of the nation. The article which we recently printed, from the pen of one who is intimately acquainted with the conditions that are met with in practice, gave numerous instances of wilful obstruction which ought to be made impossible. Besides hindering progress in connection with the larger undertakings, these practices present formidable, if not insurmountable, obstacles to the extension of electricity supply to the smaller townships and villages, and to dwellers in rural areas; and this brings us to our next point.

The Kaiser boastfully, but prematurely, declared that the future of Germany lay "on the water"; it would be true to say that ours lies not only on the water, but also on the land, as we may have good reason to know during the coming months. The uses of electricity in agriculture, both for motive power and for intensive cultivation, have for many years past occupied a prominent position in our pages, and we have missed no opportunity of impressing their importance on our readers. The present circumstances lend added weight to the demand that every effort should be made to enable farmers to avail themselves of the advantages of electric power and electroculture, and we are glad to know that the Board of Agriculture is instituting experiments in connection with the latter on a large scale in Herefordshire. In 1915 we gave an account of the excellent progress which had been made by Mr. Kerr, the city electrical engineer of Hereford, in promoting the use of electric power, and he subsequently read a paper before the Municipal Electrical Association on the subject which was regarded as marking an epoch in its history. Quite recently the work at Hereford has acquired some prominence in the lay Press, and an extraordinary amount of interest has been aroused in the possibilities of electroculture for stimulating the growth of plants. But until the movement towards interconnection has solved the wayleave problem, the extension of electricity supply into rural areas, to bring it to the door of the farmer and the villager, can make but little progress. Thus the questions of linking-up, wayleaves, village lighting, and assisting agriculture are all intimately associated, and to some extent interdependent.

Now, these subjects—wayleaves, agriculture, and the like—are pre-eminently matters which ought to commend themselves to the attention of such bodies as the I.E.E. and the I.M.E.A., and we are glad to know that both these Societies are moving to good purpose. The discussion on wayleaves which is to take place at the Institution on April 12th should prove fruitful in bringing this question to a head—Government action is urgently needed—and we trust that the members will seize this opportunity of voicing the feeling of the electrical profession on this point. With regard to agriculture, it is permissible to state that vigorous action is being taken, of which more will soon be heard. Hence, we hope the activity which has lately been manifest in the quondam Sleepy Hollows of British electricity supply undertakings may soon transform the situation, and bring us appreciably nearer to that era which was so ably foreshadowed by Dr. Ferranti in his famous presidential address, when electrical energy shall be available everywhere, for every purpose, at a trifling cost.

Industrial Federation.

We publish on another page an abstract of the speech delivered by Mr. Dudley Docker at the first general meeting of the Federation of British Industries. It will be observed that those who are interested in the development of the organisation are proceeding cautiously in order that they may learn as they go what are the safest and soundest principles and policies to pursue and to adopt in order that the Federation may adequately represent the true interests of our national industries considered as a whole. It is felt that to fill in the details of the scheme at too early a stage may defeat the grand object that is in view; and while, as we said last week, we are anxious to see the completion of a great organisation which will be capable of meeting the after-the-war industrial situation immediately that situation confronts us, we can see the wisdom of proceeding *slowly* if by doing so we are advancing *surely* in such a way that there will have to be no capitulations, or time and energy wasting retreats, as the result of false steps. It is perfectly true that the movement is a great experiment for us in this country, and that all sorts of new factors may come into play at any moment which may have a very definite effect upon future course of action, also that important and desirable interests might be excluded by too precipitate a formulation of policy. The Federation is being strengthened as an Employers' organisation by the accession of, and by co-operative working with, several other associations; we do not want too many bodies with similar objects and aims. It is also stated that the Engineering Employers' Federation will work in co-operation with the F.B.I., but, so far as our information goes, the entire engineering interests of the nation are still in need of co-ordination in order that they may take their proper place in relation to a super-organisation. The Federation is to be congratulated on the efforts that it has made to secure that better atmosphere for the co-operative working of Capital and Labour, which is so essential for the future if we are to be saved from catastrophe. Labour consists of many sections, with many ideals, and we should like to feel that its organisations were making headway with their own efforts at co-ordination, so that there might be a truly representative voice to be heard when matters come to be deliberated upon. But no doubt on that side, too, the need for proceeding cautiously is recognised, for the factors in the situation as it may develop cannot be foreseen. The objects of certain sections of Labour have been drawn up in resolution form on several occasions, but owing to the changing state of affairs due to the increasingly heavy demands made by the war the value of these as a basis for negotiation becomes lessened as time goes on. The Prime Minister has referred the Labour Party's last resolutions to the new Reconstruction Committee. There will come a time when demands which will form the read basis for deliberations will be presented; and Federated Employers may then find it necessary to make known the details of the policy for which they stand. We must expect the demands of Labour to be large; the work of negotiation will be serious and arduous, calling, as Mr. Docker says, for all the patience, tact, and consideration at command; extravagance on the one side, or obduracy on the other, will not help the situation when it comes; earnestly do we all need to strive for an after-the-war spirit of Peace within ourselves. In the meantime, however, serious efforts should proceed unremittingly on both sides to secure a continuation of atmosphere in which harmonious relations may be cultivated.

Catalogues: Notice to Manufacturers.

The Order relating to catalogues comes into force on March 24th, its operation having been deferred a fortnight to allow those having stocks to make immediate use of them. In future it will not be permissible to send catalogues and price lists "through the post or otherwise" unless a request for the delivery of same has been made in writing. As stated in our pages last week, the sending of catalogues, &c., by traders to traders for the purpose of their trade, or to persons abroad, is to be permitted, but there are electrical and engineering people in this country who, though not traders, should, in our opinion, in the interests of munition manufacturing and of export trade, be kept acquainted with new descriptive technical and trade literature. We shall be glad, under these circumstances, if electrical and allied manufacturers and traders who have been in the habit of forwarding us their publicity literature for notice in our pages will kindly send us particulars of the new catalogues, &c., that they may issue, or contemplate issuing, so that we may keep the trade informed of their doings.

SOME LONG-DISTANCE WIRELESS STATIONS.

In recent issues, the *Wireless World* has published descriptions of several famous long-distance wireless stations which have helped to make history during the war, and by the courtesy of the Editor we are enabled to reproduce some of the interesting views and particulars there given. Fig. 1 shows the interior of the United States station at Arlington, which takes the place in America of the Eiffel Tower in Europe, in that it radiates time signals and other official information. It is the property of the United States Government, and is situated near Washington, on a site of 13½ acres. Fig. 3 shows the three steel towers which support the aerials, the centre tower being 600 ft. in height and the other two, which form with it an isosceles triangle, 450 ft. high; the base of the triangle is 350 ft. long. The steelwork is insulated from the ground, and in the case of the largest tower weighs 500 tons, whilst the other towers weigh 275 tons each. Three-phase alternating current at 25 cycles is supplied to the station at 6,600 volts, and is stepped down to 220 volts for delivery to the three transmitters; one of these is the 100-kw. Fessenden spark set illustrated in fig. 1, another a Poulsen continuous-wave 100-kw. set, and the third a 5-kw. spark set supplied by the Wireless Improvement Co. The first-named set is very similar to the Marconi type, and employs several of the Marconi patents; in the illustration, the alternator and rotary spark-gap are shown on the left, the condenser banks in the centre and on the right-hand side, and the primary and secondary of the jigger above. The transformer is situated beneath the floor, the high-pressure leads being seen in the foreground. The plant is driven by a Westinghouse 200-h.p., 220-volt synchronous motor, at 300 r.p.m., which is coupled to an 8-kw. d.c. generator, which excites the fields of the driving motor and the 100-kw. alternator, a General Electric machine operating at 220 volts, 500 cycles per second, at 1,250 r.p.m. The rotary spark-gap (fig. 2) is attached to the framework of the alternator, the rotary portion being mounted on the main shaft. The rotor consists of a fibre wheel with a heavy brass ring on its periphery, from which protrude 48 copper electrodes, each about 10 in. long. Water is circulated through the stationary electrodes from tanks on the framework above. Phase adjustment with the spark-gap is effected by rotating the casing. One lead from the alternator runs to the primary of the transformer direct, the other through a large relay key, which is shunted by a resistance, so that instead of completely breaking the circuit, the key cuts the resistance out and into circuit, reducing the sparking and wear on the contacts. The relay key is controlled by a small sending key, which operates an electromagnetic mechanism. The secondary leads from the transformer go to the stationary electrodes, across which are shunted the condensers and the primary inductance of the jigger. The condensers are of the compressed-air type, each consisting of a large cylindrical metal tank, in which the plates are suspended from insulators; the plates are spaced $\frac{1}{8}$ in. apart, and the air is raised to a pressure of 250 lb. per sq. in. An external safety gap is set to a distance slightly greater than the gap between the plates, and the current is turned on intermittently, allowing sparking to take place inside, until the small particles of dust in the air are burned out, after which the spark jumps across the safety gap; the latter is then lengthened, and the process repeated until the safety gap is 1 in. in length. Each condenser has a capacity of 0·036 microfarad, and there are 14 units, connected seven in parallel and two in series. The oscillation transformer or jigger is made of copper tubing in helices about 4 ft. in diameter, the primary having eight turns and the secondary 16. The connections are shown in fig. 4, p. 284.

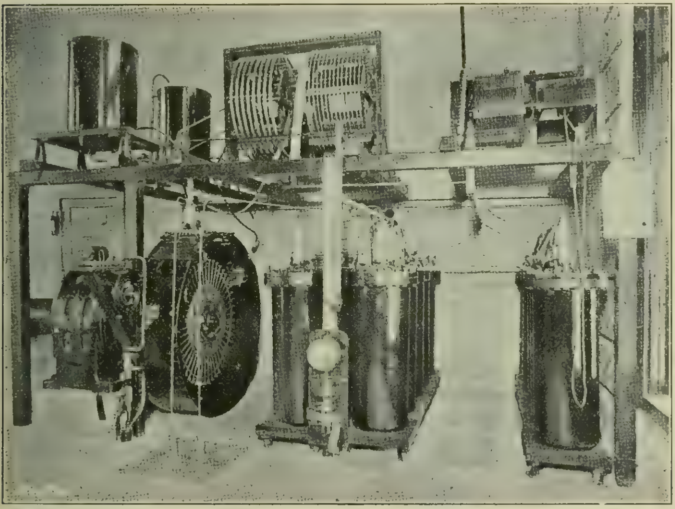

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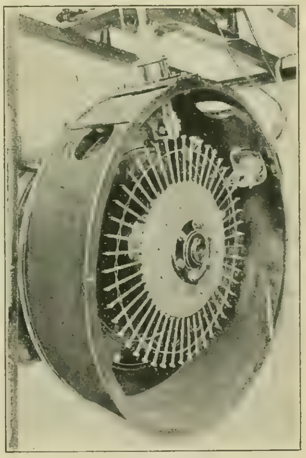
Fig. 1.—100-kw. Spark Transmitter at Arlington.



[Buck, Washington.

Fig. 2. Rotary Discharger.

The aerial is made up of three sections, with 23 wires in each section, each wire consisting of seven strands of No. 20 gauge, of phosphor-bronze. These wires are attached to spreaders 88 ft. long, the spreaders themselves being attached to the towers by 10 Electrose insulators. The aerial is open at the highest end (at the 600-ft. tower); two sections are brought down to the 450-ft. towers, and two joined to the main section by "jumpers" made up of 23 wires bunched in the form of a rope. The main section is what is known as a "T" antenna, and the vertical part is taken from the middle. The 23 wires are brought down in the shape of a fan for 300 ft., and then in the form of a large cage the rest of the way to a switch at the base of the tall mast.

The ground connections consist of many lengths of wire buried in the ground at various depths in the space near the towers, and led in a "draught-board" pattern with soldered junctions. Many miles of wire were laid in making the large network, and, finally, wire leads were run down the slopes, ending in a small stream that flows near by. The ground connection between the aerial and this network is through a large copper strip 6 in. wide and ¼ in. thick.

For the description of the Arlington station our contemporary has drawn from a paper presented to the Washington Section of the Institute of Radio Engineers, by Capt. William H. G. Bullard, U.S.N., until recently Superintendent of the United States Naval Radio Service.

The Nauen station of the Telefunken Co., which is situated near Berlin, is also described in the *Wireless World*;

it works in conjunction with the U.S. station at Sayville, and has a central mast 900 ft. high. From this station Germany hoped to maintain communication with her colonies, and early in 1914 it was proved that messages could be transmitted to Togoland, which could in turn communicate with German South-West and East Africa. The central tower is surrounded by five shorter masts (fig. 5),

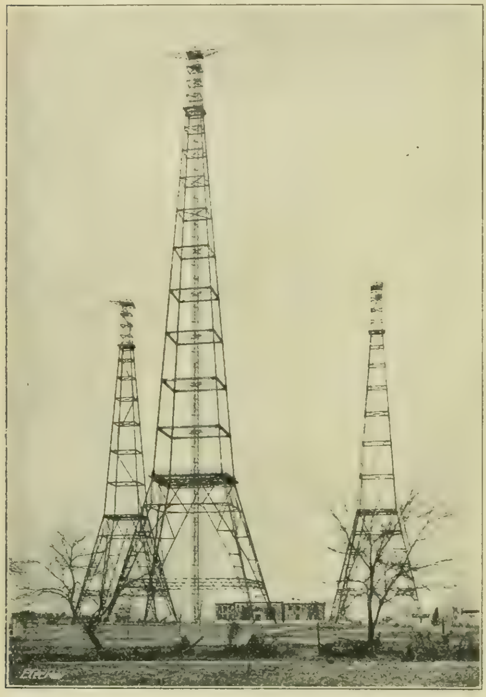
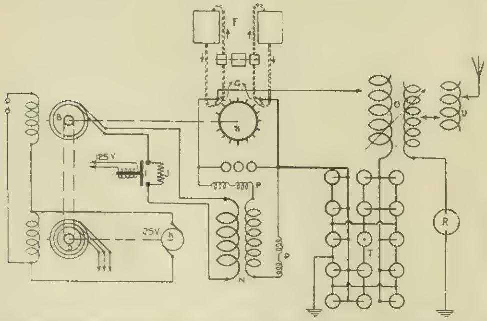


Photo. by] [*Buck, Washington.*

Fig. 3.—Arlington Antenna Towers.

and is mounted on a single steel ball resting on a slab of marble, which provides the necessary insulation, the tower being kept in place entirely by numerous stays. An earlier tower, 600 ft. high, was brought down in a gale some years ago. A very extensive earth system is provided, consisting of many miles of wire embedded in the ground. The antenna is of the double inverted L type. The plant comprises apparatus of both continuous-wave and quenched-spark type, the former being of 250-kw. capacity at 8,000 cycles per second, with a Joly frequency multiplier. Fig. 6 shows the base of the central tower. The long-distance station at Dar-es-Salaam, in German East Africa, was constructed on the same principle, but was wrecked by the enemy before the British troops took possession of the station.



B, single-phase generator ; D, three-phase motor ; K, exciter ; I, relay key ; J, resistance ; N, transformer ; P, choke coils ; H, discharger ; G, stationary electrodes ; F, tanks ; T, condensers ; O, oscillation transformer ; U, aerial tuning inductance ; R, hot-wire ammeter.

Fig. 4.—Diagram of Connections of 100-kw. Transmitter.

Passing to the Pacific side of the American Continent, the wireless service between the United States and Japan claims notice. This was inaugurated four months ago ; it bridges a distance of 4,200 miles between San Francisco and Funabashi, with a high-power relay station at Honolulu —but direct communication between the terminal stations is possible under favourable conditions. Here the Marconi system is employed, the American Marconi Co. being the manufacturers. The service forms part of a wider scheme, embracing stations at New Brunswick and Belmar, on the New Jersey Coast, to communicate with corresponding

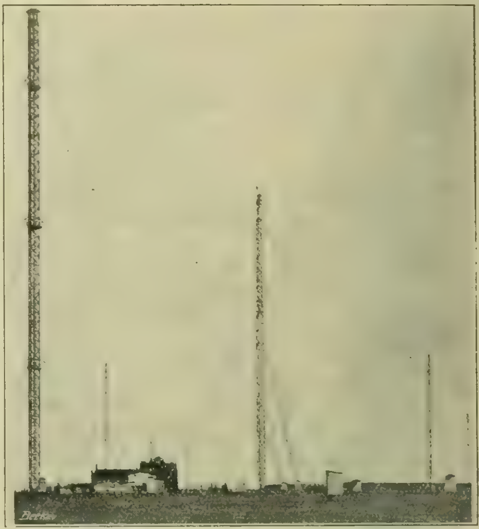


Photo. by] [*Giles Photo. Agency.*

Fig. 5.—Wireless Station at Nauen.

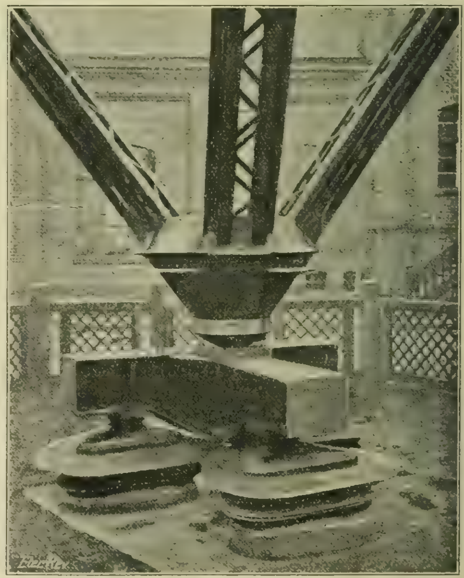


Fig. 6.—Nauen : Base of 900-ft. Tower.

stations in Great Britain; stations at Bolinas and Marshall, in California, communicating with the Hawaiian stations of Kahuku and Koko Head; stations at Manila, in the Philippine Islands, and stations at Marion and Chatham, Mass., communicating with Stavanger and Naerbo, in Norway.

From the operating house at Koko Head as a centre, the San Francisco aerial extends south-westward, and is carried on five 330-ft. masts to an anchorage. The Japan aerial extends from the operating house almost due east. The first two masts are of the standard sectional type, 430 ft. in height, the first being on level ground and the second on a hillside. From the latter point the aerial makes a span of more than 2,000 ft. to the top edge of Koko Head, an extinct volcano at an elevation of 1,194 ft. above the sea level; here there was not room enough to erect a sectional mast, only about 40 sq. ft. being available for a self-supporting structural tower, 150 ft. in height. The tail-end anchorage is far down on the inside of the crater. The balancing aerial, which is employed in both sets of antennæ, is on self-supporting towers, each of which is 100 ft. in height.

The station at Kahuku is now being employed both as a sending and receiving station, and is the largest wireless station in the world. From the power house, the San Francisco transmitting aerial extends south-westward, supported by 12 masts, each of which is 325 ft. in height; the Japanese aerial extends to the south-east, supported by 12 masts, each 475 ft. in height.

Fig. 7.—Wireless Station at Bolinas, California.

The sending station at Bolinas, Cal., employs eight masts, each 325 ft. in height, and is illustrated in fig. 7. The receiving station is at Marshall, 12 miles to the north of Bolinas.

Automatic sending and receiving apparatus plays an important part in wireless communication between the Occident and the Orient. The sending machine somewhat resembles a typewriter, and will make possible the transmission of more than 100 words a minute. Under the automatic system, 10 or 100 messages can be filed at the same time at the office of the Marconi Co. in Honolulu. They will be distributed among the necessary number of operators, and the dots and dashes punched in a paper tape by a machine. This tape is fed into an automatic sender, and the signals are conveyed by land line to Kahuku, where the dots and dashes actuate a high-power sending key, automatically energising the aerial simultaneously with the feeding of the tape in the station 30 miles or more away. At the transmitting station the signalling currents operate the magnets of the high-power sending key in the main circuit, and the signals are flashed to the point which the destination of the message calls for, either Marshall or Funabashi. If the message is destined for Marshall it will be received on a specially-constructed Dictaphone machine, each cylinder, as soon as it is filled, being handed to an operator, who will transcribe it into a type-written message by means of a Dictaphone machine running at normal speed.

The distance from California to Honolulu is 2,087 miles, and from Honolulu to Tokio 4,140 miles.

THE CONTROLLER DRUM.

By Percy H. Jackson.

It has been the practice of several controller manufacturers in this country and abroad to arrange controller drums in such a manner that the resistance step contacts and their corresponding contact fingers are smaller than the line and armature contacts. This is obviously incorrect, and the following goes to show the practice to be absolutely illogical.

Take, for example, a controller suitable for use with a 35-h.p., 230-volt, series motor, the latter being provided with commutating poles, and the electrical particulars being as follows:—

Armature resistance	0·0465 ohm
Resistance of commutating pole windings...	0·0123 ohm
Resistance of series field windings	0·0455 ohm
Full-load current	126 amps.
H.P.	35
Voltage	230

Now, a controller suitable for such a machine would probably be provided with six positions—*i.e.*, five resistance steps. Assuming that the controller has to be of such capacity as to be capable of starting the motor against a torque equal to full-load running torque, the resistance would be arranged as follows:—

Position No.	Current.		Resistance in circuit.
1	70 amperes		3·3 ohms
2	126 ,,	Motor running.	1·82 ,,
3	126 ,,		·90 ,,
4	126 ,,		·440 ,,
5	126 ,,		·215 ,,
6	126 ,,		·1043 ,,
			= Resistance of motor.

It will be noted that a current of 70 amperes only is allowed to pass on the first position of the controller; the full-load current—viz., 126 amperes—is allowed to pass on the second position, the idea of this being to reduce (so far as is reasonably permissible) the current which finally has to be broken by the controller. This is in accordance with standard practice.

Tests carried out on a controller of this description show that when passing from the "full on" to the "off" position, the current falls in steps of about 15 amperes each, the current which finally has to be broken by the controller being about 52 amperes.

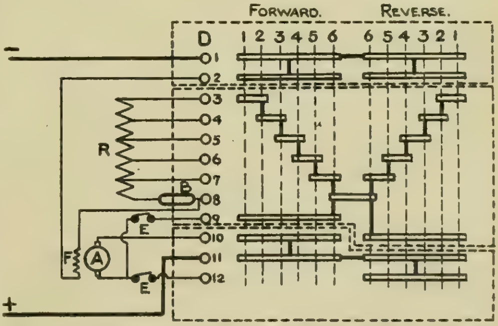


Fig. 1.—A, Motor armature; B, Magnetic blow-out coil; D, Contact fingers; E, Limit switches; F, Series windings; R, Starting resistance.

Diagrammatically, the controller would be designed as in fig. 1, the main and armature contacts being, for example, 1 in. in width, while, as above stated, some manufacturers would probably supply the resistance contacts ¾ in. wide. It will be noticed (see fig. 1) that six breaking points are provided. In other words, the current of 52 amperes is broken by six contacts having a total contact surface, at the moment of breaking, of 6 in., or about 1 in. to every 8·7 amperes, whereas each of the resistance contacts has to break 15 amperes on a contact surface of ¾ in. It is, of course, appreciated that the resistance contacts do not have to break circuit absolutely as do the main contacts, but nevertheless, the absurdity of providing resistance contacts narrower than the main contacts is at once realised. Controller designers in general would do well to drop this practice, and make the resistance contacts as wide as, if not wider than, the main and armature contacts.

INTERCONNECTION OF LANCASHIRE AND CHESHIRE ELECTRICITY SUPPLY SYSTEMS.

At the conference which took place at Manchester, on March 2nd, Mr. G. H. Roberts, M.P., Parliamentary Secretary of the Board of Trade, said that there was no one now but acknowledged that cheap and ample supplies of electricity were absolutely essential to national development; therefore, the conference was one of vital importance, not only to local authorities and the companies represented, but to the nation as a whole. Economical production should be the first aim of everybody engaged in industry. It should also be the first concern of every citizen. The circumstances at the moment were not very favourable to large projects; owing to the war, the Ministry of Munitions had to exercise a tight control over metals, and over things that were necessary for the purposes of munitions, and they were aware of the extreme difficulty of raising capital. But, although these adverse elements were present, that was no reason why they should simply rest on their oars. A cheap supply of electricity was really essential to the recuperation of the nation and the great expansion that, they hoped, would be embarked upon when peace was re-established. Since he had been at the Board of Trade, they had realised the real importance of the problems that they were to consider that day. The policy pursued in the past had not been the right one; they had been too parochial in their view. Local authorities had come to regard themselves as detached entities, whereas the local authority in the future must consider itself in relation to all the authorities surrounding it. It might well happen, with the spreading of the citizen-spirit in the broad national sense, that whenever these undertakings in the future were to be embarked upon, it would not be by a small local authority, but by groups of local authorities having common purposes and seeking to serve the common interest. In so far as legislation might be necessary, the Board of Trade was willing sympathetically to consider the necessity and to advise Parliament to enact what might be essential to carry out the scheme for the economical production of electricity.

Mr. S. L. Pearce (City Electrical Engineer, Manchester, and Chairman of the Interconnection Committee), speaking as chairman of the committee of engineers who had been responsible for the preparation of the report on interconnecting the various supply undertakings in Lancashire and Cheshire, said that the letter of May 25th, 1916, which was issued by the Board of Trade, endorsed the action which had been taken in Lancashire some few weeks previously. The letter emphasised the saving in coal, but the committee of engineers would go further, and point out that there were advantages accruing from such a scheme of interconnection other than the saving of fuel. They could be summed up as follows: If fuel costs and labour costs and capital charges were to be kept down to an absolute minimum, some system of interconnecting was absolutely essential. To enable those advantages to be obtained, what was required was the establishment of a main interconnected power distribution system linking-up the several power stations in that area of Lancashire and Cheshire, very much on the lines adopted in the North-Eastern Counties. The final finding of the committee was to the effect that basing the price of coal at 17s. 6d. per ton, and on a capital expenditure of some £281,000 required for the necessary interconnecting mains and transforming plant, there would be an annual saving on coal alone of some £82,000 per annum, arising simply and solely from the more efficient use of existing plants. That this figure could be materially increased, possibly threefold, if the present-day export value of coal were taken, would be obvious. Under Section 8 of the 1909 Electric Lighting Act, the Board of Trade, with the concurrence of the Local Government Board, had power to set up joint boards of local authorities for the express purpose of jointly exercising powers conferred by the Electric Lighting Acts on two or more local authorities, where the joint exercise of those powers appeared to be expedient and desirable, and a practical example existed in the Joint Tramways and Electricity Board of the Stalybridge, Hyde, Dukinfield and Mossley Corporations. This section of the Act did not admit of companies being represented on such a joint board, and he thought it was very doubtful whether any legislation could be set up which would admit of a joint authority comprising both municipalities and power companies. The committee considered that the co-operation of the large power companies was essential to the success of the scheme, if it was to be carried out on really broad national lines, and had suggested in the report one way out of the difficulty, which would be to empower the duly constituted joint board of local authorities to enter into working arrangements with the power companies to enable them to connect up with the power companies' undertakings, and for the use of the power companies' existing mains, and for any other arrangement that might be considered good in the view of the board. The powers which the committee considered should be entrusted to this joint board when once it was set up were given in the report. The first power was to raise capital from time to time for the provision of mains, transformers, and other works that might be required for interconnecting purposes, and to allocate all expenditure on the joint scheme on an equitable basis between the undertakings participating in the scheme. The second power was to adjust running hours of the existing generating stations, in such a way that the maximum economy of fuel might be effected. This would entail the shutting down of certain stations during the night or week-ends, or times of light load, the supply being furnished by stations provided with more economical plant. The third was to lay down rules for determining the charges for supplies. The fourth was to act in an advisory capacity with regard to all future extensions of generating plant, and to advise in which localities those extensions could be best made. The fifth was to appoint from time to time such officials as might be necessary to act in an advisory capacity to the board. The second power, namely, the question of adjusting the running hours of the existing plants in the existing stations, in the view of the committee was most important, and involved an element of control. The committee felt that if the best was to be got out of the existing plant and the existing stations, some power of control must be exercised. The existing stations should not be free to run their plant just as they chose, otherwise they would be maintaining probably the *status quo* and would not be getting the best from the most economical plants. With regard to the fourth power, the committee felt that all it could do, if its advice was asked, was to state where, in its opinion, having regard to all the local circumstances of the situation, extensions of plant could be best and most economically put down. If the Board looked favourably upon the main proposals, and the main principles involved, the committee did not consider that the difficulties would be insuperable, given a spirit of co-operation and goodwill, and the idea to do the best that was possible for the country as a whole. Everyone would agree as to the desirability of any such scheme going forward on a voluntary basis, and that there should not, if possible, be any suggestion of compulsion or of coercion. The committee also was very firmly of opinion that the control of the electricity supply in that part of the country should be in the hands of those most closely connected with the several undertakings concerned, who were, he thought, in a position to understand the requirements of the district and the area covered by the scheme. A most important point was that the statutory powers of the several undertakings mentioned in the report, exercisable in their respective areas, were not in any way interfered with by any of the proposals contained in the report. The view might be advanced that the same end could be attained by private arrangement; the opportunity for private arrangements existed for a very long time, and, comparatively speaking, not very much had been done in that part of the country. The committee considered it to be far preferable to set up a joint board whose engineering advisers would have constantly before them well-thought-out plans for co-ordinating the whole of the electricity supply undertakings of the Lancashire and Cheshire area. To have a scheme formulated in the joint interests of all, to be carried out a stage at a time, if desired, appeared to be a better plan than to continue the present somewhat haphazard private arrangements which frequently did not take a sufficiently long view into the future. Meetings of the several groups had already taken place for the purpose of considering the report, and a joint meeting of the first four groups had been held, and the representatives of the various local authorities and power companies had approved, practically unanimously, the main principle set forth in the report, namely, the principle of interconnection, but they reserved, and rightly reserved, their final approval of the engineers' proposals until they had had an opportunity of fully working out a detailed scheme. The whole essence of the scheme was cheap electrical power for industrial purposes.

Coun. Dagnall (Chairman of the Manchester Corporation Electricity Committee) said that the report had been under the consideration of the Manchester electricity undertaking, which had given it unqualified approval. Although the Manchester undertaking did not hope to be very considerable gainers by this scheme, there was a possibility that they might be ultimately gainers, and certainly they would be able to help those who were perhaps in a less fortunate position.

Mr. L. C. Evans (Town Clerk of Salford) said they were there to see how they could for some purposes get rid of municipal frontiers. That had been a somewhat difficult question between Manchester and Salford. They in Salford desired to preserve local autonomy for those subjects which were properly the subject of local administration, but they did desire co-operation outside their own frontiers with other local authorities in matters which ought not to regard municipal frontiers, and that was the attitude of mind which they brought to bear upon this question. It was difficult, however, to determine how to settle the exact details of such co-operation. Each of the constituent entities in the separate groups would be one undertaking. That, of course, would raise very difficult questions. Their friends in Manchester might possibly object to their separate electricity undertaking being merged into another undertaking upon which they only had representation, and possibly the smaller authorities included in the group might object to be part of an undertaking of which they were only a very small part. That day, therefore, a much more modest proposal was put forward. It was a proposal to secure co-operation. On that basis Salford was quite prepared, subject to the details being satisfactory, to join hands with all the other authorities. It was a basis upon which they considered there should be a desire between local authorities to preserve local autonomy for matters which could better be settled parochially, but, at the same time, to secure co-operation in regard to matters which lay outside their own frontiers and which could best be done by a joint board. It seemed to him desirable to admit the principle of a joint board or a joint committee for interconnecting the electricity undertakings, and to refer the matter to a committee to confer with the Local Government Board and the Board of Trade as to the precise details for carrying it out. Beyond that they could scarcely go that day.

The Chairman (Mr. G. H. Roberts) remarked that there were 42 electricity supply undertakings represented there by 125 delegates. That intimation would acquaint the district and the country with the very great importance of the conference.

Coun. Robinson (Stretford U.D.C.) said that the old basic principle of producing the largest volume in the shortest time at the lowest cost must ever be with them as leaders of industry. He thought the principle that they were to settle that day was that municipal boundaries should not be a bar to electricity development. With that principle he thought they would all agree, Mr. Pearce having explicitly stated that in the development of the scheme the rights of each local authority would be respected and their obligations remembered, and that it meant the building up of all and the destruction of none. He was interested in a scheme at the moment where 1,500 kw. was required to drive a mill. They were seriously considering whether the public supply authorities could supply that current cheaper than they could make it themselves. If the local authorities could do that, they could imagine what the saving would be to him from the point of view of capital outlay. Looking round those areas, and reviewing the enormous industrial interests involved and the prospective developments, if they could just reach that ideal of production which would enable a collective production to supply the units at a lower price than the separate entities could make it among themselves, the saving of capital outlay to the industries of the country would be enormous. Stretford would give this scheme its hearty support. The spirit in which the engineers had approached the question had made it possible for it to be considered on a purely economic basis apart from the municipal boundaries.

Dr. H. F. Parshall (Chairman, Lancashire Electric Power Co.) said the position of his company so far as linking-up was concerned was such that it almost automatically subscribed to the proposals or suggestions of the committee, because in the five instances given, most of them had been carried out or were in the way of being carried out, and there was no particular difficulty either from a financial or engineering point of view in carrying out the balance. So far as the company was concerned, it was quite agreeable that all its facilities should be utilised by the different local authorities and the companies it was associated with. Speaking broadly, it was really in the position of having already done what it was proposed to do on a much larger scale. The proposal to have the whole matter most broadly dealt with by the Board of Trade was the one that in the final result would lead to the greatest economies. If their own installation was not in accordance with the general economic principles governing the cheapest electricity supply, they were willing to stand by the decision of the central tribunal, and await its findings, and loyally carry out all the rules and regulations and provisions of a central committee to determine which installations should go or what the general procedure should be. If England were divided up into districts, and each district was examined from the standpoint of economic supply, and that district as a whole was accountable to a Parliamentary authority, or authority constituted by Parliament, and there was a system of inspection by the Government, or headquarters, so that the economic supply of a particular district could not be hindered—if such a body could be constituted without fear or prejudice, and be able to say, "In such and such a district such and such things have to occur," if that should be the position, then he would recognise it as ideal. That was the position that his company was prepared to stand by loyally and well.

Coun. Jamieson (Chairman of the Electricity Committee of the Bury Corporation) said that this had been a pet scheme of their electrical engineer for many years, and he had never forgotten to keep his committee well posted. His committee approved of the principle altogether. The vital part was the cheapness, and also the effect the scheme would have in saving money. In B group in five years they would save £150,000 of capital, and in the first year after they were coupled up they would save 30,000 tons of coal, and at the end of five years about 51,000. He hoped there would be no interfering with those committees which had got statutory powers. As regarded the large numbers of consumers to be supplied by joining up and pooling together, his committee thought it would be one of the best things that could happen from the point of economy. They in Bury had applications from a great many important industries. They could not supply them, and could not get any money from the Government to enable them to enlarge their undertaking. Therefore, his committee was anxious that something should be done, and that it should get coupled up before next winter.

Coun. E. Bury (Stalybridge Corporation), speaking on behalf of Group C, took up the position that the report demonstrated that the scheme was feasible, practical, and economical. The supply of cheap electrical energy having become such a vital necessity, as municipal representatives they felt that their resources should be organised on a much wider basis than the municipal unit. The supply of electrical energy by reason of its nature was an extremely favourable object for co-operative effort over a very wide area, and it was of the highest importance that the generation of electrical energy should be organised on the most economical lines so as to get the cheapest possible supply. There were few stations which were not refusing customers because they dared not take on more load, yet there were thousands of kilowatts of reserve plant in all the stations which could be combined if assistance from neighbours could be relied upon in case of emergency. They therefore thought that, in the national interest, this scheme should be pressed forward, and with regard to whatever legislative enactments might be required, they asked the Board of Trade to assist them to make the scheme effective. He represented a linked-up scheme on a small scale which was yielding most excellent results. The four towns of Hyde, Stalybridge, Dukinfield, and Mossley formed a joint board, and had only one interest in common —an abundant, reliable, and cheap supply of electrical energy. The board worked solely with that end in view. They considered that, after making the undertaking commercially sound, the greatest service they could render to the community was to give it a cheap supply of energy, and not to make profits to go in relief of rates. They considered they were assisting the rates by increasing the rateable value of the area by industrial development. The result was that they were supplying 250 units per head of the population in their area, which was very largely indeed in excess of the consumption per head of population in any other area in the country. That result could not have been achieved if each of the four Corporations had been acting independently, and these four Corporations had come to recognise in this joint scheme that they had got a most valuable asset. If they had the money to lay down new plant they could raise the consumption to 500 units per head. The joint scheme of these four towns was a shining example of what could be done by linking up. In Lancashire and Cheshire there were 4,350,925 people already served by various electrical undertakings. The average consumption of all those areas was something under 100 units per head, but in the next few years, if they had the capital to lay out in electrical plant, the consumption could be raised to 500 units for the whole of the area. An enormous amount of plant would have to be put down, and this plant should be laid down upon the best lines. His board gave the scheme their heartiest support, and wished it every success.

Ald. Higham (Chairman of the Accrington Corporation Electricity Committee) said that his Corporation had already expressed its approval, and heartily wished the scheme to go forward. He understood that it was not intended to put any obligations upon any authorities in which the expenditure would not be justified by the saving to be effected. Even wider powers might be conferred upon the joint board to put into effect the objects in view. He had in mind the small townships in the district served by Group D, which were begging for an electrical supply—Great Harwood, Rishton, and Padiham, which were populous and successful manufacturing areas, and were being absolutely starved for a decent supply of electricity. There ought to be some machinery whereby these small authorities could approach the joint board with a view to acquiring a cheap supply of current, to which they were undoubtedly entitled, and with which they could not possibly provide themselves.

Mr. E. Russell Taylor (Chairman of the Liverpool Corporation Electricity Committee), speaking for a group that had been left out of the working report, said that geographically they were rather different to the other groups, having a huge river dividing the area, the River Mersey. As this scheme was intended to effect a saving in coal, and it had to be done quickly, they found that, so far as Group E was concerned, it was a physical impossibility to link up with any immediate advantage. There had, however, been this advantage, that since the committee sat, districts in that area had already grouped together, namely, Bootle to Liverpool, and Southport and Birkdale. It was their intention to give every possible support to the movement so far as Group E was concerned. The war had demonstrated nothing more forcibly and plainly to them than the immense amount of waste that had taken place prior to the war, in every department of life. The time had now arrived when municipalities should pay more attention to the scientist and to the chemist, including their own engineers, to see what could be done in the saving of fuel. If coal was consumed as coal ought to be consumed, after the essentials were taken from it, leaving quite sufficient heat in it to do its work, it would not be £82,000 that would be saved, but many hundreds of thousands of pounds. The Liverpool Electricity Committee gave the scheme its benediction.

Mr. L. Beard (Town Clerk of Blackburn), taking the point of view of the towns of a smaller size, which he thought would be those which would derive the greatest benefit from the scheme, said that the problem which was presented to the early developers of municipal electrical undertakings had been entirely changed by the passage of time. They looked upon electricity in those days as a means of lighting shops and the houses of the well-to-do. To-day it was the great source of cheap power. The result of the way in which the question was tackled at the beginning, especially in the smaller towns, was that they found themselves handicapped by their early mistakes. Each of these undertakings was too small in itself, generally speaking, to be developed into a really modern and up-to-date power-producing undertaking, and they wanted to find a solution of the difficulty, a solution in which the future of their industries was largely concerned. It was a problem not of linking-up, which was the mechanical part of it, but of co-operation. Co-operation was not a new thing to municipalities in Lancashire. They should look at the scheme not merely as an emergency war measure, the advantages of which were to be estimated by the period of the war, but as a far-reaching scheme for the future development of these undertakings over a long series of years. Some of them had been a little afraid that by coming into this joint board they might lose some of their local autonomy. He did not think that they could get the advantages which they hoped to derive from the scheme of co-operation without paying something for them. He appealed to all authorities which, like Blackburn, were on the small side, and expected to get great advantages from this scheme, to consider whether it was not worth their while to come into it at once. By so doing they would have a voice in the framing of this scheme.

Ald. F. Smith (Deputy Chairman, Liverpool Corporation Electricity Committee) held the view that it was their duty to provide as far as possible for the distribution of electricity in its best and cheapest forms. Every advance that could be made in the quick and cheap supply of electrical power was favourable to English trade.

Mr. W. H. Tyrer (Town Clerk of Wigan) said on behalf of the Wigan Corporation, that it whole-heartedly supported the principle implied in this excellent scheme of interconnection. Wigan had a scheme of interconnection with the Lancashire Electrical Power Co., and would like to know to what extent it would be possible to use what had been done there, and whether possibly it might get some contributions towards the capital. What would be the next step?

The Chairman remarked that it was a very happy omen that there was such a remarkable unanimity. They all wanted the most economical form of production. Unless they could accomplish that object in the next few years, Great Britain would be deposed from its position of commercial eminence. It was no exaggeration to say that the cheap supply of electric current afforded one of the greatest possibilities for the development of national industries in the coming years. The next step rested with themselves. It was for them to work out the details of the scheme, and then to submit them to the Board of Trade for the consideration of those who advised the political heads on the matter. He could only give the official assurance that his right hon. friend, the President, and himself were really seized with the urgency and importance of the problem, and they might rely upon it that the proposals submitted would be thoroughly investigated in a sympathetic spirit. Since he had been at the Board this was a subject that had been specially brought to his notice, and had in a very large measure been placed under his control; therefore, he was very glad to have the opportunity of listening to the many speeches that morning, and had been very much helped by being there. That conference might not only prove to have been of local advantage, but also a splendid and enduring contribution to the future development of the trade of the nation.

The proceedings ended with a hearty vote of thanks to the Chairman.

BRITISH CAPITAL AND FOREIGN TRADE.

On Monday last Mr. Edgar Crammond delivered a lecture before the Institution of Civil Engineers on the subject of "Foreign Trade and its Relation to Investment of Capital Abroad." In a brief introductory speech the President referred to the new era of efficiency and freedom from red tape that lay before us, and expressed the hope that engineers would realise their responsibilities and take broad views; questions of finance came within their scope, and investments made abroad should bring large orders to this country.

Mr. Crammond, who dealt with his subject in a masterly fashion, traced the history of British investments of capital abroad from a remote period, and gave numerous statistics showing the distribution of our investments throughout the world as a whole, and the British Empire in particular; curiously enough, the amount invested outside the Empire was approximately equal to that invested in our Dominions and Dependencies, and the latter was fairly equally divided. It was owing to our very large foreign investments that we had been able to maintain the rate of exchange and to finance our Allies, the process involving the transference of large sums from the hands of neutral nations to those of our Allies. It had been abundantly proved that shipping was our greatest industry, and our mainstay during the war, and he hoped that every effort would be made when peace returned to maintain its supremacy. British capital should be employed to increase our exports and improve our food supply —it was made clear by statistics that the countries in which our capital was invested were devoting increased attention to manufacture and neglecting agriculture, and for that reason alone, apart from the war, the manufacturing countries of the world would have been in sight of a shortage of food supplies. British capital should also be applied to develop the Empire. The new conditions created by the war had rendered necessary the adoption of a new economic policy; in the past, if we had had an Imperial policy at all, it was rather that of internationalisation of capital, war being regarded as a remote contingency. Our money market was open to the world, we were dependent on foreign food supplies, and on Germany for commodities of vital importance. In Germany, on the contrary, the tendency had been towards centralisation and the creation of a self-supporting state, discouraging the emigration of capital and labour, a policy which had brought us many economic advantages. In future the scientific direction of investment of our capital abroad was indispensable; it was of urgent importance that the British Trade Bank should be established as soon as possible, though weighty interests in the City appeared to be opposed to its formation. The growth of our shipping, the guidance of emigration, and the development of the oversea Dominions demanded attention, but we must not confine our trade to the limits of the Empire, for the world-wide character of our trade had been of immense benefit to us in the war. The Empire of which we were the trustees would be enormously increased after the war, and it was our duty to develop its economic resources, and to consolidate the Empire by means of a moderate tariff. He objected to the Channel tunnel as adverse to the interests of British shipping, and urged that British capital must not be used in the future, as in the past, to develop foreign manufacturing industries.

A discussion followed the reading of the paper. Dr. Dugald Clerk pointed out that we had four times as much capital invested abroad as Germany had, and hence had been able to maintain our rate of exchange and to obtain supplies. Self-sufficiency was shown, by the present plight of the Central Powers, to be an impossible condition. The future of the Empire, in his opinion, depended more on the engineer than on the soldier, sailor, or politician, and being carriers for the world made us also manufacturers for the world.

Mr. Harold Cox remarked on the marvellous way in which the war had shown that our economic policy had increased our military strength—the result of Imperial expansion. We must beware of too much State control, and not hamper the trade of the Empire by artificial restrictions.

Mr. W. H. Ellis referred to the question of limiting the trade of our enemies with other countries, and deprecated too ruthless a policy as against our own interests. He pointed out the defects in our methods of representation abroad, and the evil effect of competition between British merchants in the same line, and advocated joint representation under capable management. With regard to shipping, he inveighed against the absurdity of dockage terms which favoured foreign shipowners; and he thought our present banking institutions could do all that was required by industry.

The Hon. Sir John McCall (Agent-General for Tasmania) showed how his Government placed orders in this country for steel rails in spite of tempting offers from Germany, but no effort was made to see that money lent by us was spent with us, and a shameful example was set by corporations sending orders to the Continent. He thought the war had brought a glimmer of light to Free Traders, and strongly advocated a preferential tariff as a guarantee against dumping, and to secure the investment of capital in industries.

The Hon. Mr. F. W. Young (Agent-General for South Australia) said that not Free Trade, but the war itself, had saved the Empire from ruin—if Germany had waited 20 years longer, where should we have been? There was a danger that after the war our shipping would be busy returning troops to the Dominions, and emigration would be diverted to foreign countries. The income-tax laws needed amendment, as income from investments in Australasia was subject to double taxation, amounting in some cases to 13s. in the £.

Sir Robert Hadfield drew attention to the Federation of British Industries, with 350 members, which was going to make a great improvement in our trading methods by bringing about an understanding between manufacturers and preventing waste of effort through competition. We should not neglect home trade in favour of foreign trade. As for engineering opportunities, there was plenty of scope, and large amounts of money could be spent advantageously in this country.

Mr. C. Hamilton Wickes (H.M. Trade Commissioner for Canada) described his experience of many years in watching German methods of penetration in the self-governing colonies, and said that if we went on after the war, as before, the Empire would soon cease to exist. If the Germans had not been such fools as to declare war, they would have swallowed us up in ten years. Our watchword should be *preparation*—the obtaining of information, and raw materials, the study of commercial treaties trade by trade, and the establishment of a commercial intelligence department throughout the whole world.

Mr. Crammond briefly replied, remarking that practically all the speakers agreed with the views which he had put forward, and that an Imperial economic policy was necessary.

BARE WIRE SIGNALLING IN MINES.

At a meeting of the Newcastle-upon-Tyne Section of the Association of Mining Electrical Engineers, in Newcastle, on March 5th, Dr. W. M. Thornton gave an address upon "Bare Wire Signalling." He said that the explosion at Senghenydd called general attention to the fact that under certain circumstances bells might be as dangerous as large power circuits. Mr. Carey, H.M. Inspector at Bedwas, wrote to him asking if he thought there was any risk from bells. In his (Dr. Thornton's) opinion at that time he did not think there was. Shortly afterwards he went into the subject and found that, practically speaking, any bell might be dangerous, and he patented a bell with a shunt winding for suppressing the sparking, not only at the bell, but also on the bell wire used for signalling. That was shown at the Senghenydd inquiry, where he gave evidence at the invitation of the Home Office. It had been suggested that he had patented the bell after the recent report was issued, whereas the reverse was the truth. He was asked to the Senghenydd inquiry because of his work on the subject, and afterwards to collaborate with Dr. Wheeler in an investigation of the whole question of bare wire signalling. There were two points in regard to bare wire signalling. There was the sparking at the point where the wires were brought together to send a signal. Then there was the ordinary trembler spark at the bell. This latter was not in the past generally deemed to be dangerous. By making the bell safe they made the wire safe at the same time, but they had to suppress the voltage. What was the essential of safety? Did it depend on energy, or current, or voltage? There was no doubt at all that it depended on the suppression of voltage at the spark wherever formed. When an electric circuit having self-induction was broken quickly there was a rise of voltage, which might be many times greater than the circuit voltage. On mining bells it was usually about six times the battery voltage, unless means were taken to suppress it.

Dr. Thornton then showed a number of lantern slides which made it clear that as the voltage came down the igniting power came down very quickly, until they got to 25 volts, when it took a relatively large amount of current to ignite gas, and under certain conditions they could scarcely get ignition at all. He mentioned that alternating current greatly reduced the risk of ignition. Dr. Thornton referred to the Home Office report on the subject, wherein it was laid down that the essential thing to suppress was the voltage across the spark, and four methods were given by which this might be dealt with.

The Chairman, Mr. Mark Ford, asked whether the relays used with underground bells were much safer than ordinary bells; the voltage was considerably less. Dr. Thornton admitted that the voltage was less, but said the inductance was greater, and the relays were sometimes worse than bells themselves.

Mr. Hanks raised a point as to the maximum safe voltage for signalling, and expressed the opinion that the limit should be lower. Dr. Thornton agreed that 25 volts was perhaps on the high side, but said 25 volts was accepted throughout the country. If they were using Leclanché cells it was all right, but if they used secondary cells, resistance equal to that of the Leclanché cells should be inserted in the circuit. 25 volts from a motor-generator was too much; they must have resistance inserted.

Mr. Day mentioned the 5, 8, or 12-volt transformers, and asked if they would comply with the Act. Dr. Thornton said they might get too high a voltage on the secondary circuit from a leakage on the primary.

Mr. Gunn asked whether the adoption of the shunt winding meant the consumption of more current. Mr. Hanks said his experience was that there was no increase of consumption, and Dr. Thornton said the action of the shunt really was to slow the action of the magnet. It was a wonder the device was not more used in signalling operations, quite apart from the questions of risk and suppressing the sparking, to save platinum.

Mr. Veitch said he thought the Home Office should give them a definite lead. Manufacturers, of course, made bells to sell, but if they knew what the Government wanted it would guide them in all future designs.

Mr. Hanks advocated the use of Leclanché or similar cells for underground work, especially when both positive and negative wires were run side by side, as was sometimes the case in three-wire systems. He pointed out that an accidental short circuit would probably be harmless with such cells, whereas with a battery of accumulators or a generator the effect might be disastrous.

Dr. Thornton said he quite agreed, and that was one of the reasons why he advised a certain amount of permanent series resistance in circuits where generators or cells of low resistance were used at anything approaching the maximum voltage permitted.

WAR ITEMS.

Exports to China.—A further notice respecting exports to China appears in the *London Gazette* for March 9th, giving authority to export articles to the Peking Technical College.

Exports to Switzerland.—The "London Gazette" for March 13th contains a Proclamation prohibiting the exportation from the United Kingdom to Switzerland of certain articles. Various electrical lines are included.

To be Wound Up.—The Board of Trade has ordered the following to be wound up under the Trading with the Enemy Act:—

Meirowsky & Co., Carriage Street, Old Trafford, Manchester, electrical insulation manufacturers. Controller: G. H. Warmington, 33, St. Swithin's Lane, London, E.C.

Women in Engineering.—The demand for trained women in the munition factories has not yet been satisfied. Students are urgently needed for engineering, and there is a good opportunity for educated girls of a robust type and for women who have proved their vigour in their chosen path of life. The work to be done involves tool-setting, machine operations in which great precision and keenness of judgment are essential, and various processes in the construction of aeroplane engines. The success of women in these expert processes is now beyond doubt. The training classes which have been established by the Ministry of Munitions have already turned out many hundreds of efficient workers. The preliminary training lasts from eight to nine weeks, and during that period a maintenance allowance of 25s. per week is given to approved students. All women able to undertake skilled work of the kind required should apply in writing to the Ministry of Munitions (Training Department), 6, Whitehall Gardens, London, S.W.—*Morning Post*.

German Preparations for Trade in China.—According to the *Vossische Zeitung* (Berlin), of February 9th, active preparations are being made in Germany to revive and strengthen intercourse with China. The German China Association, it is stated, has carried out a scheme whereby young Chinamen have been taken into German industrial establishments. Lectures and visits to factories and works have been arranged for the Chinese students in Germany, with a view to acquainting them with German industrial achievements. In order to provide a supply of young German traders and technical specialists with a knowledge of Chinese, the Association, in co-operation with the Oriental Seminar of Berlin University, has instituted elementary courses in colloquial Chinese, for which many students are stated to have been enrolled.—*Board of Trade Journal*.

American Central Station Industry and War Possibilities.—The American *Electrical Review and Western Electrician* for February 17th devotes its leading article to the threatening war situation and the preparedness of the central station industry to fulfil its part in whatever may occur. We make the following extracts:—

"To-day the country stands at the brink of an unknown situation, one that has passed beyond the country's ability to control. The future is pregnant with uncertainties; at any moment latent possibilities may arise to become stern realities. While uncertainty lurks broadcast over the land everywhere is to be found feverish excitement and frenzied effort in preparation for whatever the future may have in store. It is a time when much has to be done, when the time in which to do it may be short. Forced outputs are the order of the day. . . .

"The central-station industry stands prepared, already mobilised, ready to serve the individual, the community, and the nation, whether for peace or war. Solidly and surely founded it stands, the central-station industry, not the creation of a moment's hasty frenzied action, but the evolution of wise, far-sighted policies, careful and painstaking development, and judicious fostering. Long since have intensive co-operation and unified effort been the keynotes for the cheap and reliable generation, transmission, and utilisation of electrical energy. Unification of effort has come out of duplication, co-operation has grown out of competition, and efficient monopoly has absorbed the agglomerations of concerns of all sorts and sizes, giving us what we have to-day—cheap, reliable power, flexible, ever ready in bulk or the smallest quantity. Out of war-stricken Europe word has come from time to time of the value of central-station service, of how it has made possible the conservation of materials of the warring nations, of how it has enabled forced production to be obtained where existed a scarcity of labour, and time was short. This country is fortunate in the extreme in not knowing the stress of necessity that arises from the insatiate demands of war in our midst. We are fortunate indeed in being privileged to be able to watch and learn afar lessons being taught by the dire suffering and agony of others. Peace or war, the central-station industry is mobilised in readiness to serve the individual, the community, and the nation. Take advantage of it now, for there is no time like the present, and this applies with more than usual truth in the present instance. Extensions to existing plants are handicapped by the scarcity of machinery and inability to obtain immediate or quick deliveries It will in the majority of cases be found quicker, cheaper, and eventually the more pleasing, to resort to central-station service. The nation-wide coal shortage is driving many to central-station service. The larger the consumer the less likely is he to suffer from coal shortage, because he is better able to guard against embargoes, congested railroads, and those other factors causing erratic deliveries, sporadic famines, and fluctuating prices. The user of central-station service is practically immune from the condition of the coal market, whereas the owner of an isolated plant is constantly faced with the problems of reduced working hours, restricted outputs, fluctuating costs, and uncertain deliveries.

"Vast numbers of industrial concerns are flocking to central-station service, entirely or in part. Many are finding the present time particularly opportune to abolish their isolated plant and substitute central-station energy entirely because the price of scrap metal is high, as high as it may reasonably be expected to attain, and selling their isolated plant now realises handsome profit in addition to the economy and convenience that accrue in the way of greater available space, lower energy charges, &c., from central-station service."

Exemption Applications.—Before the East Central of Yorkshire Appeal Court, the Military appealed against exemption held by N. Tate (23), engaged as a mechanical draughtsman with the Yorkshire Power Co. The appeal was allowed, and the calling-up deferred until the middle of April.

At Llandudno, the Llandudno and Colwyn Bay Electric Railway Co. appealed for an electric car driver, who is in a low category. The general manager, Mr. A. G. Balfour, said that they had just voluntarily released two Class A men. It was necessary to have a staff of competent drivers and mechanics. The Military Representative suggested that a reduced service of cars should be run in order to release more men. The man appealed for was conditionally exempted.

At Bexhill-on-Sea, Messrs. J. L. French & Co. appealed for further exemption for Mr. H. E. Mullinger, manager of their electrical department, in order to complete several contracts. Appeal disallowed; calling-up fixed for April 7th.

Four tramway drivers, aged respectively 30, 31, 34, and 37, were appealed for at Birkenhead by the Corporation. It was stated that the men were selected out of 20 in the service to be substituted. Exemption was refused, and the cases were referred for substitution.

Maidstone Tribunal has withdrawn, on the appeal of the Military, conditional exemption held by J. Bowden (39), wireman, formerly engaged in the Corporation electric light department.

Before the South Yorkshire Appeal Court, the Mexborough and Swinton Tramway Co. appealed for a switchboard attendant. The local Tribunal had given exemption until April 16th, but recommended that an older man should be trained for the work. The Military Representative stated that the man was 21, single, passed for general service, and had had a year's exemption. The appeal was dismissed.

Before the Herts. Appeal Court, on March 3rd, the North Metropolitan Electrical Power Supply Co., Ltd., appealed for Mr. A. Brown (25), senior clerk and cashier at St. Albans, placed in Class B3. On behalf of the company it was stated that it was intended that the whole of the staff should enrol for national service, and Mr. Brown promised to enrol. Subject to that, six months' exemption was granted.

At Peterborough, appeals were entered by the Electric Traction Co. for J. G. Manning (28, Class A), tramway electrician; E. A. Sowter (30, B2), electric car fitter and turner; and F. G. Jessop (29, B2), mechanic and driver. The two former were granted until April 9th, and the last-named was conditionally exempted.

At Reigate, the Tribunal has granted temporary exemption until May 6th to J. G. Toonjan (28), shift engineer at the Corporation electricity works.

At Deal, an appeal was made for C. H. J. Graves, electrician at the South-Eastern Hotel. It transpired that an elderly substitute had been obtained, and a short period was sought to make him better acquainted with the work. The Tribunal granted a fortnight beyond March 19th, when the previous exemption expires.

After a review, the Folkestone Tribunal has confirmed conditional exemption held by Mr. Marchant (41), on the staff of the Electric Light Co.

At Aldershot, on March 6th, the Traction Co. appealed for A. J. Chitty (30, in Class A), foreman engineer fitter, claimed to be in a certified occupation. The Tribunal decided that the man was not in a certified occupation, and they allowed a final month for the company to make arrangements.

Diesel Engine Making in Sweden.—A new company has been formed in Stockholm, with a capital of over £1,100,000, for the manufacture of Diesel motors.—*Times.*

LEGAL.

BACKNER *v.* MILE END PALLADIUM, LTD.

IN the King's Bench Division, on March 7th, before Mr. Justice Shearman and a common jury, an action was heard in which Arthur and Constance Backner, kinematograph artistes, sued the Mile End Palladium, Ltd., to recover damages in respect of personal injuries caused to the female plaintiff by contact with an electric generator used for the supply of light at the Palladium, and also for loss caused to both the plaintiffs through failure to keep professional engagements on account of the lady's injuries. The case for the plaintiffs was that in January, 1916, they were performing at the time in what are known as "synchronised pictures," and the lady was shown a certain room for the purpose of changing her theatrical dress. In this room was the dynamo, and the female plaintiff said that her dress was caught in it, and she was drawn to the dynamo, and her knee and leg injured. As the result of the injury, the female plaintiff had to have medical attention, and both the plaintiffs suffered loss through inability to carry out booked engagements at other kinema houses. The defendants denied that they were guilty of any negligence or breach of duty, and they denied liability to pay compensation.

The jury found for the plaintiffs, and awarded £50. and judgment was entered accordingly, with costs.

LEAVING CERTIFICATE.

AT Bolton Munitions Tribunal, last week, an electrician employed by the Corporation applied for a leaving certificate, on the ground that his skill and qualifications were not employed to the best national interest in his present employment. He wished to go to a local Council's electrical distribution plant to take charge. His present wages were only two guineas per week, while at the other place he could get £2 10s.

It was stated that applicant was engaged on work of great national importance, inasmuch as he was keeping the plant going for the production of material for which the Government was pressing. The Corporation had spent over £7,000 to install additional plant, and if this man went away they had no man to replace him.

The leaving certificate was refused.

CLAIM FOR THEATRE ELECTRICAL INSTALLATION.

MR. POLLOCK, High Courts Official Referee, on March 7th, gave his reserved judgment in the action in which Messrs. F. W. Vaughan and Co., Ltd., electrical engineers, Islington, claimed the balance of the contract price (£1,700) and extras for putting up an electrical installation at the Golder's Green Theatre of Varieties for the Golder's Green Amusement and Development Co., Ltd., who were the defendants. The case has already been reported in our pages.

The OFFICIAL REFEREE, in giving judgment, said that of the contract price there was an unpaid balance of £609, in addition to which the plaintiffs claimed £382 for goods sold and delivered. The defendants admitted the contract, but denied that it had been properly executed, and claimed that they had had to do various things which were left undone. They also denied that they had received proper notice of the assignment of the old company to the new (plaintiffs), and they counterclaimed for a large amount. He (the Referee) was satisfied, upon the case put before him on behalf of the defendant company, that there was no proper notice of assignment of the old company to the new company which would make the defendants liable in an action brought by the assignees. The question then arose as to what were the respective rights of the parties in respect of the contract. There was no doubt that during the first part of the correspondence between the parties, the plaintiffs thought they were in a position to sue upon the contract: but, in his opinion, they were not in that position, and all they could sue upon was the assignment. Supposing there were any balance beyond the set-off, the defendants could not recover it from the plaintiff company. The plaintiffs had launched their case entirely upon the contract—and their right to recover on the amount of the contract—and they now sought to base their claim for extras on a *quantum meruit*. In his opinion, they could not do that. When parties had done work on a contract, they could not depart from it, and must necessarily sue upon the contract. In his opinion, Mr. Crew did not, and coul not, make any variation in regard to the area of the cables, but Mr. Mitchell had said that they might have an extra in regard to it It was pointed out that the cables required by the contract would have cost a great deal more than was allowed by the contract For extras, an order in writing was required, but no such orders were given; and, moreover, he was not satisfied that the contract was carried out in accordance with the specification. In regard t other items, he had looked at the case in this way. Mr. Crew, wh had acted on behalf of the defendant company, had said that certain things were ordered by the managers, and it was hardly fai under the circumstances for the defendants to say that they woul not pay. In the result, he found that £744 was due to the plaintiffs, from which had to be deducted £130 to complete, making th amount £614. In addition, they were entitled to £50 balance o the contract, and other small amounts, making the sum due to th plaintiffs on the claim £684. As to the set-off he thought, havin regard to the evidence, the sum of £700 for the cables was quit moderate, and as to the other matters, he awarded £300.

MR. POLLOCK, K.C., said that the result of the judgment, afte arranging the figures, was that it wiped out the claim of £684 and left a balance of £186 due to the defendants. He, therefore, asked for judgment for the defendants on the claim and the set-off.

The Referee said there would be judgment for the defendants on balance of claim and set-off, with costs, and the counterclaim would be dismissed, without costs.

A stay of execution was refused.

British Thomson-Houston Co., Ltd., *v.* Duram, Ltd.

This case came before the Court of Appeal, composed of the Master of the Rolls and Lords Justices Warrington and Scrutton, on Tuesday last week, upon the appeal of the plaintiffs from a judgment of Mr. Justice Astbury, in the Chancery Division, in favour of the defendants.

Mr. A. J. Walter, K.C., Mr. Colefax, K.C., and Mr. J. H. Gray appeared in support of the appeal, and Mr. T. Terrell, K.C., Mr. Kerby, K.C., and Mr. Courtney Terrell for the respondents.

Mr. Walter said the appeal was from a judgment of Mr. Justice Astbury in December last. The action was originally for the infringement of two patents by the defendants, but the appeal was only with regard to the patent of 1906. Mr. Justice Astbury had dismissed the action on the ground that the plaintiffs' patent was bad for want of subject-matter. After explaining the circumstances, he dealt exhaustively with the evidence given in the Court below and all alleged anticipations on which the defendants relied, and contended that nobody before the present patentee had ever solved the problem which he had successfully solved, and which had proved of the greatest importance and utility. The plaintiffs' patent was worth hundreds of thousands of pounds, and had undoubtedly contributed valuable information as to the metallurgy of tungsten.

Mr. Colefax having followed on the same side,

Mr. Terrell, in support of the judgment of Mr. Justice Astbury, said that the view that the respondents wished to put before the Court was that the plaintiffs' patent never did anything at all, and that the present action was brought for the purpose of trying to see whether the persons owning the patent could not reap the reward due to other inventors. His learned friends on the other side had been floundering for a long time in this case, and at last were crystallised down to one or two things—one of which was that nobody had ever made tungsten in the form of a rod before. But the patentee claimed a vast amount more than that. If it was electrically conductive, it did not matter whether it was a rod or a block. The patentee had put in two claims, one of which was "electrically heated," and the other was "general." He did not limit himself to a rod, but a piece of solid metal which was capable of being heated, and, when heated, hammered.

Lord Justice Warrington: He does not in his description necessarily contemplate heating by electricity?

Mr. Terrell: No.

Mr. Walter: We never suggested it.

Lord Justice Warrington: What is the meaning of the claim?

Mr. Walter: A special form of wire which is being treated electrically.

Mr. Terrell: It is plain it is not limited to the metal tungsten in the form of a rod. It is much more general than that. I say it is a patent for making tungsten in any form, and, when hot, hammering it into any shape. Before the date of the patent it was known that you could make incandescent filaments of tungsten. The minute you are told that these highly refractory metals are capable of being consolidated by being made intensely hot in the battered form, you have got the whole thing. Wilson, Moissan and Welsbach told you that.

Lord Justice Warrington: And Just and Hanaman told you that.

Mr. Terrell: Yes. Dealing with Moissan, Mr. Terrell said it was beyond doubt that Moissan had in his possession pure coherent malleable tungsten. The secret of the malleability of tungsten was that you elongated the crystals. That was all it came to. In conclusion, he submitted, on the face of the plaintiffs' specification, there was no subject matter, and that on the face of the specification it was blown out of Court. He also contended that the alleged invention was completely anticipated by Moissan and Siemens. For these reasons he contended that the appeal failed.

Mr. Hall followed on the same side.

On Monday, Mr. Walter replied on behalf of the appellants, contending that the plaintiffs' patentee was the first to tell the world how to get an agglomerated body of tungsten. He submitted that the plaintiffs' patentee was on absolutely sound ground, and that the attack made on the specification was not one warranted by the law relating to patents in this country. He asked the Court to allow the appeal, and to grant the appellants the relief they claimed.

Judgment was reserved.

Tramcar Accident Claim.

At Glamorgan Assizes, David Williams, contractor, of Caerphilly, was awarded £700 damages against the Rhondda Tramways Co. for injuries received as a result of the sudden stoppage of a tramcar.—*Times.*

British Power, Traction, &c., Co., Ltd., *v.* Hodgson.

Mr. Justice Peterson, in the Chancery Division on Tuesday, disposed of a summons by which the plaintiffs in this action claimed taxation against the defendant of the costs since the judgment, given so long ago as 1905.

By consent judgment was given against the defendant in respect of certain alleged breaches of trust, and £7,652 11s. 11d. was found due from him under that judgment. Between the issue of the writ and judgment the defendant became a bankrupt, but the bankruptcy having been annulled, the Court recently held that as the judgment was based upon legal fraud, the defendant was not absolved from liability under it by the bankruptcy.

On behalf of the defendant, it was now argued that though the bankruptcy did not absolve him from liability as regards the judgment it did with respect to subsequent costs.

His Lordship, however, did not accede to that view, and directed taxation as asked for by the plaintiffs.

BUSINESS NOTES.

Federation of British Industries.—A report of the first general meeting of this Federation, held on March 2nd, was published in a number of daily papers on Monday last. Mr. F. Dudley Docker, C.B., who presided, said that the membership had now reached a total of 269 firms and individuals and 50 associations, with 18 applicants awaiting election, making a total of 337. He thought in the near future it would be increased to at least 1,000. They were engaged upon a great experiment, upon which the whole future prosperity of the country might depend, but they could not carry it on with their hands tied. They must be free to develop perhaps into a Federation of Associations, perhaps into some other type of organisation. They had chosen certain principles, which they intended to observe, and their object was to secure united action by the manufacturers of the country through a national federation for the development of the industry of the country. If they tried to lay down a fixed programme of policy before they had included in their membership all the manufacturing interests of the country, they could not become a national federation: they would only be a Federation of the persons who happened to agree with that programme. If they adopted an immutable form of constitution they would lose the chance of learning from their mistakes, and in an experiment so novel as the attempt to secure united action by British manufacturers they were bound to make many mistakes. They must first get together and learn to consult each other before they took action, and to modify their individual wishes and views, so as to conform to the common good. When they had done that they could take vigorous and united action, and from that consultation and action they could develop a constitution and a policy based upon a practical experience of their requirements. Mr. Docker referred to arrangements made with other bodies formed with objects not dissimilar to those of the Federation, for application to the Federation, notably the Employers' Parliamentary Association, by which the various district branches of that Association would become branches of the Federation. The British Manufacturers' Association (a body chiefly composed of smaller manufacturers) had joined as an Association. The British Empire Producers' Association was also working, to a certain extent, in conjunction with the Federation, there being a Joint Committee of the two bodies, which met at stated periods to discuss matters of mutual interest. Satisfactory arrangements had been made also with the Engineering Employers' Federation to work in co-operation. The question of their relations with Labour called for all the patience, tact, and consideration that they could command. If the Federation did nothing more than it had done already to bring Capital and Labour together, it would be an achievement to be proud of. Meetings of Employers and Labour held at Birmingham, Cardiff, Manchester, &c., had had a good effect, and the atmosphere of friendliness and co-operation which they had engendered would make subsequent negotiations with Labour more easy and more productive. It would be necessary to speak plainly to Labour in future, not to be afraid to ask for what they wanted, and not to be afraid to give what they ought to give for fear of something more being demanded. The welfare of the Empire was essentially dependent upon the existence of a satisfactory understanding between Employers and Employed, and he hoped that the Federation would play an important part in promoting such an understanding. Other matters briefly touched upon by Mr. Docker were the questions of a Trade Bank and organised education.

Book Notices.—*Guide to the Registration of Business Names Act.* By Kenneth Brown. London: Sir Isaac Pitman and Sons, Ltd. 1s. net.—The author had occasion to prepare a synopsis of the provisions of the Act named, for the members of the Wholesale Grocers' and Provision Merchants' Alliance, Ltd., and being deluged with inquiries, he has elaborated that synopsis in this book. He deals with many difficulties which the queries raised show business men to feel as to the Act. We need say nothing more to suggest the potential usefulness of this publication.

"Science Abstracts." A and B. Vol. XX. Part II. February 26th, 1917. London: E. & F. N. Spon, Ltd. Price 1s. 6d. each net.

"Atoms." By J. Perrin. Translated by D. Le Hammick. London: Constable & Co. Price 6s. net.

"Manual of Reinforced Concrete." By C. F. Marsh and W. Dunn. London: Constable & Co. Price 10s. 6d. net.

Fined.—A local firm of electrical engineers complained, at Oldham Munition Court, that three workmen had absented themselves from work. They were each earning over £3 a week. A fine of 19s. was imposed in each case.

New Companies in France.—A new company has lately been formed in Lyons (13, Rue Grolée), with a capital of £20,000, and the title La Société Electro-Métallurgie d'Auvergne, to engage in the electrical production of ferro-silicon and other alloys, special steels, and all classes of electrometallurgical and electrochemical products.

A new company has lately been formed in Paris (9, Place des Ternes), with a capital of £40,000, and the title La Compagnie des Machines et Magnétos Zenith, to engage in the manufacture of ignition magnetos for motor vehicles.

Catalogues and Lists.—British Thomson-Houston Co., Ltd., 77, Upper Thames Street, E.C.—Catalogue of 28 pages, detailing and pricing "Paramho" wires and cables, and accessories for the use of wiremen. These wires, cables, and flexible cords are made in accordance with the C.M.A. specifications, and are supplied in several grades to meet various conditions of service. Large stocks of practically all the cables and accessories listed are held at Mazda House.

Messrs. T. W. Broadbent, Ltd., Victoria Electrical Works, East Parade, Huddersfield.—Eight-page leaflet (No. 5) containing description and tabulated particulars and prices of their N-type squirrel-cage motors. Copies may be obtained on application.

Messrs. Vincent Roberts & Co., Leeds.—Eight-page illustrated pamphlet, describing their new patent electrolyser for use on board ship, in hospitals, &c., its construction, mode of working, and utility.

Trade with Italy.—The British Chamber of Commerce for Italy, at Genoa, includes the following in its latest lists of openings for British articles in Italian markets :—

No. 1,247.—Works at Turin would buy Electric lamps and electric motors, &c. T.S.T.A.T.

No. 1,252.—Party at Foggio Imilia would buy Electric lamps, wire, insulators, apparatus, and other electric sundries. R.S.T.

No. 1,262.—Merchant at Turin would handle. Electrical articles, electric lamps and accessories, illumination plants, &c., engineering articles for mechanical engineering, ammunition works, tools. T.D.G. 5.

No. 1,263.—Party at Rome would represent, or buy for own account. Manufacturers of machinery and tools. R.M.P.

No. 1,266.—Party at Rome would represent manufacturers of: Industrial machinery, electric motors, &c. R.V.D.A.O.

Liquidations.—Electric Railway and Tramway Carriage Works, Ltd., British Electric Car Co., Ltd., and George F. Milnes & Co., Ltd.—Meetings are called at Manchester for April 10th, to hear an account of the winding up from the liquidator.

Quarzlampen Gesellschaft, M.B.H.—The Controller, Mr. R. W. Brown, 12, Old Square, Lincoln's Inn, W.C., has applied for his release.

Excel Water Circulator Co., Ltd.—This company is winding up voluntarily, with Mr. F. E. Smith, 3, St. Helen's Place, E.C., as liquidator. Meeting of creditors, March 27th.

"Dac" Accumulator Syndicate, Ltd.—Creditors should send particulars of their debts, &c., to the liquidator (Mr. H. C. Bound, 61 and 62, Lincoln's Inn Fields, W.C.), by April 9th. Meeting to hear account of liquidation, April 20th.

LIGHTING AND POWER NOTES.

Accrington.—At the meeting of the T.C., Ald. Higham, referring to the revised and increased scale of charges for electricity, said that all consumers were being asked to bear some of the added cost of production. The additional charges were sufficient to meet the added cost, and the Committee hoped that in the year commencing April 1st the works would be self-supporting, with possibly a little surplus ; one of their largest consumers had waived their electricity contract, which did not expire until 1918, and had entered into a new agreement at a higher price.

Aldershot.—Addressing the meeting of the Aldershot Gas, Water and District Lighting Co., Mr. W. T. Robertson, the chairman, said that the electricity department had completed its second year, and the results had been marvellous. It was extraordinary to start a new business, and at the end of the second year to be able to place on record that it was paying its expenses. He did not know that there were very many electric light companies in the country which could start their business *de novo*, and in two years record that it was paying its expenses.

Australia.—The working of the Perth (W.A.) City Council's electrical undertaking for the year ended October 31st last, resulted in an output sold of 5,777,182 units, an increase of 8 per cent. over the previous year. The number of connections increased 11·33 per cent. to 8,015. The general manager reported that the greater portion of the apparatus for changing the consumers' installations had been received, and the rewiring of consumers' premises for the A.C. system had been completed. Great progress had been made in rearranging the distribution system for the new supply, some 10 miles of fourth wires have been erected, and small extensions of pole lines have been made. The total length of pole lines is 114·1 miles. The wires have been attached to extensions of the steel tramway poles in the principal city streets, and about 300 wooden and steel poles have been taken down, thus greatly improving the appearance of the streets. The gross profit on the electric supply was £37,937, as compared with £37,725 in 1915. The expenditure to date in connection with the new electric system totals £112,878, including all new buildings, plant, consumers' apparatus, and labour, and it is estimated that a further sum of £49,000 will be required to complete the conversion.—*Commonwealth Engineer.*

The Mayor of Subiaco (W.A.) in a report states that, owing to the continually increasing demands on the capacity of the electric lighting plant, the question of extensions will have to be taken into consideration shortly.

The Echuca B.C. (Vic.) has rejected the proposal of the Milo Co. to install electric lighting and pumping. Inquiries are to be instituted as to whether a loan could be obtained for a municipal electrical scheme.

The Victoria Park (W.A.) Council proposes borrowing £3,750 to carry out electric light installations, in addition to other works.

The Gladstone T.C. (Queensland) has decided to accept an offer to light the streets with electricity, at a total cost of £210, for 14 lamps of 350 C.P. The offer included the erection, supply, and maintenance of the lights for 22 nights each calendar month, and the increased cost on the present system of lighting will amount to £110 per annum. The offer is for a 10 years' agreement.—*Tenders.*

Belfast.—The deputation recently appointed to wait upon Sir John Snell on the subject of extension of the electricity undertaking, has submitted a report to the Tramways and Electricity Committee ; consideration is held over pending the receipt of Sir John Snell's report.

The latter is understood to advise certain small expenditure on the existing plant, which it is considered will be able to meet the peak loads of another winter with plant in reserve to the extent of 3,400 KW. Sir John advises the Committee to complete all its plans for the new station at Hamilton Road, so as to be able to carry out the work at a favourable opportunity. According to the statement of the Committee, the margin of plant at the electricity station was so small that it was necessary to refuse new consumers, and about 60 applications have been held up for that reason, which are now to be proceeded with.

Birkenhead.—Price Increase.—The Electricity Committee recommends that from April 1st the charge for electricity for lighting be increased by 5 per cent., and in the case of prepayment meters from 5d. to 5½d. within the borough, and from 6d. to 6½d. per unit outside the borough.

Bradford.—The T.C. has given authority to the electrical engineer to proceed with the new cooling tower foundations, and also to prepare a scheme for additional cooling towers. Tenders to be invited for the same.

The Electricity Committee has authorised the purchase of two electric (5-ton) chassis and one petrol (25-cwt.) tipping wagon for the leading of coal and ash to and from the Valley Road works. This has been necessitated by the shortage of carters and vehicles.

Buckfastleigh.—The U.D.C. has assented to the Electricity Co. using overhead mains for the supply of current to a local hospital at Bigadon for the period of the war and the year after, at the company's risk.

Chorley.—Workhouse Lighting.—The Guardians have had under consideration a report by Mr. A. W. Paul, consulting engineer, as to the lighting, &c., of the workhouse, recommending the installation of a steam-driven electric lighting plant, the exhaust steam from this plant to be used in the calorifiers for heating and hot water supply, and have decided that Mr. Paul draw up a scheme for the work.

Continental.—Russia.—A note from Abo, Finland, says that the charge for energy has been increased there by 10 pennis per KW.-hour for motor power ; Moscow advices announce an advance in the price by the Electricity Transmission Co., and similar announcements come from Veaborg, Kishinieff, Elizabetgrad, Taganrog, Nizhni-Novgorod, Kazan, &c., where the price of current has either been advanced, or the step is under consideration.

The Reveal T.C., owing to the serious condition of the municipal electrical station, has asked subscribers to use as little current as possible, so that the lighting of the town and the water supply may not be interfered with.

The demand on the Kieff electrical station has grown to such an extent, that trouble will result unless many consumers reduce their demand. It is proposed to increase the price to users.

A note from Lutsk says that when the Austrians left that town they destroyed the electric lighting station, so that for a long period the inhabitants passed their nights in darkness. The necessary repairs have now been effected, and the town is illuminated in the evening.

The assistant town governor of Odessa, Mr. L. N. Metchnikoff, has submitted a report to the Council suggesting that, in view of the difficulty in obtaining coal, water power should be used. The first year's cost is estimated at 54,000 roubles. The present annual cost is 53,000 roubles. In consequence of the bad quality of the coal used at the electrical station, its output is affected, particularly between the hours of 6 and 7 p.m., when it has to carry its full load, and certain less important districts have to be cut out.

Besides being engaged on the proposal to raise the price of electric current, the Elizabetgrad T.C. is suffering from a lack of meters which were long ago ordered by the town, but have not yet been delivered. It has been decided to make a fixed price for 25-C.P. lamps for a year, which would obviate the need for meters.

The Smolensk T.C. has bought up the local electrical company's concern for 500,000 roubles.

On October 4th, O.S., 1916, the Kieff T.C. decided to increase the tax on current from 5 to 20 per cent. to meet various increased expenses falling on the town ; it is now protested that this tax is a heavy burden out of all proportion to any advantage obtained from it.

On the proposition of the General Governor, the electrical station belonging to O. Mazing, in Omsk, has been sequestrated, and passes under the control of the Board of Land and Government Properties, according to the decree of the Council of Ministers, duly confirmed.

Dublin.—The Citizens' Association Executive has entered a protest against the action of the Corporation Housing Committee in having, without an estimate from an outside firm, placed contracts for electric lighting valued at £230, with the Corporation electricity department.

Eccles.—The Council has obtained terms for a bulk supply of energy from the Lancs. Electric Power Co.

Elland.—In order to give the Council a concrete case to work upon, Mr. Holroyd, a member of the Council, offered, at a recent meeting of the Electricity Committee, to take current on a standing charge of 15 per cent. of the rateable value of his house, plus ½d. per unit for current used, and to sign an agreement that the Council should not lose anything through the experiment. The offer was accepted.

Gloucester.—The Electricity Department reported that the energy sold during the month of January was 189,000 units, being an increase of nearly 23,000 units, and the traction output 44,300 units, showing an increase of over 4,000 units, as compared with the corresponding month of last year.

Ilford.—Proposed Loan.—Correspondence is proceeding between the Council and the L.G.B. with regard to an application by the former for sanction to borrow £10,000 to utilise steam at the refuse destructor works, and augment the supply of electricity.

Kirkcaldy.—Proposed Plant Extensions.—The Electricity Committee having rejected the recommendation of Sir J. Snell that the present generating station should be sold to the Fife Electric Power Co., and that electricity should be purchased from the company, the manager has submitted two schemes for the consideration of the Committee :—(1) Remodelling the existing generating station, at an estimated cost of £19,000 ; (2) to erect a new station near the sea in the near future, and to make temporary extensions at the present station to tide over the next 3 or 4 years, at an estimated cost of £25,000. Without committing itself to any scheme, the Committee decided to recommend the T.C. to apply to the Secretary for Scotland and the Treasury for permission to borrow £27,000.

London.—The Kensington Council has agreed to the conversion of 52 street lamps from series to parallel working, at an estimated cost of £72 ; the Council has also agreed to extend the period during which the Notting Hill Co. may charge 6d. per unit to September 30th next.

Fulham.—The Electricity Committee has recommended the B.C. to increase the charges for electricity by 5 per cent.

Motherwell.—Proposed Plant Extensions.—A report prepared by a Sub-Committee of the T.C. on the necessity of increasing the generating plant, with a view to meeting prospective demands, states that the day load has increased by 50 per cent. during the last two years, and that shortly 1,000 additional H.P. for motors will be required. Of the three suggested methods of increasing the available power, (1) purchasing in bulk from the Clyde Valley Co., was impossible, because the company's plant was fully loaded ; (2) the possibility of building a new works, was rather doubtful ; and (3) the remaining scheme, of extending the present works, involves the removal of certain plant and substituting a 2,000-KW. turbo-alternator, which would increase the total plant capacity by about 1,600 KW. It is proposed to adopt the H.T. alternating system of generation and supply to large consumers, and the estimated saving by introducing such plant is about £1,500 per annum. To carry out this work, it is proposed to ask for sanction to a loan of £30,000.

New Zealand.—It has been estimated that owing to the increased use of electricity in Christchurch, from the Lake Coleridge hydro-electric plant, the amount of coal received in the city last year showed a decrease of 27,000 tons as compared with the amount of coal normally used.—*Commonwealth Engineer.*

Pontypridd.—Year's Working.—The accounts of the Council's electricity undertaking for the year ended March, 1916, show a total revenue of £12,468, as against £11,557 in the previous year ; and after meeting all charges, a profit of £374 is shown, as against an even balance in the previous year. Contributions to sinking fund in respect of working-capital loan, and capital expenditure out of revenue in respect of plant on hire amounted to £1,827, towards which rate aid contributed £1,130 ; and after allowing for various balances brought in, a deficit of £171 was carried forward. Some 1,630,150 units were sold, the maximum load amounting to 922 KW.

Sheffield.—According to the *Sheffield Independent*, the Lord Mayor, the Deputy Lord Mayor, town clerk, and the manager of the electricity department had an interview in the House of Commons, last week, with the local members of Parliament, concerning the proposed new power station at Sheffield. It was agreed to prepare an amended scheme to submit to the authorities, which can be utilised for approved industrial purposes at an early date.

Prov. Order.—The B. of T. is to hold an inquiry into the application for an electric lighting prov. order for Wortley ; Sheffield Corporation is objecting to the Order, and has engaged counsel.

Shipston-on-Stour.—The B. of G. has received from the Receiver of the old Electric Light Co. an account for £20, together with a letter asserting that the Board had not fulfilled its part of the contract, which contained a penalty clause of 2s. per hour during which there was no light. The time during which there was no light was 162 hours. The Board has decided to ask the Receiver where it had failed to carry out the agreement.

Sleaford.—Price Increase.—The U.D.C. has decided to increase the charges for current by ½d. per unit for lighting and heating, and by ¼d. per unit for power.

South Africa.—According to the Cape of Good Hope *Official Gazette*, the Electric Light Regulations framed by the Paarl (C.P.) Municipal Council, under the provisions of Ordinance No. 6, of 1911, have been approved by the Administrator. *Board of Trade Journal.*

Johannesburg Cable Trouble.—The Municipal Council is proposing to renew certain of the heavy direct-current feeders, each consisting of two cables of 1 sq. in. cross section, which supply the town area. Ten of the 13 feeders were laid in 1905-6 to the specification of Messrs. Mordey & Dawbarn, and were of the paper and bitumen-insulated steel-armoured type ; these after a few years led to serious faults, owing to the decentralisation of the conductor, and in 1912 they were relaid solid in troughs, with the steel armour stripped off. About two years ago trouble restarted, the deterioration of insulation having been only delayed, and the question of completely renewing the 10 D.C. feeders at a cost of £33,550 has been under consideration, but not yet carried out, owing to lack of funds. It has been decided as a preliminary step to renew those feeders, &c., which control the central business section of the town ; in this way a further expenditure (after allowing for the value of copper recovered) of about £11,000 will serve to relieve the present position. The cable will be of an approved type suitable for any future scheme for supplying the inner area.

Queenstown (Cape Prov.).—In his annual report to the Council, the electrical engineer (Mr. W. Bellad-Ellis) mentioned that during the year ending December 30th, 1915, a total of 132,833 units were generated, and for the same period of 1916 the output was 150,652 units, an increase of 17,814 units. Mr. Bellad-Ellis recommended to the Council a scheme for developing a cooking and heating load, charging a fixed sum per month equal to the average cost of lighting, plus 2d. per unit for the first 50 excess units and 1½d. for every additional excess unit.

St. Helens.—Proposed Loan.—The Corporation Electricity Committee has resolved to apply to the L.G.B. for sanction to a loan of £5,500 for electricity purposes.

Stretford.—The Council has re-appointed Mr. Thomas L. Miller as consulting engineer for a year.

At the last meeting of the Electricity Committee, a discussion took place on the augmentation of the electricity supply and the provision of additional plant. The recommendations of the Sub-Committee will in due course be submitted for full consideration.

The Council has agreed to contribute 16 guineas towards the expenses of the Hackney electricity rate case.

Stockport.—Plant Extensions.—At the last meeting of the T.C., the electrical engineer (Mr. R. Lomax) presented an exhaustive report on the necessity of installing additional plant. The units generated for all purposes in the year 1910-11 were a little over 5½ millions, as compared with 22 millions estimated for 1916-17. They were now generating well over 500,000 units a week, therefore upon present demands the output for 1917-18 would exceed 26 million units. The scheme was approved.

The T.C. has decided to ask for official permission to install the additional plant required at the works, although, in view of the linking-up scheme, it appears to be doubted whether such permission will be granted.

The Electricity Committee has re-affirmed its previous decision not to contribute towards the cost of the Hackney electricity rate case, on the ground that both the electricity and gas undertakings are under the control of the Stockport municipal authority.

Tasmania.—The Government has placed the orders for extensions of the Great Lake hydro-electric scheme, the present capacity of which is 10,000 H.P. The hydraulic equipment consisting of steel pipes with valves, and the 8,000-H.P. Pelton wheel will be supplied by Messrs. Boving & Co., Ltd. The new pipe line will have a capacity of 16,000 H.P., but it is only intended to install an 8,000-H.P. tubine set to supply the present demand. The present generating machinery consists of two 4,050-K.V.A. British Westinghouse alternators, and a third unit of 7,000 K.V.A. is on order from the Australian G.E. Co. : the additional transformers in the power house and sub-stations will be supplied by the British Westinghouse Co., whilst the equipment for the 4,000-K.V.A. outdoor sub-station at North-West Bay will be supplied by the Australian General Electric Co. : four 1,333-K.V.A. transformers (including one spare) have been ordered. The sub-station will supply the power required for the manufacture of carbide and the electrolytic treatment of zinc ores by the Gillies process.—*Commonwealth Engineer.*

Todmorden.—Gas *v.* Electricity.—At the T.C., last week, on a proposal of the Electricity Committee to spend £10,000 on new plant, the Finance Committee suggested that the matter be deferred six months. Mr. Brook (chairman of the Electricity Committee) said the proposal was absolutely necessary to bring the plant up to date and supply power consumers, or the whole undertaking might as well be scrapped. The Chairman of the Gas Committee denounced the proposal, and said it would only increase the annual loss of £2,000; he contended that the proposal meant selling at 1d. per unit what would cost 2d. per unit to produce, but this statement was ridiculed in the Council, and the proposal to defer the matter was defeated.

Walsall.—The Electric Supply Committee reports that so long as there is only one generating set at the new generating station, it will be necessary to keep Wolverhampton Street station fully staffed and ready to take the load at any moment. The electricity mains are to be extended to the works of Gas Developments, Ltd.

In order to raise £45,924 for capital expenditure in connection with the new generating station at Birchills, the Finance Committee recommended that instead of exercising statutory borrowing powers by the creation of additional Corporation stock, the amount should be taken from the Corporation Loans Fund. The Council, at its meeting on Monday, decided to agree to this course.

York.—Street Lighting.—The Streets and Buildings Committee has decided to carry out a temporary installation of electric light in certain streets previously illuminated by gas. As many electric lamps will be put up as possible, but owing to the dearth of labour, some time will elapse before the scheme is carried out in its entirety.

TRAMWAY and RAILWAY NOTES.

Ashton-under-Lyne.—The Ashton Master Carriers' Association is seeking an interview with the Corporation with reference to proposals in the Corporation Bill now before Parliament. The Council was granted powers in 1900 to carry goods, and as the Bill provides for linking-up with other tramway systems, the Association is afraid the Council might enter into competition with it. A formal petition has been lodged against the Bill.

Australia.—The financial report on the year's working to June 30th, 1916, of the West Australian Government tramways shows receipts amounting to £118,934; working expenses to £84,780; and a balance of £34,154, representing 6·07 on the capital invested. After deducting interest, £24,927, there remains a net profit of £9,227. The receipts show an increase of £4,913 over the previous year; the passengers carried were 11,243,138, an increase of 443,073; the amount debited for working expenses includes the 3 per cent. contribution to local bodies, £3,543, and £10,000 on account of belated repairs for the purpose of bringing the track and plant up to standard condition. The work in connection with the erection and equipment of the new power house is nearly completed; the buildings have been finished and all the machinery erected, and the completion is now dependent on the installation of the switchgear by the British Westinghouse Co., which has been delayed by the war.—*Commonwealth Engineer.*

Continental. Spain.—A company has just been formed in Madrid, with the title La Compania del Metropolitano de Alfonso XIII, to construct an underground electric railway in the Spanish capital.

Doncaster.—The Electricity and Tramway Committee reported that the capital expenditure necessary at the termination of the war would amount to £19,050, £10,000 being for doubling the Balby track and £2,000 for car-shed extensions.

Dublin.—Alderman Byrne, M.P., continues to impress on the Government that the Dublin and Lucan Electric Railway should be taken under control, urging that, even on the assumption that the line is a "tramway," other tramways have been taken over, and that, in the event of the closing down of the service, not alone would Government contracts be disturbed, and the tillage scheme outside the city handicapped, but residents along the important Liffey Valley route would be cut off from ready communication with the city.

Exeter.—Accident.—On March 7th, a car, which had got out of control, ran down Fore Street Hill, came into collision with a van, and on reaching the points at the bottom of the hill, overturned, one person being killed and several injured.

Halifax.—The tramway service to Queensbury was suspended at 6 o'clock in the evening on Thursday last week, owing to the wintry conditions.

Ilford.—The Tramway Committee has abolished halfpenny fares and revised the table of fares and stages. The Barking U.D.C. is to be asked for a renewal of the lease of the track on the same terms and conditions as now existing.

Little Hulton.—A deputation of the Council is to urge on the South Lancashire Tramways Co. the need for a better service locally.

Middlesbrough.—Tramway Purchase.—The General Purposes Committee, after special consideration, has reported in favour of the purchase by the Corporation of the local tramway system, provided a satisfactory agreement can be arrived at.

Plymouth.—Price Increase.—The Electricity Committee reported that an agreement had been arrived at with the Tramway Committee for a flat rate charge of 1·56d. per unit for electricity supplied to the tramway undertaking in lieu of the present charges; the new rate represents a slight increase to cover the increased cost of production.

Pontypridd.—Year's Working.—The returns for the year ended March last of the Council's tramway undertaking show that 5,453,421 passengers were carried, and 417,449 car-miles run. The total revenue amounted to £23,118, or rather less than in 1915; and after meeting working and financial charges, a deficit of £2,095 resulted, as against a deficit of £2,271 in the previous year.

Salford.—The Tramways Committee has decided to accept the offer of the boys, about 50 in number, of the Manchester Grammar School, to serve as trolley boys on the cars on Friday evenings and all day on Saturdays and Sundays.

Spen Valley.—Fire.—On the evening of the same day that a car-shed at Castleford was destroyed by fire, as reported in the Electrical Review last week, a fire occurred at the shed belonging to the same company, at Frost Hill, in the Spen Valley, in the course of which two cars were partly demolished and the shed roof destroyed.

Torquay.—The T.C. has accepted an offer from the Tramway Co. to pay £150 instead of an increase of 10 per cent. in price in respect of electricity supplied from Michaelmas to December 31st, 1916.

U.S.A.—Railway Electrification Projects.—The *Electric Railway Journal* mentions that there have been numerous rumours recently of projected electrifications of steam railways in the States. The most notable refers to the Lehigh Valley Railway, which has under consideration the electric operation of the heavier part of its coal tonnage; the total route of 115 double-track miles, including the Wilkes-Barre cut-off and sidings, if electrified will involve an expenditure of, roughly, $20,000,000, and it is stated that a large return on the investment should be possible. It is stated that the engineer's report on the project will be available within a few months.

It is also rumoured that the Chicago steam railway terminals are to be electrified as a sequel to the recently-announced plan of electric operation of the Illinois Central Railway's terminal service.

Legislation has been introduced to provide an hourly electric service on a 10-mile branch of the Boston and Maine Railway between Dover and Portsmouth.

It is also rumoured that the Baltimore tunnel electrification scheme of the Pennsylvania Railway has been revived; this is not credited, though the possibility of electrifying the main line of the Pennsylvania Co. between Baltimore and Washington has been under consideration for several years back.

The intention of the Erie Railway to install electric operation on the Jersey City-North Newark section has been talked about for several years; the preponderance of local passenger traffic is in favour of electrification, but our contemporary doubts whether it is sufficiently heavy to justify the expenditure.

Wigan.—Tower Wagon.—The Tramways Committee proposes to purchase a new tower wagon.

TELEGRAPH and TELEPHONE NOTES.

Cable Breakdown.—The Danish cables between Newcastle and Copenhagen broke down last week.

Guernsey.—The Report of the Guernsey States Telephone Department for 1916 shows that the revenue was £7,565, and the expenditure £7,169, leaving a net profit of £396. Allocations were made to the sinking fund of £393, to the special sinking fund of £379, and to depreciation of £1,529. There were, in all, 2,235 subscribers' and other lines, and the total mileage of lines was 1,555 overhead and 1,060 underground. During the year 1,436,153 local and 3,492 trunk calls were handled, and 9,789 telegrams and letters were telephoned to the Post Office.

Mexico.—The U.S. Government has been semi-officially advised that Mexico City is in direct communication with Germany by wireless. An investigation has been ordered.

Storm Damage.—Telephonic and telegraphic communication between Bradford and Halifax was interfered with last week, many miles of wires being damaged in the hilly country about Queensbury by the effect of a gale of wind, and also by the breaking of wires by the weight of ice.

The fierce weather played havoc also with the telegraph and telephone wires just beyond the Summit, Manchester Road, Burnley. The main wires between Burnley and Manchester go over this exposed height, and the poles and wires meet the full force of the wind. Many of the poles were blown down and the wires badly broken. The wires were found coated with ice.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—U.D.C. Electricity Department. Battery of accumulators complete. See "Official Notices" to-day.

Australia.—Adelaide.—March 28th. P.M.G.'s Department. Telephones, telephone parts, line and battery material, &c. Schedules 444 to 453. See "Official Notices" February 2nd.

Bolton.—March 19th. Tramways Committee. Twelve months' supply of overhead materials, carbons, insulating materials, &c. Mr. J. Barnard, General Manager.

Bristol.—March 22nd. Six or twelve months' supply of unwashed small coal (with alternatives for washed pea coal) for the electricity works. Mr. H. Faraday Proctor, Chief Engineer and Manager, The Exchange, Corn Street.

Burnley.—March 19th. Electrical goods, for the Board of Guardians. Mr. J. S. Horn, Clerk.

Canada.—March 28th. Toronto Electric Commissioners. Synchronous condensers, 5,000, 7,500 or 10,000 K.V.A. capacity. See "Official Notices" February 9th.

Dundee.—March 28th. Corporation. Twelve months' supply of electrical stores, &c. Specifications from the Electricity Department, Dudhope Crescent Road.

Glasgow.—April 5th. Corporation. Turbo-alternators (15,000 KW.), transformers, and condensing plant for the new generating station at Dalmarnock. Particulars from Mr. W. W. Lackie, Chief Engineer and Manager, 75, Waterloo Street, Glasgow.

Liverpool.—March 19th. Electrical supplies for three months, for Toxteth Park B. of G. Mr. R. A. James, Clerk, 15, High Park Street.

London.—St. Pancras.—April 12th. B.C. Arc lamp carbons. See "Official Notices" March 9th.

Londonderry.—March 17th. Corporation. Engine-room stores, carbons, electricity meters, cables, &c., for the Electricity Department. Town Clerk.

Rhondda.—March 21st. U.D.C. Twelve months' supply of house-service meters. See "Official Notices" March 2nd.

Salford.—March 19th. Electricity Department. 5,000 tons of washed slack coal during the next six months. Borough Electrical Engineer.

Spain.—The municipal authorities of Caceres have just invited tenders for the concession for the electric lighting of the town during a period of 15 years. Tenders have also been lately invited by the municipal authorities of the town of Carabanchal (Province of Madrid) for the lighting concession during an unnamed period.

Warrington.—April 11th. Electricity and Tramways Committee. One 3,000-KW. turbo-alternator and surface condensing plant. See "Official Notices" to-day.

CLOSED.

Bexley.—U.D.C. Sub-station for power plant installation at East Wickham: D. Rowell & Co., Westminster, £104 10s.

Bradford.—Corporation. National Rail and Tramway Appliances Co., Ltd., 100 tons of cast-iron brake blocks for the year.

St. Helens.—Electricity Committee. Amended tender of Messrs. Babcock & Wilcox for two new boilers.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, March 16th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Papers on "Heat Treatment of Large Forgings," by Sir Wm. Beardmore, Bart.; and "Heat Treatment of Steel Forgings," by Mr. H. Hashdown.

Electro-Harmonic Society.—Friday, March 16th. At 8 p.m. At the Holborn Restaurant, W.C. Smoking concert.

Association of Mining Electrical Engineers.—Saturday, March 17th. At 4.30 p.m. At the Royal Technical College, Glasgow. Paper on "Maintenance of Underground Plant," by Mr. M. Baird, jun.

Institution of Post Office Electrical Engineers (London Centre).—Monday, March 19th. At 6 p.m. At the Institution of Electrical Engineers. Paper on "The Provision of a Telephone Exchange," by Mr. G. F. Greenham.

Institution of Civil Engineers.—Tuesday, March 20th. At 5.30 p.m. At Great George Street, S.W. Paper on "The New Electric Power House at Birchills, Walsall," by Mr. E. M. Lacey.

Liverpool Engineering Society.—Wednesday, March 21st. At 7.30 p.m. At the Royal Institution, Colquitt Street. Joint meeting with the Manchester Section of the Institution of Electrical Engineers. Paper on "Equipment of King George Dock, Hull," by Mr. L. Leighton.

Institute of Metals.—Wednesday, March 21st, and Thursday, March 22nd. At 36, Victoria Street. Spring meeting.

Institution of Electrical Engineers.—Thursday, March 22nd. At 8 p.m. At Victoria Embankment, W.C. Paper on "Machine Switching Telephone Gear," by Mr. F. R. McBerty.

(Scottish Local Section). Tuesday, March 20th. At 7 p.m. At Princes Street Station Hotel, Edinburgh. Paper on "Voltage Regulation of Rotary Converters," by Mr. G. A. Juhlin.

(Manchester Local Section).—Wednesday, March 21st. At 7.30 p.m. Joint meeting with the Liverpool Engineering Society at the Royal Institution, Colquitt Street. Paper on "Equipment of King George Dock, Hull," by Mr. L. Leighton.

(Yorkshire Local Section).—Wednesday, March 21st. At 7 p.m. At the Philosophical Hall, Leeds. Paper on "The Voltage Regulation of Rotary Converters," by Mr. G. A. Juhlin.

Royal Institution of Great Britain.—Thursday, March 22nd. At 3 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Modern Improvements in Telegraphy and Telephony: Telegraphy" (Lecture I), by Prof. J. A. Fleming, F.R.S.

Greenock Electrical Society.—Thursday, March 22nd. At 7.45 p.m. At 22, West Stewart Street. Paper on "Electric Welding," by Mr. D. Angus. Saturday, March 24th. Visit to Gateside Colliery, Cambuslang.

NOTES.

Electrically-tempered Tools.—A recent issue of the *Electrical World* contains some interesting data regarding the cost of tempering steel tools electrically in an American automobile manufacturing plant. The furnace was operated 98·5 hours on 19 days, or 5·18 hours per day; in that time, 1,978 high-speed steel tools, consisting of circular cutters, reamers, reamer blades, keyway cutters, taps, circular form tools, thread chasers, profile cutters, pointing tools, hollow mills, &c., were treated, at a cost of $26·6, with energy at 3 cents per KW.-hour.

Adding the cost of renewing the carbon heating elements, $4·48, the total cost for the period becomes $31·11, or 1·57 cents per tool.

During five runs, 352 lb. weight of tools were treated, at a cost of 2·33 cents per lb. These tools are treated in a Hoskins F.C.-204 furnace, with internal dimensions of 6½ in. × 5 in. × 11 in. and maximum rating of 15 KW.; with temperatures of 2,100° to 2,300° F., the average demand is 9 to 10 KW. The accurate control of temperature and furnace atmosphere is a great advantage, because the better the tool the greater the efficiency of the machine. Improper temperature treatment may result in a difference of from 30 to 70 per cent. in the life of the tool.

Volunteer Notes.—First London Engineer Volunteers. Headquarters: Balderton Street, Oxford Street, W.

Saturday, March 17th. The Parade for Route March will be 2.45, Golder's Green Station.

Monday, March 19th. Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30–8.

Wednesday, March 21st. Instructional Class, 8.15. Platoon Drill, Platoon No. 1

Thursday, March 22nd. Platoon Drill, Platoon No. 7. Ambulance Class by M.O., 6.30.

Friday, March 23rd. Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.30—8.30.

Saturday, March 24th.—N.C.O.'s Instruction Class. Captain Castell, Bridging.

Sunday, March 25th.—Special work at Bombing School. Parade Clapham Junction Station (City & S.L. Tube Ry.), 9.45 a.m.

Easter Training will be at Esher. Names can still be sent in.

(By order), Macleod Yearsley, *Captain and Adjutant.*

The Metric System.—We are informed by the Decimal Association that a Weights and Measures Bill, drafted by the Associated Chambers of Commerce, is now being circulated throughout the country for consideration and criticism.

Although nothing of the kind has happened in any "metric" country, some British manufacturers fear that the compulsory adoption of the metric system in this country would necessarily involve the immediate scrapping of all their existing machinery, patterns, tools, and other workshop standards. It should therefore be known that to overcome this difficulty the following clause has been inserted in the Bill:—

4 (*a*) "Provided that nothing in this Act shall affect the manufacture or use of any machinery, tool, pattern, sieve, template, or other article made by measures other than metric measures."

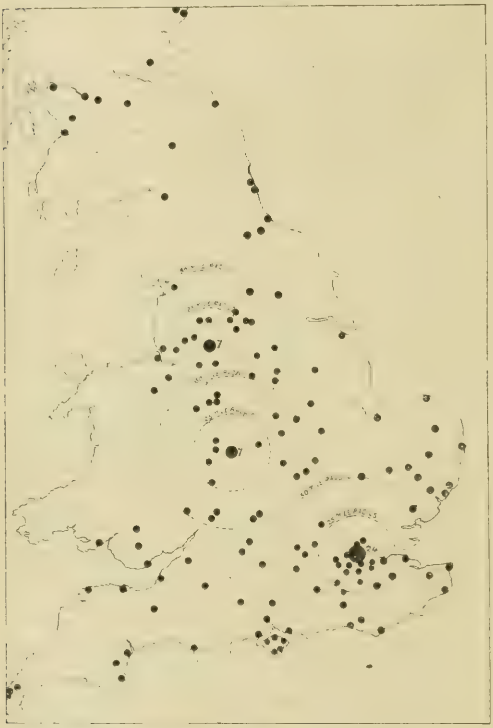
The passing of an Act on the basis of the proposed Bill would thus mean that, while we should all be required to buy and sell in metric quantities, we should be at liberty to continue the use of our existing weights and measures for manufacturing purposes until such time as we ourselves chose to amend them.

The Coventry Chamber of Commerce, at a special meeting held for the purpose of considering the draft Bills of the Association of Chambers of Commerce for the introduction of decimal coinage and metric weights and measures, has passed a resolution approving of the Coinage Bill, and also of the Weights and Measures Bill, with the proviso in the latter case that the time of change be extended to three years from the passing of the Act.

Late Legal.—H. S. Barrett *v.* The Enfield Electric Cable Manufacturing Co., Ltd.—Before Mr. Justice Ridley, on Tuesday, Mr. H. S. Barrett, an architect, sought to recover from the defendant company £115 10s., fees for professional work done for the defendants, the main portion of the fees being in connection with the preparation of plans for a new factory at Brimsdown for the defendant company. The defence was that a verbal agreement was made between the plaintiff and Lord Grimston, acting on behalf of the defendants, by which the plaintiff was to prepare the plans at his own risk. If the work was afterwards carried out plaintiff was to be paid for his services, and if not (as did happen) he was to receive nothing. In the result, the defendants agreed to submit to judgment for £105, to include £10 10s. paid into Court, with costs on the High Court scale. Judgment was entered accordingly.

Commercial Electric Vehicle Investments in the U.S.A.—From figures supplied by Mr. W. P. Kennedy to the Electric Vehicle Section of the N.E.L.A., it appears that the estimated value of commercial electric vehicle equipments in use (presumably in the States) is roughly 36 million dollars (or over £7,000,000). Brewers and department stores each figure at some 6 million dollars, public service companies at 4 million dollars, express companies at 3½ million dollars, and manufacturers' and merchants' industrial trucks at 2¾ million dollars.

Charging Stations for Electric Vehicles.—In our last issue we referred to the official list of stations at which the batteries of electric vehicles can be charged, which has been prepared by the Electric Vehicle Committee, and embraces about 180 names of places. The list in itself is of importance, as marking the growth of opinion favourable to the use of such vehicles; but its significance can be far better appreciated from the small map which we publish herewith, and which indicates at a glance the situation of these charging stations with regard to each other which is obviously of more importance to the user than mere numbers, if the full advantages of the electric vehicle are to be realised.



The London County Council area can now boast of some two dozen public charging stations, sprinkled well over the area, and we would suggest that the metropolitan users would better appreciate their possibilities if they were shown diagrammatically on a map, which could be published with the list of charging stations.

The Metric System in the U.S.A.—During the sixty-ninth meeting of the American Association for the Advancement of Science in New York, during Christmas week, 1916, a conference was held, designated the "Metric Conference," at which were present representatives of national business organisations, the United States Department of Commerce, and men prominent in engineering and educational work. The object of this conference was to discuss the Pan-American use of the metric system. Its outcome was the formation of a permanent organisation to be known as the American Metric Association, to further the adoption of the international metre, gramme, and litre, which have been legalised in the United States since 1866.

The Association maintains an office at 156, Fifth Avenue, New York, and is especially desirous of receiving catalogues of manufacturers who use the metric system for domestic or export purposes.

War and Industry.—In an address delivered to the members of the Delphian Coterie, at the Cannon Street Hotel, London, on the 7th inst., Mr. Samuel Turner, of Rochdale, joint author with Dr. Gray of the work "Eclipse or Empire," made certain references to the effect of the war upon various departments of British industry. The war had undoubtedly given us a great creative impulse, which had for result that during the war period this country had, he believed, invented more, developed more, and achieved more by way of industrial and scientific organisation and reconstruction than in the previous 20 years. Thus they saw the logical position which research and experimentation might occupy. As regards methods in other countries, they saw that Germany had forty chemists to our one; the United States had a like preponderance of mechanical experimenters; Columbia University had a new laboratory in prospect to cost £125,000, with an endowment of £500,000; the Bureau of Standards employed 400 men, 75 per cent. scientists, and spent £120,000 a year. The Bell Telephone Co. had 300 experts whose sole job was to improve the telephone; the Western Electric Co. had 1,000 men in the laboratory, and the results of these two particular phases of activity were that America controlled the telephone business of the world, in so far as she supplied three-fifths of the apparatus, and everyone who knew America realised that she had a telephone service, and we had not. Our service was really a joke in comparison with that of America, and he doubted whether there were in this country a score of men who were solely engaged in trying to improve the telephone service. But the two companies named had 1,300 men doing nothing else, consequently the technique of the industry had passed to America. The Pennsylvania Railroad had 360 men in their laboratory, and spent £100,000 a year. The General Electric Co. spent a like amount, and had 200 men in laboratory work. The Westinghouse Co. spent £70,000, the Eastman Kodak £30,000, and the Goodrich Tyre Co. £20,000 annually. And why all this? Simply because these people believed in the evolutionary and dynamic nature of industry, and had not been content to wait for things to happen. They had planned and worked for the future, just as steadily as they did for present-day requirements. People asked him what about the cost of this kind of thing. Well, the experience was that the cost did not really enter into the calculations, because these laboratories were found to pay for themselves. That was not theory, but actual practice. The evidence was overwhelming in demonstration of the necessity of adopting scientific methods in industry in this country. Industries must also be so organised that they would bring greater leisure and prosperity for the workers. The evidence on all hands was conclusive that the country which adopted scientific methods and efficiency, and went in for high production and high wages, was a better place for the worker to live in than a country which was industrially inefficient.

Employers and National Service.—A deputation, representing the Federation of British Industry, the British Manufacturers' Association, the Association of Controlled Establishments, and the Employers' Association waited upon Dr. Addison and Mr. Neville Chamberlain, at the House of Commons, on Wednesday. These bodies, it is estimated, represent three-quarters of the manufacturing firms in the country. The classification of the non-essential trades, and orders relating thereto, were the principal subjects under consideration. Mr. George Terrell, M.P., who introduced the deputation, said that they represented between 8,000 and 9,000 manufacturing firms, employing many millions of workpeople, and he urged that if employers were taken into the confidence of the Government, they would probably be able to meet the requirements of the country with a minimum of interference with output. Dr. Addison intimated that a Consultative Committee, with members nominated by the employers of labour, would be set up.—*Times.*

Radium and Food for Cattle.—Writing to the *Financial Times*, Mr. Barton Scammell, M.S.C.I., President of the Society for Radiumising the Soil, says:—In the words of the Prime Minister, "we have a larger stock of cattle than I think we ever had before in this country," and therefore any addition to our supplies of food for cattle is of national importance. This addition can be provided by the new discovery of science that the solutions of radio-active matters will convert cellulose (sawdust, &c.) into an assimilable starch-like material, of which as much as 50 per cent. in finely-powdered form can be mixed with the ordinary foodstuffs, the cost working out at under £3 per ton, and forming a fattening and nourishing food for pigs, cattle, and poultry. The typical cellulose is represented by the formula $C_6H_{10}O_5$, identical with that of starch, with which it has many chemical analogies.

The Engineers' Club.—The membership of the Engineers' Club, Manchester, is now 753. After allowing for resignations, deaths, &c., the net increase for the year is 70. The Club has elected Alderman T. Smethurst (the Lord Mayor of Manchester) to be its first honorary member, in recognition of his services to the engineering industry. The Club Roll of Honour bears the names of 73 members and six of the staff of the Club. Mr. E. L. Hill resigned the honorary secretaryship early in January, 1917, owing to his now residing in London; Mr. H. T. Wilkinson has been appointed to succeed him. The balance sheet shows the funds of the Club at £2,257, less "deficit on trading account from 1613 to 1916 inclusive, £108." And yet we had a dim recollection of this Club being formed since we were born.

Use Solid Wire in Place of Small Stranded Cable.—The Council of the INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION having considered the letter of the CABLE MAKERS' ASSOCIATION to which we referred in our issue of March 2nd, has passed the resolution given below, and recommended the members of the I.M.E.A. to agree to it:—

"That in view of the demand by the Government for small stranded wires being so great, the restrictions as to the use of single-strand conductors of 18 S.W.G., 16 S.W.G., and 14 S.W.G. should be temporarily suspended during the war, and that the use of such for installation wiring in place of 3/22 and 7/25 S.W.G., 3/20 and 7/23 S.W.G., and 7/22 and 7/21½ S.W.G. respectively be accepted."

Night Ploughing by Electric Light.—According to local papers, the Government is sending out electric lighting sets in connection with night ploughing operations in Yorkshire, where it is intended to use from 100 to 150 motor-ploughs and tractors.

Institution and Lecture Notes.—Institution of Electrical Engineers.—Prior to the meeting of the Institution on Thursday, last week, the president (Mr. C. P. Sparks) announced the probability of H.M. Office of Works taking over the Institution building, in which case arrangements would be made to hold the meetings elsewhere.

Association of Draughtsmen.—The Association of Engineering and Shipbuilding Draughtsmen (London Branch) held its first general meeting on Saturday last, when officers and Council representative of the various firms in the district were elected to carry on the work of the Association within the London area. There were present about 150 members out of nearly 350 members, composing the London Branch, and this membership is increasing week by week. Discussion on the future business of the Association ensued, and Mr. L. Blair, the general secretary of Glasgow, gave a short account of the work of the Association during the past year. The total membership of this Association is now over 5,000, enrolled from all branches of engineering and shipbuilding in Great Britain and Ireland. The address of the honorary secretary of the London Branch is 38, Craster Road, Brixton Hill, S.W.2.

Birmingham Electrical Club.—There was a large attendance at the seventh annual dinner of the club, which was held under the chairmanship of Mr. A. B. Mudie (president). An excellent concert was given.

Nottingham Society of Engineers.—On Wednesday evening, Mr. David Rushworth gave a lecture (with 100 special slides) on "The Fuel Economiser."

Royal Dublin Society.—A lecture was delivered recently by Prof. J. A. McClelland, F.R.S., on "Radiations."

Engineers' Wages.—It is stated by Mr. J. T. Brownlee that the recent wages award in the engineering trades will affect 1,000,000 persons, and cost £12,000,000 as an annual increase in the wages bill.—*Westminster Gazette.*

Appointments Vacant.—Working foreman, also shift engineer (40s.), for the Guildford Electricity Supply Co.; mains superintendent and shift engineer for the Neath R.D.C. electricity works. See our advertisement pages to-day.

Fatality.—Johannesburg.—An electrician employed at the Victoria Falls power station at Vereeniging, whilst engaged in dusting portions of a switchboard with a feather duster, made contact with an 80,000-volt conductor; he was shockingly burned and succumbed to his injuries.

Nitric Acid in Sweden.—A new company, with large capital, has been formed for the manufacture of nitric acid and other chemical products in Sweden, according to the *Chemical Trade Journal*. It has entered upon a contract with the Royal Waterfalls Board for a supply of electrical energy, and the works will be erected on the area reserved for industrial installations at Trollhattan. The annual capacity will be some 7,000 tons of concentrated nitric acid, with nitrates as an auxiliary product. The new company will use the Birkeland-Eyde method, for which rights have been secured for Sweden. The work is being pushed ahead with all speed to be ready this year.—*Metallurgical and Chemical Engineering.*

REVIEWS.

Groupes Electrogènes en régime troublé. By L. Barbillion. Paris: Gauthier-Villars et Cie. Price 11 fr.

This work chiefly consists of a series of lectures delivered by Prof. Barbillion at the University of Grenoble during the session 1912-13. The book was ready for publication in June, 1914, but owing to the war, and to the fact that the author was called up during the first days, its appearance has been delayed. It deals with the functioning of what he calls "groupes électrogènes," that is, with combinations of at least two machines, one of which is a generator of electricity and another a motor of any kind driving it. The question of the regulation and governing of such groups is gone into very thoroughly from the theoretical point of view, mathematical and graphical methods being both employed. Large numbers of diagrams are incorporated in the text.

Principles of Electrical Design. By Alfred Still, Professor of Electrical Engineering, Purdue University. London: Hill Publishing Co. Price 12s. 6d. net.

In the preface the author emphasises the fact that the book is intended for the use of students rather than for the use of designers working under commercial conditions. With this end in view, greater stress is laid on the principles underlying design and on the methods to be used to achieve certain results than on short methods, based largely on personal experience, used by many commercial designers.

In an introductory chapter the author points out to would-be designers the importance of an accurate knowledge of theory and of acquiring the spirit of initiative and research: the necessity of attaining power of expression, both verbally and by diagrams, and the acquisition of what is termed engineering judgment are also rightly insisted on.

No attempt is made in the book to deal with the whole field of electrical design. The ground covered includes electromagnets, direct-current dynamos and motors, and alternators; another volume, dealing chiefly with induction motors and converting plant, would be valuable.

In perusing the book, the outstanding feature, to which the attention of the reader is repeatedly drawn, is the importance the writer attaches to the study of the actual flux distribution (particularly in the gap) under working conditions. He points out that while shorter and easier methods may give results sufficiently accurate for the designer when dealing with standard or normal machines, the flux-distribution method is the only safe way of dealing with new designs or with machines working under abnormal conditions. This idea of flux distribution is used very clearly in connection with the calculation of the additional ampere-turns required on the field of a direct-current generator when load is increased. Put very briefly, the method in such a case consists of first determining the flux distribution when the machine is generating the necessary pressure on no load. The resultant distribution of ampere-turns on the gap is then found under full-load conditions, and the consequent flux deduced. The total flux produced is, of course, lower than on no load, and gives a lower generated pressure. Finally, the flux on load is increased in the necessary proportion (not forgetting to allow for resistance drop in the armature, &c.) to give the required terminal pressure on load, and the increase in field ampere-turns above those necessary for the no-load condition is then readily ascertained.

A similar procedure is recommended in the case of alternator regulation, though a vector method for attaining the same end is also considered at length.

The chapter dealing with commutation in direct-current machines is also written on lines which differ from those usually followed, and affords much food for thought. Questions of heating, ventilation, energy losses, and efficiency are dealt with on normal lines in an adequate manner.

The arrangement of armature windings, both for direct and alternating-current machines, is always a source of difficulty with students, and it would seem that the space devoted to the subject might be increased in subsequent editions with advantage. A considerable number of tables of constants, derived from modern commercial experience, are inserted in the book, and these will be especially useful to students who are unable to find such data in their personal experience.

Such criticisms of the book as can be made relate merely to minor points, and in this connection it is to be noted that the writer, when dealing with magnetic circuits, uses the gauss as the name of the unit of strength of magnetic field; it is perhaps largely a matter of opinion, but it seems better to use the line per sq. cm. as the name of the unit of field strength, reserving the gauss as the name of the unit of magnetising force.

The diagrams are clearly drawn and adequately serve their purpose; the only suggestion that can be made is that in all vector diagrams the direction of rotation of the vectors should be specifically indicated by a curved arrow.

The book is thoroughly worth the attention of all men engaged in the design of heavy electrical machinery and of all teachers of electrical engineering. Students in technical universities will also profit considerably by a perusal of the book in the later part of their course.

Practical Safety Methods and Devices. By G. Alvin Cowee. London: Routledge & Sons, Ltd. Price 12s. 6d. net.

It has been rightly said that even with the most highly trained workers and under the best conditions there is always present the human liability to err. A moment's inattention, a sort of mental air pocket, so to speak, and a mistake is made which may have the most tragic consequences. Especially is this the case at the present time, when a large amount of ill-trained and even unskilled labour is working under conditions which are far from approaching the ideal with material which may contain in itself all the elements necessary for a great and terrible disaster. Accidents, wherever and whenever they occur, are almost invariably due to some slip on the part of someone, more often than not the victim, which not only need not have been made, but which he had been deliberately avoiding making until the avoidance had become a habit, a second nature as it were, and so had given rise to the momentary relaxation of the watchfulness necessary for safety.

At the moment it is Utopian to hope for the avoidance of accidents altogether, so that all we can do that is likely to be of practical value is to consider how they can be reduced to a minimum. There is not the slightest doubt as to the avoidability of the great majority of accidents; that being so, what we have to find out are the best precautions that can be taken against their occurrence. Here, again, is the human element to be considered. No mechanical protection to any form of machinery can be regarded as efficient unless the worker understands exactly why it is necessary and recognises its true value. In connection with this, cases will at once come to mind where safety devices have been either ignored or in some cases put deliberately out of action by the very people they were designed to protect.

He would be a bold man who would say that he considered the limit had been reached in regard to safety or protective devices; many experimentalists are still engaged in thinking out schemes and designing safeguards which shall still further promote the immunity of the worker from accident. The tendency is for more and more attention to be paid towards ensuring the safety of the worker; in fact, it may be said that the modern motto is "Safety first." It has been calculated that in the United States some 35,000 lives and some £100,000,000 are lost every year in preventible accidents in factories and workshops. It has been recognised in that country that the most important factor in the elimination of avoidable accidents is the education of the employés, and it has been stated that the United States Steel Corporation, by giving proper attention to the human element as well as by adopting the best safety devices, have during the past five years brought down their accident rate by forty per cent.

Mr. George Alvin Cowee, in his work "Practical Safety Methods and Devices," gives an excellent description of the "Safety First" movement in that country, which is carried out, so far as the education of the workers is concerned, by what are called Safety Committees. Although safety methods have been systematically studied for a number of years on the Continent, the fallacy has largely prevailed in America that all work accidents were necessarily incidental to industry and that casualties were more or less inevitable. Comparatively few employers and safety engineers, together with the accident indemnity companies, says Mr. Cowee, have clearly demonstrated that this assumption is incorrect; furthermore, that it is possible, practicable, profitable and eminently humane to prevent this large proportion of industrial accidents.

Many of the large industrial corporations in the States utilise the kinematograph to illustrate the dangers which the employés should avoid. A number of others pin their faith to pamphlets which are replete with photographs and drawings. Some award a "Safety First" button to the men who have passed an examination, chiefly if not wholly oral, in the rules which have been adopted by the company. It may be doubted whether this would commend itself to the British mind, but still it is only one of many suggestions and practices, and the author appears to pin his faith to the adoption of safety committees. These consist of several workmen in each department, and periodical meetings are held for the discussion of accident prevention. A safety inspector is appointed for each section by the workmen concerned, and it is his duty to caution everyone whom he may notice adopting unsafe methods, and to report upon every unsafe place and every insufficiently guarded machine. The Dodge Manufacturing Co., it has been mentioned, uses an accident prevention score board, on which the employés are divided into sections, and the accidents in these are duly registered. A premium is given to the sections which come out best at the end of each year. This strikes one as being a scheme which might be adopted with advantage by the larger British manufacturing concerns. The United States Steel Corporation are said to find that the saving in casualty expense over expenditure for safety during the last three years has been over 35 per cent., while, on the workers' side, must be estimated the amount saved in wages.

The book is intended to provide for employers, superintendents, underwriters, and engineers generally a convenient summary of standard safety methods and devices as developed and perfected by those who have specialised in that direction. It is the result of careful observations made in hundreds of mills and manufacturing establishments, and reflects the experiences of hundreds of practical men. Amongst the subjects dealt with are safety devices and appliances for electric supply work, electric traction, and electric power. Steam railways, mechanical engineering works, machine tools and grinding, and wood-working machinery are all dealt with from the safety-first standpoint, and in addition there are valuable chapters on welfare work, sanitation, fire drills, first aid, and other subjects likely to be of interest and value. The book can be confidently recommended, and will be of value to all who study its pages.

Applied Electricity for Practical Men. By Arthur J. Rowland. London: Hill Publishing Co. Price 8s. 4d.

"The book is offered to the public in the hope that it may fill a need in connection with the study of applied electricity in trade and industrial schools, and that the explanations may be helpful to electrical workers everywhere." It is seldom that a book which sets out to "fill a need" so adequately fulfils its purpose, but a careful perusal of Mr. Rowland's book leaves little doubt that it will appeal to a very large public, and that whoever buys the book will at least be satisfied that it does all that it professes to do.

The writing of a text-book for practical men on *any* subject involves considerable difficulties, but the breadth of the subject, and the absolute necessity for some form of mathematical treatment in some parts of applied electricity render the preparation of a text-book such as the one under review a task beset with obstacles of an unusual character. There is always the possibility of slipping into the superficial method of treatment in order to cover the whole gamut of things electrical, from the elementary phenomena of frictional electricity to wireless telegraphy and X-rays. And, on the other hand, there is the temptation to deal too much with principles and leave no room for the application of principles to practice. Mr. Rowland has fortunately succeeded in avoiding both of these extremes, and has written a well-balanced, common-sense book which is neither superficial nor too theoretical.

In the first chapter he deals with the fundamental principles of current electricity, and gives some practical ideas of the magnitude of currents used for various purposes, such as glow-lamp lighting, electric train propulsion, &c. He then passes on to discuss electromotive force and Ohm's law, illustrating every principle by reference to modern electric practice. This, together with a concise chapter on the phenomena of magnetism, leads immediately to a study of the D.C. dynamo. Mr. Rowland has succeeded in two chapters in giving a remarkably full account of the principles, construction, and working of the modern dynamo. Special attention has been given to the winding of armatures, and it is evident from the examples given at the end of the chapter that the author has aimed at no superficial knowledge.

A short chapter is given up to electric heating, and this is followed by a long one on systems of power distribution, including switchboards and switchboard instruments. The latter chapter is an excellent one, and the illustrations are also excellent. D.C. motors are then studied, and, after a further chapter entitled "More Principles," alternating currents are dealt with very completely in half a dozen chapters. Transformers, alternators, polyphase circuits, and A.C. motors are treated in turn, and here, again, the perusal of the text and reference to the examples which follow each section indicate a thoroughness of treatment unusual in a text-book which has so plausible an excuse for superficiality—that it is written for practical men.

The three remaining chapters do not fall short of the promise of the early part of the book. The sections on storage batteries and electric lights are well planned essays on large subjects, designed to give a maximum of accurate and up-to-date information in a short compass; and the final chapter on wires and wiring is equally satisfactory, except that its usefulness to English readers is impaired by the use of the "circular mil" in stating sectional areas of wires.

As we have already indicated, the author has succeeded in producing a book on applied electricity of undoubted usefulness, and we heartily recommend it as a text-book for trade and technical classes in electrical engineering, and as a useful handbook for all classes of electrical workers.—P. H. S. K.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Mr. J. Watkin, accountant to the Urban Electric Supply Co. at their Grantham Works, on leaving for another appointment, has been presented by the staff with a fountain pen and walking-stick.

Mr. G. E. E. Williamson, second charge engineer at the Ilford electricity undertaking, has resigned. Mr. A. Glazier, third charge engineer, has been promoted to the vacancy at £150 per annum.

Mr. Salt, electrical engineer to Torquay Corporation, has been promoted to the rank of full lieutenant in the Army.

The Halifax T.C. has resolved to increase the salary of the tramway traffic manager from £400 to £425, and that of the tramway engineer from £300 to £325 per annum, but has referred back to the Electricity Committee, for consideration along with the estimates for next year, a proposed advance to the electrical engineer from £700 to £800.

The West Hartlepool T.C. has decided to grant a sum of £105 to Mr. J. W. Spark, acting general manager of the tramways, for his services during the past 18 months in the absence of the manager, Mr. C. Burgess, on military service.

The directors of the Clyde Valley Electric Power Co. have appointed Mr. Arch. Page, Glasgow, to be assistant general manager of the company. Mr. Page has been in the employment of the Glasgow T.C. electricity department for the past 18 years, having acted for 12 years as deputy chief engineer and manager. At the last meeting of the Scottish Local Section of the I.E.E., Mr. Page was nominated as chairman of the Section for next session. For several winters he was president of the Students' Association of the Section.

The General Purposes Committee of the Cape Town Corporation has recommended that Mr. G. H. Swingler be appointed acting electrical engineer in the place of Mr. J. W. S. Clunas, who recently resigned. The appointment is for a period of six months at a salary of £750 per annum. Mr. Swingler has recently been acting as assistant electrical engineer to the Corporation, and previously was electrical engineer to the Municipality of Murzenberg, now amalgamated with the Cape Town Municipality. In connection with Mr. Clunas's resignation, presentations were made to him of a gold watch by the office staff, of two silver entrée dishes by the running and maintenance staff, and of a combined cigarette and sovereign case by the coloured workmen.

General.—Mr. R. B. Dunwoody, A.M.I.C.E., secretary to the Association of Chambers of Commerce, has been appointed Secretary of the Board of Trade Canals Committee. His address will be 7, Princes Street, Westminster, S.W. 1.

Mr. E. G. Peill, director of the Bromley (Kent) Electric Light & Power Co., Ltd., has been elected an alderman of the Town Council.

A new board of four commissioners has been appointed by the New South Wales Government for the control and management of the railways, as follows:—Mr. J. Fraser, chief commissioner; Mr. E. Milne, deputy-chief commissioner; Mr. J. H. Cann and Mr. H. Fox, commissioners.—*Commonwealth Engineer.*

On Wednesday last week, the Manchester City Council agreed to the proposal to increase the salary of Prof. Miles Walker, Professor of Electrical Engineering at the Manchester School of Technology, to £1,200 per annum by three equal instalments of £200 on April 1st, 1917, 1918, and 1919. Sir Thomas Shann spoke of the ability of Prof. Miles Walker, and said he had been offered £1,800 a year to take control of an electrical engineering concern working entirely in the national interests.

Sir Home Gordon, the Controller of the Staff of the National Service Department, is a director of the Electric Supply Corporation, Ltd. Major G. C. Hamilton, M.P., who is Director of Enrolment to the Department, was a joint managing director of Messrs. Drake & Gorham, Ltd., until he took up military duties in 1915.

Mr. H. W. Albrow announces that his position as manager with the Electrical Co., Ltd., has come to an end owing to the winding up of the business by order of the Board of Trade. An advertisement regarding his movements appears on another page.

On February 10th, a banquet was held in the States to celebrate Mr. T. A. Edison's 70th birthway. The American *Electrical Review* quotes the following message sent by President Wilson:—

> I wish with all my heart that I might be present to take part in celebrating Mr. Edison's 70th birthday. It would be a real pleasure to be able to say in public with what deep and genuine admiration I have followed his remarkable career of achievement. I was an undergraduate at the university when his first inventions captured the imagination of the world, and ever since then I have retained the sense of magic which what he did then created in my mind. He seems always to have been in the special confidence of Nature herself. His career already has made an indelible impression on the history of applied science, and I hope that he has many years yet before him in which to make his record still more remarkable.

Roll of Honour.—Sergeant Green, who was on the staff of the Isle of Thanet Electric Traction & Lighting Co., Ltd., has fallen in action at Kut.

Lieutenant-Colonel A. B. Layton, A.M.I.E.E., of the South Lancashire Regiment, for 14 years electrical engineer to Messrs. Joseph Crosfield & Sons, Ltd., of Warrington, has been mentioned in dispatches.

Private John Giblin, K.O. Royal Lancaster Regiment, killed in action, was employed by the British Westinghouse Co., at Trafford Park.

Acting Staff-Sergeant J. W. Clayton, formerly a motorman on the Burnley Corporation tramways, has been awarded the Meritorious Service Medal.

The many friends of Mr. Percy Rosling (W. T. Henley's Co.) will desire to join with us in expressing sympathy with him in the loss of his elder son—Alan Percy Rosling, Second Lieutenant, Worcestershire Regiment—who was killed in action on March 4th.

Charles Henry Harper, R.E., who has died at the Front at the age of 41, served his apprenticeship with the Telephone Co. in Dundee. He afterwards went to Manchester, and subsequently to Madras, where he held an appointment for seven years with the Oriental Electric Co. Returning to this country, he entered the telephone service in Glasgow, where he was employed up to the outbreak of war.

Intimation has been received of the death from wounds, on March 6th, of Captain Norman C. Lowson, M.C., R.E., the only son of Mr. James Lowson, senior partner of the firm of Messrs. W. C. Martin & Co., electrical engineers, Glasgow. Captain Lowson was a member of the O.T.C. at Glasgow Academy, and afterwards at the University, where he graduated B.Sc. in engineering. While studying, he served for short periods with the Glasgow T.C. electricity department, with Messrs. Drysdale & Co., Yoker, and the Albion Motor Car Co. He was subsequently a year with the British Electric Plant Co., Alloa, leaving that firm before the outbreak of war for training with the Special Reserve of Officers, and at the outbreak of hostilities he was in command of the 7th Divisional Signalling Company, Chatham. Captain Lowson was mentioned in dispatches for services at Neuve Chapelle and at Loos, and was awarded the Military Cross.

The *Times* records the death in Leeds, on March 6th, of Colonel F. W. Tannett-Walker, R.E., who had been for 12 months in command of a battalion of Royal Engineers in France. He was a member of the Institution of Civil Engineers, and for many years a director of Tannett Walker and Co., engineers, Leeds.

Obituary.—Mr. E. Kay.—The death is announced of Mr. Edward Kay, electrical engineer, of Bury (Lancs.), aged 52 years.

Mr. S. Charlesworth.—The sudden death has occurred of Mr. Sheard Charlesworth, electrical engineer, of Oldham. Mr. Charlesworth, who was in his 57th year, was until 1894 partner in the firm of Messrs. Charlesworth, Hall & Co., electrical engineers, and on the partnership being dissolved he went into business for himself in Clegg Street.

Mr. H. L. Elward.—The death has occurred of Mr. Henry L. Elward, A.M.I.E.E., one of the oldest members in Ireland of the Institution of Electrical Engineers, who had been for a quarter of a century connected with the Dublin Corporation electrical department, and was previously associated with electrical schemes in London, Eastbourne, and Madrid.

Mr. A. E. White.—The death has occurred, at the age of 61 years, and after a long illness, of Mr. A. E. White, M.Inst.C.E., who was for 28 years city engineer at Hull. He was responsible for the special character of the tramway track construction, which saved the city a great deal of money.

Mr. D. Huntley. We regret to learn of the death, which occurred on 6th inst. from pneumonia, of Mr. David Huntley, A.M.I.E.E., who was for many years chief engineer and works manager of the Dowsing Radiant Heat Co., Ltd. Mr. Huntley commenced his electrical career at the age of 17 as a pupil of Mr. H. J. Dowsing, M.I.E.E., in his private practice, and remained with him when the business developed into the Dowsing Radiant Heat Co., Ltd. He represented the firm in the Electrical Section of the B.E.A.M.A., of which he was chairman. He was a man of great energy and ability, and his experience and knowledge of electric heating was very considerable. During the war he had been carrying out special Government work in connection with electric heating appliances and in other important directions, and his loss will be greatly felt. Mr. Huntley was buried in the Ruislip Parish Churchyard on Saturday last, and was followed by Mr. H. J. Dowsing and Mr. A. C. Newstead, two directors of the company, and a number of his fellow employés. Mr. Huntley was a Freemason, and his Lodge was represented at the funeral.

NEW COMPANIES REGISTERED.

Little Wonder Battery Co., Ltd. (146,385).—Private company. This company was registered on March 9th, with a capital of £7,500 in £1 shares (3,100 10 per cent. cum. pref.), to take over the business of manufacturers of electric dry cell batteries carried on by Albert A. Bil. and Co., Ltd., at 8/9, Regnart Buildings, Euston Street, London. The subscribers (each with one pref. share) are: A. Richmond, 4, Budge Row, E.C., manufacturer; J. Price, 71, St. George's Road, Leyton, N.E., secretary. The first directors are to be appointed by the subscribers. Registered office: 4, Budge Row, E.C.

Victoria Chemical Co., Ltd. (146,393).—Private company. This company was registered on March 9th, with a capital of £11,500 in 10,000 ord. shares of £1 each, and 30,000 def. shares of 2s. each, to take over from T. Hadham, F. H. Rogers, and F. B. Dehn the option of purchasing from J. A. Kendall his patent, No. 26,866/12, for the treatment of chlorides of the alkali metals for obtaining useful products therefrom, and the option of purchasing a patent which J. A. Kendall holds jointly with the exors. of the late Sir Joseph Swan for improvements in the manufacture of metallic sodium. The subscribers (each with one ord. share) are: Captain A. G. Elliot, R.F.A., 15, Victoria Square, S.W.; and F. B. Dehn, Broad Sanctuary Chambers, S.W., consulting chemist. The first directors are T. Needham, F. H. Rogers, F. B. Dehn, and A. G. Elliot. Solicitors: J. H. Mote & Son, 11, Gray's Inn Square, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Rubber Bronze & Metal Co., Ltd.—Re-issue on February 22nd of £4,400 debentures, part of a series of which particulars have already been filed.

Stephens, Smith & Co., Ltd.—Particulars of £1,200 debentures created February 12th, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees. Memoranda of satisfaction in full on February 12th, 1917, as of first mortgage debentures dated April 1st, 1903, securing £600, and also of second mortgage debentures dated December 3rd, 1903, securing £600, have been filed.

County of Dorset Electric Supply Co., Ltd.—Particulars of £2,500 second debentures created November 27th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £2,000. Property charged: The company's undertaking and property, present and future, including uncalled capital, if any, subject to first debentures for £16,000. No trustees.

Brecknell, Munro & Rogers, Ltd.—Mortgage on lands, factories, &c., at Bristol, dated March 1st, 1917, to secure [illegible] to become due from company to Lloyd's Bank.

Allen, West & Co., Ltd. (108,870).—Capital, £30,000 in £1 shares. Return dated January 11th, 1917. 25,235 shares taken up; £25,235 paid. Mortgages and charges, £20,000.

CITY NOTES.

Underground Electric Railways Co. of London, Ltd.

Lord George Hamilton presided at the annual meeting. He said that the total receipts of the five companies increased by £557,385, or over 10 per cent. The revenue liabilities, including interest, depreciation, and reserves, increased by £501,783, slightly under 10 per cent. There had been an accelerated rate of increase in working expenses, and there was every indication that these would become still greater in the current year. The maintenance of the various properties, while sufficient for safe and regular operation, had not been up to the usual high standard owing to scarcity of material and labour. The companies had, therefore, increased their reserves rather than their dividends. The total income of this company showed a decrease of £27,380 for the year. Under the present conditions no considerable schemes of development and improvement could be carried out. Arrangements had now been completed for the through running of the London Electric Railway trains over the L. & N.-W. line to Watford, and the service would be commenced on April 2nd. The greatest obstacle to the increased prosperity of the operating companies was the increased cost of everything that they required. Coal had increased in price to more than double the pre-war figure, and it was still rising. Lot's Road power station used more than 200,000 tons a year, and the increased cost already amounted to £1 per ton. The District Railway recovered its extra costs under the arrangement with the Government, but the other railways were uncontrolled, and must find them from their own resources. The petrol situation was not only somewhat precarious as to the supply, but the price had been considerably increased since January 1st. The Government Order regarding advertising posters would cause a loss of a considerable part of their revenue from that source, which was not far from £100,000. The increased costs would probably compel them to consider a readjustment in rates of fares. In common with all great transport enterprises, they were beginning to feel the pinch of the war, but the foundations of the business and its profits were sound, and the satisfactory way in which they had stood the strain of the past two years gave confidence for the future.

Notting Hill Electric Lighting Co., Ltd.

Sir Wm. Crookes presided, on March 6th, at the annual meeting. He said that the receipts increased by £868, but this increase was more than nullified by the heavy advance in cost of coal and materials. The net result was a profit of £23,306, against £25,270 for 1915. A further £3,000 had been put to depreciation, &c.; it had not been necessary to trench upon that fund during the year. The total amount of the sinking funds for the redemption of the Wood Lane joint debenture stock is now £79,563. The efficiency in electrical distribution shows an improvement of 2 per cent. Units sold increased from 2,436,498 to 2,438,393. The number of new consumers and of additional lamps connected was the lowest in the company's history, and it was impossible to look forward to any improvement until the close of the war. The Government had recently issued a regulation that no new meters must be purchased except for consumers who required current for Government work and for renewals. The reduction in the dividend on the ordinary shares from 5s. to 3s. was entirely due to the war, but it was only temporary. If the price of coal, &c., were kept within reasonable limits they might be able to show a better result this year. The increase of 10 per cent. in the charge to consumers was only in force three months, but they hoped that the Kensington Borough Council would consent to the increase continuing until after the war. At one time during the year their coal stock fell so low that they were within a few days of having to shut down, but on strong representation in the proper quarter they managed to get a further supply. At present they had a stock sufficient for some weeks. Though the reduced profit reduced also the bonus due under the co-partnership scheme to considerably less than in former years, the employés were receiving a bonus on the scale of the previous distribution, as they had worked so loyally and well. The chairman hoped that the blessing of Peace would be restored before the next annual meeting. He anticipated then the demand would be so great that they would soon return to their usual rate of dividend, and probably exceed it.

City of London Electric Lighting Co., Ltd.

The net capital expenditure at December, 1916, was £2,032,020, an increase of £2,188. The profit has again been prejudiced by the enforced reduction of lighting, by the further increased cost of coal, and all other items of production, and by the effects of the Summer Time Act. The total revenue was £332,936; expenses of generation and distribution £103,322; repairs and maintenance £9,747; street lighting expenses £5,217; rent, rates, taxes, management expenses, &c., £82,824. Including £18,024 brought forward, £151,849 is the available revenue. After deducting loan charges, debenture stock charges, employés' provident fund, and putting £40,000 to the reserve, £79,501 remains for dividend. The preference dividend is paid, and 8 per cent. per annum on the ordinary shares (as in the previous year). £17,132 is to be carried forward. The gross revenue increased by £21,117, and the net revenue by £16,980. The average price obtained per unit rose from 2.27d. to 2.51d. The number of customers fell by 104 to 14,616, but the connections increased by 1,170 kw. to 47,331 kw. The reduction in customers is due to war conditions, which have caused the suspension of many businesses, notably among stockbrokers and foreign banks and firms. The units generated were 33,758,872; sold 28,982,456 (a decrease of 496,623); metered and used by the company 1,966,187; expended in distribution, &c., 2,810,229. The maximum supply demanded increased from 17,424 kw. to 19,198 kw. Power and heating units continued to show a steady increase; power took 12,321,795 units, and heating 3,165,613 units = 15,487,408, equal to 54.9 per cent. of the total units sold for private supply. The Marquess of Winchester, a director, is still serving with the Army in France. Leave has been granted to Mr. A. F. Harrison, the secretary, to take up a Commission in the Royal Defence Corps. Nine members of the staff have been killed, 19 wounded or invalided, and one is a prisoner of war. The company applied for £37,400 War Loan, making the total £50,000.

Newcastle-upon-Tyne Electric Supply Co., Ltd.

During 1916 the connections increased by 24,360 h.p. to 282,750 h.p. The profit was £224,266 (against £204,419 last year), plus £5,191 brought forward, less £60,568 interest on debentures, &c. The preference dividend, 5 per cent., absorbs £45,617, 7 per cent. on the ordinary shares requires £55,837 (last year 6 per cent. was paid), there is put to depreciation reserve £30,000, against £25,000, and to general reserve £30,000, against £28,000, £7,435 being carried forward. Out of the £28,000 put to reserve last year, the balance of the cost in connection with the issue of first and second mortgage debenture stocks, amounting to £13,798, has been written off, and £12,593 transferred as a provision for possible loss on realisation of investments. Plant, mains, &c., have been efficiently maintained, £98,199 having been spent thereon out of revenue. Extensions in progress at Carville and Dunston power stations and to the general distribution system during the year cost £63,882. It is proposed to make an offer to acquire, by an exchange of shares, the shares and funded preference income stock of the Cleveland and Durham Electric Power, Ltd. The scheme is to be submitted at the annual meeting on March 23rd. If the proposed exchange of shares is carried through it will involve an increase of this company's capital.

County of London Electric Supply Co., Ltd.

Mr. J. B. Braithwaite, presiding at the annual meeting on Monday, said that the receipts from sale of current had increased by nearly £44,000, and although the cost of coal had gone up by 90 per cent. their coal costs during the year only increased by 65 per cent. as compared with 1914. Whereas in 1914 the freight from the Tyne to London was 3s. per ton, at present it was 18s. Coal had risen from £62,398 to £87,475. The total expenses advanced from £150,398 to £186,171. The net result was that £156,894 was carried to net revenue account against £159,639 last year. For the first time they had been able to debit the whole of the repairs against revenue, instead of against reserve for depreciation. They were increasing the appropriation to depreciation from £40,000 to £45,000, and intended ultimately to raise this to £50,000, which was the figure he had always considered the one to reach before paying an increased dividend. During the war the riverside stations, which in the ordinary course of things were far more economical than stations dependent upon railway supplies, were now more expensive owing to the heavy rise in freights. At the present time rail-borne coal was cheaper than sea-borne coal. Fortunately, however, the company were able to use both, and by means of the interconnection between City Road and Wandsworth they were able to utilise their coal supplies at either end, whichever was the more economical at any given time. After the war freights would no doubt come down with a run, and stations with water facilities would again prove their greater advantage. Having regard to all their difficulties, restricted lighting, the Summer Time Act, &c., the result shown was an exceedingly gratifying one. They could hardly have had a more difficult year than 1916 proved to be, but so far their officers had managed to bring them through successfully. The arrangement entered into for giving a bulk supply to various tramways and lighting undertakings south of the Thames, at Sutton and elsewhere, had been working very satisfactorily during the past year, over one and a half million units having been sold for this purpose, and they had now come to a similar agreement with the South London Electric Supply Co., in which they themselves were very large shareholders. They hoped that that further interconnection would be made by the end of the present year, and were expecting to sell to that company a large amount of current. As opportunity offered they were steadily pursuing the policy of linking-up and concentrating electric supply in a smaller number of big stations rather than in a large number of small stations. With regard to their scheduled site at Barking for a large power house, that was now carefully protected and secured beyond any question, so that whenever the time came to develop there the site was waiting. They had subscribed £50,000 to the 5 per cent. War Loan. As to the current year, he preferred not to prophesy. He was afraid they must anticipate the war continuing throughout this year, and this would probably mean that the high price of coal would continue, with probably increased difficulties in that respect and also restrictions in various other directions. The Summer Time Act would come into force earlier this year than it did in 1916. The second advance of 10 per cent., however, in the price of current which came into effect on April 1st, 1916, would help their receipts in the first quarter of the present year; he did not want to predict what the final result would be for the year. He thought the company should be able to maintain the dividend, with the possibility of an increased appropriation to reserve this year.

British Engine Boiler and Electrical Insurance Co., Ltd.

At the annual meeting, held at Manchester, Mr. R. Charles Longridge (chairman) announced that the results of operations during 1916 were most satisfactory, having regard to business conditions. There had been a marked growth in the number of firms insuring their plant against breakdown, with the result that the premium income had increased from £117,112 to £125,851—their largest advance in any single year, with one exception. They had felt the effects of a noticeable increase in the cost of repairs, and in the cost of travelling expenses. The profit earned showed only a small reduction from the previous year. There had been some further depreciation of the company's investments, which the directors had decided to meet by writing off the sum of £7,553 out of profits, and after making provision for this and for a final dividend, the total funds of the company stood at the increased figure of £179,777. Their chief engineer, Mr. Michael Longridge, had been elected President of the Institution of Mechanical Engineers.

Cleveland & Durham Electric Power Co., Ltd.—The capital expenditure during the year was £4,819. Gross profits were £37,130, as compared with £31,157 in 1915. The profits shown are largely due to the fact that the majority of consumers have agreed to pay a temporary advance in price and to new contracts at higher prices. To meet increased demands, the whole of the available generating plant has been run continuously. Less the amount required for debenture interest, there remains a net profit of £16,925, plus £8,575 brought forward. A dividend of 2 per cent. on preference shares absorbs £6,674; there is transferred to depreciation and renewals account £8,000; and there is applied in reduction of expenses of issue of debentures £1,000, carrying forward £9,825. The connections to the system at the end of the year aggregated 81,469 H.P., as compared with 75,840 at the end of 1915, and a further 11,000 H.P. has been arranged for. Regarding the suggested exchange of shares with the Newcastle Supply Co., the directors have prepared a scheme. They are satisfied that the development of the area cannot otherwise be adequately proceeded with.

South London Electric Supply Corporation, Ltd.—The gross receipts during 1916 were £59,037, and the expenses were £30,649, leaving £28,388, plus £3,010 brought forward. There is placed to depreciation £7,000, and after paying debenture interest and 6 per cent. preference dividend, the balance is £16,053, out of which 5 per cent. is paid on the ordinary shares, and £3,053 is carried forward. New connections were 26,481 lamps (927 KW.), making the total 392,999 lamps (equivalent) (13,754 KW.). The units sold were 6,698,357, an increase of 380,217. Units generated 8,372,740; used on works 378,490; expended in distribution 1,295,893. Annual meeting: March 20th.

Bristol Tramways & Carriage Co., Ltd.—The gross receipts for 1916 were £555,907; working and general expenses and renewals, £450,447; including balance brought forward, net revenue £110,516. After paying the debenture charges, preference interest, 6 per cent. (less income-tax) on the ordinary shares, and putting £30,000 to reserve fund for contingencies and renewals, £9,636 is to be carried forward. The receipts of the tramway department increased by £6,241, or 2½ per cent., and those of the carriage department by £35,552, or nearly 14 per cent. Passengers carried on cars and omnibuses were 60,628,342, an increase of 355,942.

Northampton Electric Light & Power Co., Ltd.—The annual meeting was held on Friday, Ald. F. H. Thornton, J.P., presiding. The chairman said that good progress was being made with the new works at Hardingstone. The site was being raised 4½ ft. to avoid the danger of flooding. In connection with that work £36,000 of the £50,000 asked for was subscribed, so that, with a few debentures which would be available, practically the whole of the money was obtained.

Rushden & District Electric Supply Co., Ltd.—The annual meeting was held on Friday. Ald. F. H. Thornton, J.P., said that a new engine had been installed during the year, but almost the whole of the current supplied had been taken up, and the company had been doing work of enormous national importance. The increased cost of coal and oil had compelled them to raise their charges, but that was inevitable, and like action had been taken by other companies.

Companies Struck Off the Register.—The following companies have been struck off the register, and are dissolved:

Electric Stores, Ltd.
Hammersmith Welding, Engineering & Electrical Co., Ltd.
New Electric Rifle & Target Co., Ltd.
Panama Electric Lighting, Power & Traction Co., Ltd.
Telephone Instalment System Co., Ltd.

Stewarts & Lloyds, Ltd.—After setting aside £100,000 for depreciation and paying 6 per cent. on the preference and 10 per cent. on preferred ordinary shares, a dividend is recommended of 2s. on deferred shares, together with a bonus of 6d. per share. £60,000 is placed to general reserve, £20,000 to employés' benefit reserve, and £110,000 is carried forward. —*Financial Times.*

British Westinghouse Electric & Manufacturing Co., Ltd.—The directors recommend a dividend of 7½ per cent. on the preference shares.

Bournemouth & Poole Electricity Supply Co., Ltd.—The balance from revenue account for 1916, after deducting generating and other costs, rates, taxes, fees, &c., is £35,215, plus £3,607 brought forward. Debenture and loan interest absorbed £8,782, leasehold and special redemption fund and interest £2,047, reserve for depreciation, &c., £8,000, leaving £19,993. After paying the preference dividend and 6 per cent. on the ordinary shares, £2,263 remains to be carried forward. Total applications increased by 910 KW. to 11,459 KW. Units sold for all purposes 4,082,836; used on works 779,990; not accounted for 826,331; units generated 5,689,157.

Brompton & Kensington Electricity Supply Co., Ltd.—The accounts for 1916, subject to audit, and after appropriating £7,150 to depreciation and reserve, admit of a final dividend at the rate of 7 per cent. on the preferred shares and a final distribution at the rate of 10 per cent. on the ordinary shares, making 9 per cent. for the year, less tax, carrying forward £5,075.

Scarborough Electric Supply Co., Ltd.—The lamp connections at December last totalled 132,542 (30-watt), an increase of 765. Units supplied, 618,019. Profit, £715. After paying bank interest and placing £500 to depreciation account, the credit balance is £1,602, which is to be carried forward.

Hadfields, Ltd.—In addition to the interim dividend of 1s. per share, a further dividend of 4s. per ordinary share is announced, making the rate the same as last year, together with a bonus of 1s. per share, all free of tax.

W. T. Henley's Telegraph Works Co., Ltd.—Subject to audit, the directors recommend a final dividend on the ordinary shares of 10 per cent., less income-tax, making 13 per cent. for the year, and also a bonus of 10s. per share, less income-tax, the same as a year ago.

Direct Spanish Telegraph Co., Ltd.—Dividends at the rate of 10 per cent. per annum on the preference shares, less income-tax, and at the rate of 6 per cent. per annum, free of income-tax, on the ordinary shares (making 5 per cent. for the year 1916), both for the half-year ended December 31st last. In addition, a bonus on the ordinary shares of 2 per cent. for the year 1916, free of tax.

Western Telegraph Co., Ltd.—Second quarterly interim dividend of 3s. per share, free of income-tax, for the year ending June 30th, 1917, at the rate of 6 per cent. per annum.

STOCKS AND SHARES.

Tuesday Evening.

There is a good deal of strength about the markets round the House. The capture of Bagdad was hailed with a feeling of relief, though this was tempered to some extent by the slight anxiety felt in regard to affairs in Russia, the food problem, for instance, being noted with some nervousness. The news from the Western Front is considered distinctly satisfactory; and, on this account, capital is finding its way readily into gilt-edged markets and those also which offer high rates of interest attached to speculative conditions, such as surround the rubber industry.

It is pleasant to be able to record a spurt in the market for Home Railway stocks, although so far the improvement is mostly confined to what is called the heavy brigade. Pre-eminent amongst these, North-Western stands out as most in favour, it being held that the electrification prospects add to the other attractions of the stock. In regard to the purely Underground group, the meeting of the Underground Electric Railways, held last week, produced dulness for the time being.

Lord George Hamilton's reference to the possibility of fares being raised, while it evoked applause from the stockholders, aroused some comment in the market as to whether such a step might not lead to curtailment of travelling, though it was pointed out, in answer to this objection, that, as the Tubes and 'bus companies are nearly all under one control, the vast body of travellers would have no option but to pay what the companies liked to charge in order that they might get backwards and forwards to and from their work. Underground income bonds fell back to 80½, but Districts gained 10s.; the market in Metropolitan Consolidated stock is stagnant.

Electricity supply shares keep very firm upon the publication of the dividends. Metropolitans are ⅛ up. The City of London report is one of the most interesting this week. Gross revenue rose to £333,000, an increase of £22,000, for the corresponding period, but net profits dropped to £105,000, some £23,000 less than those of 1915. As already noticed, the dividend is retained at 8 per cent. The carry-forward of £17,000 is slightly reduced from that of a year ago. The Bournemouth & Poole Co. has declared a final dividend at the rate of 7 per cent., making 6 per cent. for the year, the same as that for the previous twelvemonth.

Marconis are again conspicuous, with a rise to 2⅞, the usual reason for the buying being advanced, namely, the expectation of what the company will receive from the Government by way of compensation for its services since the outbreak of war. Nothing has been paid, of course, up to the present. With the rise in the parent shares Americans sympathised by improving to 16s. 3d. Canadians firmed up to 8s. 9d. It is humorously hoped by some that the Government will defer making any award until after the conclusion of Peace, since it is the uncertainty which stimulates activity in the market, and gives the speculator something to "go for." There are no other changes to report in the telegraph market.

Brazil Tractions have risen to 47, Brazilian issues of all kinds being decidedly firmer. The apprehension aroused by the action of our Government in forbidding exports of foreign grown coffee has to a large extent subsided, and buyers are on the look out for what they regard as cheap stock. Argentine Tramways continue dull, although for other Argentine issues there is more inquiry. The Mexican group is fairly steady, and a rise of a point occurred in Mexico Tramways 5 per cent. bonds, though it must be confessed that what little news has come through from Mexico is not particularly cheering.

The feature of the manufacturing group is a rise of 4½ in Edison Swan 4 per cent. debenture stock. The Fives advanced to the same figure, showing a gain in their case of 3 points. The partly-paid shares are better at 11s. 3d., and it is expected with some confidence that the new scheme will enable the company to advance within sight of dividends on the shares. General Electrics are 10s. up. The prices in this department are firm, with few shares on offer. In fact, industrials as a whole show a good deal of strength. The rubber market is still the centre of attraction for those whose fancy attracts them to speculative investments. Considerable activity prevails throughout the list, and the steady way in which the price of the raw material hugs 3s. 3d. per lb. is conducive to confidence on the part of the buyers. Iron, armament, and steel shares have begun to revive. So far as the markets for base-metal shares are concerned, there is little that is new to report.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1914.	Dividend 1915.	Price Mar. 13, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary	5	5	8¾	—	7 8 2
do. do. do. 4½ Pref.	4½	4½	8 9/16	—	7 1 2
Chelsea	5	4	3	—	6 18 4
City of London	9	8	11	—	7 5 5
do. do. 6 per cent. Pref.	6	6	9⅞	—	6 1 6
County of London	7	7	10¼	—	6 16 7
do. 6 per cent. Pref.	6	6	9⅝	—	6 6 4
Kensington Ordinary	9	7	5⅜	—	5 11 7
London Electric	4	8	1	—	Nil
do. do. 6 per cent. Pref.	6	6	8¾	—	5 6 8
Metropolitan	8½	8	2⅝	+ ⅛	6 6 4
do. 4½ per cent. Pref.	4½	4½	8⅛	—	7 4 0
St. James' and Pall Mall	10	8	6¼	—	6 8 0
South London	5	5	2⅛	—	6 19 0
South Metropolitan Pref.	7	7	1 3/32	—	6 7 8
Westminster Ordinary	9	7	5¾	—	6 1 9

Telegraphs and Telephones.

	Dividend 1914.	Dividend 1915.	Price Mar. 13, 1917.	Rise or fall this week.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	94	—	6 7 8
do. Def.	80/-	83/6	22	—	6 16
Chile Telephone	8	8	6 15/16	—	5 15 3
Cuba Sub. Ord.	6	6	8¼	—	6 8 6
Eastern Extension	7	8	13¾	—	*5 16 4
Eastern Tel. Ord.	7	8	137	—	*5 16 10
Globe Tel. and T. Ord.	6	7	11⅛	—	*5 19 2
do. Pref.	6	6	9¾	—	6 3 1
Great Northern Tel.	22	22	34¼	—	6 7 5
Indo-European	13	13	46½	—	6 19 9
Marconi	10	10	2⅞	+ 1/16	8 9 2
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord.	10	10	2⅛	—	4 14 1
United R. Plate Tel.	8	8	6⅜	—	*6 5 6
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13¾	—	*5 16 4

Home Rails.

	Dividend 1914.	Dividend 1915.	Price Mar. 13, 1917.	Rise or fall this week.	Yield p.c.
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1½	1	23	—	4 7 0
do. District	Nil	Nil	16⅛	+½	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A"	Nil	Nil	5/6	—	Nil
do. do. Income	6	6	80½	—1½	*6 9 1

Foreign Trams, &c.

	Dividend 1914.	Dividend 1915.	Price Mar. 13, 1917.	Rise or fall this week.	Yield p.c.
Adelaide Sup. 6 per cent. Pref.	6	6	4 13/16	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	2⅞	—	9 11 4
do. 2nd Pref.	5½	5½	2⅜	—	—
do. 5 Deb.	5	5	64½	—	7 15 0
Brazil Tractions	4	4	47	+ ½	8 10 2
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	60	—	8 6 8
do. do. Preferred	—	Nil	43	—	Nil
do. do. Deferred	—	Nil	37½	—	Nil
do. do. Deb.	4½	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	26	+1	Nil
do. 6 per cent. Bonds	—	Nil	22½	—	Nil
Mexican Light Common	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	14½	—	Nil
do. 1st Bonds	Nil	Nil	27½	—	—

Manufacturing Companies.

	Dividend 1914.	Dividend 1915.	Price Mar. 13, 1917.	Rise or fall this week.	Yield p.c.
Babcock & Wilcox	14	15	2¾	—	6 9 1
British Aluminium Ord.	5	7	27/6	—	5 8 0
British Insulated Ord.	15	17½	12¾	—	6 17 3
British Westinghouse Pref.	7½	7½	2 1/16	—	6 9 10
Callenders	15	20	12¼	—	8 4 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	8⅜	—	6 10 8
Edison & Swan, £3 paid	Nil	—	7/16	+ 1/16	Nil
do. do. fully paid	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	66	+4½	6 1 3
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9½	—	6 6 4
do. Ord.	10	10	14½	+ ½	6 18 0
Henley	20	25	15	—	8 6 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11¾	—	*8 10 2
Telegraph Con.	20	20	87	—	*6 15 2

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, March 14th.

CHEMICALS, &c.			Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Oxalic	per lb.	1/6	..
a	Ammoniac Sal	per ton	£75	..
a	Ammonia, Muriate (large crystal)	,,	£54	..
a	Bisulphide of Carbon	,,	£23	
a	Borax	,,	£38	£4 inc.
a	Copper Sulphate	,,	£63	..
a	Potash, Chlorate	per lb.	2/6	..
a	,, Perchlorate	,,	2/-	
a	Shellac	per cwt.	187/-	15/- inc.
a	Sulphate of Magnesia	per ton	£16	..
a	Sulphur, Sublimed Flowers	,,	£32	£3 inc.
a	,, Lump	,,	£23	..
a	Soda, Chlorate	per lb.	1/-	..
a	,, Crystals	per ton	120/-	..
a	Sodium Bichromate, casks	per lb.	..	..
METALS, &c.				
c	Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c	,, Tubes (solid drawn)	,,	..	..
c	,, Wire, basis	,,	..	..
c	Copper Tubes (solid drawn)	,,	1/8¾ to 1/9¼	..
g	,, Bars (best selected)	per ton	£174	..
g	,, Sheet	,,	£174	..
g	,, Rod	,,	£174	..
d	,, (Electrolytic) Bars	,,	£151	..
d	,, ,, Sheets	,,	£176	..
d	,, ,, Wire Rods	,,	£159	..
d	,, ,, H.C. Wire	per lb.	1/7	..
f	Ebonite Rod	,,	3/-	..
f	,, Sheet	,,	2/6	..
n	German Silver Wire	,,	2/3	..
h	Gutta-percha, fine	,,	6/10	..
h	India-rubber, Para fine	,,	3/2	1½d. dec.
i	Iron Pig (Cleveland warrants)	per ton	Nom.	..
l	,, Wire, galv. No. 8, P.O. qual.	,,	£38	..
g	Lead, English Pig	,,	..	..
g	Mercury	per bot.	Nom.	..
e	Mica (in original cases) small	per lb.	6d. to 3/-	..
e	,, ,, ,, medium	,,	3/6 to 6/-	..
e	,, ,, ,, large	,,	7/5 to 14/- & up.	..
d	Silicium Bronze Wire	per lb.	1/10	..
r	Steel, Magnet, in bars	per ton	..	..
g	Tin, Block (English)	,,	..	..
n	,, Wire, Nos. 1 to 16	per lb.	8/-	..

Quotations supplied by—

a	G. Boor & Co.	g	James & Shakespeare.
c	Thos. Bolton & Sons, Ltd.	h	Edward Till & Co.
d	Frederick Smith & Co.	i	Bolling & Lowe.
e	F. Wiggins & Sons.	l	Richard Johnson & Nephew, Ltd.
f	India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.	n	P. Ormiston & Sons.
		r	W. F. Dennis & Co.

Linking-up Electricity Works.—A meeting of representatives of electricity supply undertakings was held recently at Plymouth, to consider the linking-up of works in Devon and Cornwall. It was decided to go into the matter in detail, and to prepare a suitable scheme. The area was divided up into four districts, respectively adjoining Exeter, Torquay, Plymouth, and Hayle, and the engineers of the electricity works in these localities are to collect information and report progress to Mr. E. S. O'Kell, of Plymouth, who was appointed chairman of the Committee.

At the second meeting of the North-East Coast Committee which has been appointed to investigate the linking-up of power stations, it was decided that load diagrams should be exchanged between the Sunderland and South Shields electrical undertakings and the Newcastle Electric Supply Co., with a view to finding out whether it would be to the mutual advantage of the parties to link up in order to give and take a supply of current. Apart from the cost, it would not be a difficult matter to link up Sunderland and South Shields undertakings, because in each case the periodicity of the alternating-current supply is the same; consequently, all that is required is a connecting cable, or cables, between the two power stations (about 7 miles apart), and the necessary transformers, the voltages being 5,500 and 2,200 volts respectively.

With regard to South Shields linking-up with the Newcastle Electric Supply Co., the conditions are more complicated, in that the frequencies of the two supplies are different—one being 50 cycles and the other 40 cycles per second—so that it would be necessary to install frequency changers.

Conferences of West London authorities are taking place with the idea of establishing on a co-operative basis a bulk supply power station on the banks of the Thames to deal with the whole of the non-peak supplies for the western area of Greater London.

The British Empire Producers' Organisation.—This organisation held another luncheon meeting at the Savoy Hotel, on Wednesday. Viscount Milner presided, and he was supported by Sir Edward Morris, Prime Minister of Newfoundland.

Chemical Manufacturers' Association.—The first general meeting of the Association of British Chemical Manufacturers was held last week. Dr. Charles Carpenter, who presided, said their object was to do for their industry what had been done for engineering in this country and for applied chemistry in Germany.

FIGHTING HAIL AND STORM BY "ELECTRIC NIAGARAS."

(*Concluded from page* 275.)

Installation and Maintenance of "Niagaras."—The electric niagara is simply a large-capacity lightning conductor. Its action in discharging storm clouds is generally in the form of invisible brush-discharge (or aigrettes). During very violent storms (or incipient violent storms) the brush discharge may be visible. This is unimportant if the discharge is *usually* invisible, especially if there be a second line of niagaras in the barrage to complete the protection. On the other hand, if the discharge is regularly visible, the niagara is probably of insufficient capacity, but, before altering it, the resistance of the conductor system itself, and of the earth connection and of the surrounding soil should be measured. The conductor system should be of high conductivity, with ample surface rather than large cross-section, and the path to earth should be as free as possible from bends.

If lightning strikes the niagara, this is a still more definite indication that its capacity is inadequate,* whilst the most serious sign of all is a lightning flash *in the neighbourhood* of a niagara, for this indicates a very defective earth connection, and, so far from the niagara being of any value in such a state, it is rather a source of danger, and may disturb telegraphic operation in the vicinity.

The precise construction and arrangement of niagaras varies with the altitude, the frequency, and nature of storms hitherto noted in the neighbourhood, the presence of high buildings, trees, &c. In all cases, however, high conductivity, large surface of conductor, minimum self-induction, and low-resistance earth connection are essential. The closer together the posts, the more certain the protection afforded, and they should always be on the highest ground, so that storm clouds may not pass over them "untapped." The area protected by each niagara varies with the potential of the storm clouds, with climatic conditions, and with the height, altitude of erection, and general surroundings of the post. As a rough guide, a niagara 100 to 130 ft. in height should protect an area extending 2½ to 3 miles right and left of the station, an equal distance in the direction of the storm wind, and from 550 to 1,100 yd. against the latter.

Provision has been made in France to ensure that the proposed construction and location of niagaras (whether singly or in barrages) shall be approved by a central committee, in order that the best results possible shall be attained, and in order that a consistent and homogeneous system of protective posts may gradually be developed. In laying out a barrage, the centre O of a certain vineyard or other estate is marked on a map or scale drawing (fig. 1), and the usual direction A O of storm-bearing winds is marked, the necessary information being derived from local experience or from meteorological statistics. Lines B O, C O are then set out representing the limiting directions of storm-bearing winds. Naturally, the line A O does not necessarily bisect the angle B O C, and it may happen that one of the limiting directions is practically opposite to the prevailing direction for the district, owing to storm clouds being sometimes carried along valleys on practically a semi-circular course. The angle B O C represents the sector of storm-winds for the area of which O is the centre. In similar manner, sectors B′ O′ C′ and B″ O″ C″ may be set out for the centres O′, O″ of adjoining areas. The direction U V is the "resultant" of O A, O′ A′, O″ A″ and the line X Y, perpendicular to U V, is a suitable line for a barrage intended to protect the area considered. Posts about 100 ft. to 130 ft. in height (and not less than 30 ft.–35 ft. higher than trees in the neighbourhood) are then set out on or near the barrage line and on high ground, so that they may deal with storm clouds, whatever the direction of the latter and their undulations with regard to those of the ground. Each post of a barrage designed on these principles becomes the focus of a protected area, and the curve enveloping all these areas includes the whole district protected by the barrage. According to circumstances, the barrage is set on a straight or curved line, or on the sides of a rectilinear or other closed figure. The posts may be aligned or staggered.

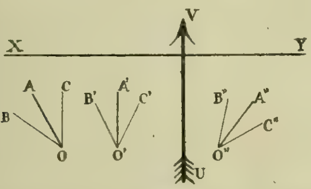


Fig. 1.—Laying Out a Barrage of "Niagaras."

Results Obtained in France.—There are at present five barrages of niagaras in France, that of the Vienne being the oldest, and followed by those of the Dordogne, Beaujolais, Gironde, and the Lower Loire. The Vienne barrage has six posts, and, during the storms which have broken in Poitiers since this barrage was erected, very little hail has fallen in the protected zone, whereas formerly the banks of the Clain and the Boivre were often swept by hail. The St. Julien niagara and the Chauvigny post have proved very satisfactory, and testimony as to the good effects of the Paizy-le-Sec post is to be found in the petition by the municipality that the niagara should be re-erected after it was thrown down by a cyclone in 1911. The St. Savin-sur-Gartempe niagara is on a basilica steeple 330 ft. in height, and the protection it affords is practically complete. The Chitré post, established in 1912, protects a well-defined parabolic area, the axis of which is the direction of the wind, and the focus the post itself.

On the other hand, the Beaujolais barrage has not given satisfactory results; indeed, £400,000 worth of damage was done in 1913, as against £100,000 average for the years 1901-10, when hail cannon were in use, and £280,000 average for the period 1891-1900, when no protective measures were in force. If this unsatisfactory result be compared with the very favourable official report from the Dordogne and Vienne districts (where exactly similar equipment is in use), it is obvious that the trouble lies not in the system, but in local conditions or faulty application of the system thereto. The rocky nature of the country in the Beaujolais district is very unfavourable to effective earth connection, and the heights of the very broken land have little forest growth upon them. Probably the unsatisfactory nature of the earth-contact and the high resistance of the earth in this district are the cause of the unsatisfactory protection yielded by the niagaras. Hailstones the size of a nut have been known to fall on the Regnie niagara, and, during another storm, the Thion post seemed to attract lightning flashes and to divert storm clouds. M. Chatillon has emphasised the importance, when laying out a barrage, of providing not only for the prevailing storms, but also for "return storms" from (or nearly from) the opposite point of the compass. Under the influence of low winds (near the ground) developed and guided by valleys, gorges, &c., storm clouds may be temporarily divided, and subsequently brought into collision with one another to the accompaniment of a deadly hailfall. The Saône Valley, for instance which bounds the Beaujolais district on the east, runs S.E. to N.E. from Lyons to Villefranche, and does much to deflect storms coming from the south-west or west.

In 1911 two niagaras were installed on the Eiffel Tower for experimental purposes. Each of the supports of the top terrace of the Tower carries a band of electrolytic copper terminating in four points in the form of an inverted Y, constituting the "diffusing" system. Four strips of copper run from the diffuser down the whole height of the tower (984 ft.), and are connected to the pipes serving the hydraulic lift and to 33-ft. wells sunk specially for the purpose. Neither hail nor lightning was observed near the Tower in 1912, hence plans were completed for the erection of two more hail-rods in the Paris district, one on the Pantheon, the other on the Montmartre basilica.

Following the completion of maps showing the direction, intensity, and frequency of storms all over France, it is hoped to erect a system of barrages which will protect the whole country. The principal frontier barrage will run from the Spanish frontier to Bidassoa, about half-way along the Pyrenees (to meet a barrage running alone the Gironde), and also along the whole coast line to Cherbourg. This barrage will afford frontier protection against storms from the south-west, and use will be made of lighthouses, semaphores, wireless masts, spires, &c., as supports for the hail rods wherever practicable. It is hoped that all the low-lying (most dangerous) clouds entering France from the south-west will be thus discharged. Inland barrages will, however, be necessary to cover the possibility of clouds being dangerously electrified by one means or another after entering the country. The inland barrages will be across the general direction of prevailing storms, and those contemplated run along the Gironde, the Charente, the lower reaches of the Loire, the Rhone, and upper reaches of the Loire, from Orleans to Evreux, from Avranches to Nantes across Brittany, from Bourges to Poitiers, and on to the coast, round the whole Mediterranean coast from Spain to Italy, and from Belfort to the Belgian frontier. The total cost of all these barrages would be small in comparison with the losses which are now occasioned every year by hail and lightning; moreover, by manufacturing the component parts on a large scale the cost per unit would be reduced materially.

M. Turpain has suggested the use of lofty trees on high ground as supports for niagaras, and, in order to give the conductors the desirable surface, they might be composed of two copper wires carrying between them a strip of thin brass sheet 12 in. to 16 in. in width. It is absolutely essential, in all cases, to obtain an earth connection of negligible resistance, and, if possible, in a direct continuation of the foot of the conductor. Running water makes the best earth connection, but if this be not available, connection may be made to permanently moist subsoil or to an "artificial" earth made by the aid of coke. Wells often act as huge Leyden jars, and isolated layers of moist soil surrounded by rock or other poorly conducting media, are often very unsatisfactory as earth connections. Hail rods built on this principle could be erected every 500 yd. or so, according to the frequency and intensity of storms; more lofty rods of specially large capacity would be desirable at intervals.

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* The St. Julien niagara, which has been very effective, has been known to be struck only once during 17 years, and it very rarely shows visible brush discharge.

It is not only in France, but in many other countries as well, that interest is being taken in electric "niagaras." From the Himalayas to the Andes, and from Russia to the Transvaal the possibilities of barrages are under consideration. In Argentina, for instance, a niagara 180 ft. in height was recently installed in the province of Mendosa at the foot of the Andes, and four other posts are under erection. Ultimately, it is hoped, useful application will be found for the vast quantities of electricity collected by barrages of niagaras, so that the latter may benefit crops by electroculture, by electrically-manufactured manures, and by electrically-driven agricultural machines, as well as by protecting them from the ravages of hail and lightning. For this optimistic view of the future, however, we accept no responsibility.

THE VOLTAGE REGULATION OF ROTARY CONVERTERS.

By G. A. JUHLIN, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

The importance of the rotary converter as a link in power distribution is constantly increasing, as well as the necessity of utilising to the utmost the material at our disposal. In order to obtain the best possible results at minimum expense, it is essential that the exact conditions of operation as regards voltage regulation and power factor should be known, and that the influence of the one upon the other should be clearly understood.

It is of great advantage to keep the range of voltage within the smallest possible limits compatible with the requirements of the service for which the machine is intended, as the difficulties and cost may be increased to a great extent by a few per cent. extra regulation, which may bring the range outside the limit of one system and, therefore, necessitate the adoption of a more costly arrangement.

Reactance Control.—If reactance is introduced in the line or in the transformer supplying a rotary converter, and wattless currents are produced which flow through this reactance, the E.M.F. delivered to the converter slip-rings can be increased or decreased, depending on change in the field strength of the machine. This will be clear when it is considered that a leading current is 90 deg. ahead of the load current, and therefore 90 deg. ahead of the E.M.F. in phase with this current. The E.M.F. of self-induction produced by this wattless current lags 90 deg. behind it, and is, therefore, in phase with the E.M.F. supplied to the converter, thus increasing it.

A lagging current is 90 deg. behind the E.M.F. in phase with the load current, and as the E.M.F. of self-induction lags 90 deg. behind the current producing it, it will lag 180 deg. behind the supplied E.M.F., consequently decreasing it. Thus, if a reactance is introduced, the E.M.F. at the continuous-current terminals can be increased by strengthening the rotary field, and reduced by weakening the field.

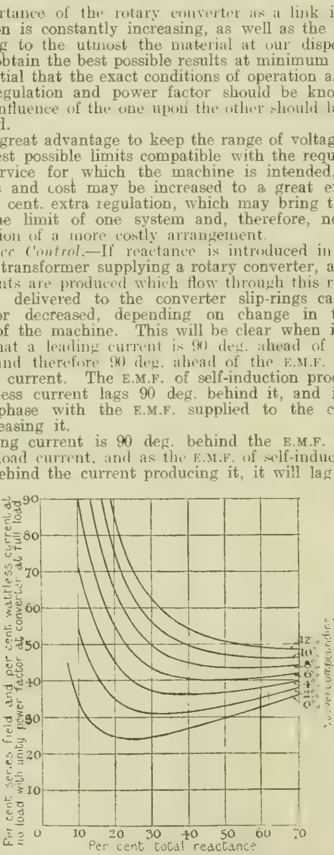

Fig. 1.—Curves showing Relation between Reactance and Wattless Current required in Rotary Converters for Different Amounts of Over-compounding.

Resistance = 3 per cent.

The wattless currents may be produced by variation in the shunt current, in which case the voltage variation is independent of the load, or, if the voltage regulation be desired as a function of the load, the wattless currents may be produced by a series winding.

In order to determine the most satisfactory value of reactance for a given compounding, it is necessary to know the change in wattless current with varying values of reactance. The E.M.F. of the high-tension side of the transformer is assumed to be constant, and as the E.M.F. desired is fixed at no load and full load, an expression for the transformer electromotive force is easily obtained assuming the power factor at the converter to be unity at full load, from which the value of the wattless current is obtained. Fig. 1 shows the approximate relation between wattless current and reactance for different values of compounding. The curves are approximate in so far that the influence of saturation in the converter has not been taken into account. It would obviously not be possible to make allowance for this, owing to the very wide range over which it varies in different designs. The influence of the saturation on the compounding will, however, be discussed later. The curves are based on the assumption that the E.M.F. of self-induction of the transformer varies in direct proportion to the current. A total resistance drop of 3 per cent., including transformer and converter, has been assumed. This value will, of course, vary with the capacity and voltage of the machine under consideration, but may be taken as an average for ordinary outputs and voltages. The ohmic, as well as the reactance, E.M.F.'s are expressed as a percentage of the no-load E.M.F., and the power factor has been taken as unity at full load. The curves may, however, be used without any appreciable error in cases where unity power factor is desired at any other load. In such a case the value obtained from the curves does not represent the wattless current at no load, but what may be termed the change in wattless current between no load and full load. For example, 10 per cent. compounding with a reactance at 25 per cent. gives 63 per cent. wattless current at no load with unity power factor at full load. If, instead, it should be desired to obtain unity power factor at half load, the wattless current would be approximately half of this value, lagging at no load and leading at full load. The amount of series field required would therefore be approximately the same in either case.

It will be seen that, except in cases of high percentage of compounding, the reduction obtained with increased reactance is very small when the reactance is higher than 30 per cent. Higher values than this are seldom met with in practice, as transformer builders are unwilling to build transformers having very high reactance, and the extra cost entailed in providing separate reactance is not compensated for by the small reduction obtained in the wattless current.

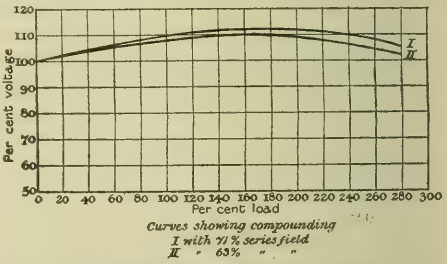

Fig. 2.—Compounding by means of Reactance having Straight-line Characteristic.

Reactance = 25 per cent. Resistance = 3 per cent.

The question as to the point of the load at which unity power factor at the converter should be obtained is of considerable importance. Large lagging currents can be carried by the converter at no load without difficulty, and, so far as the system is concerned, a lagging power factor is less objectionable at light loads than at heavy loads. If the lagging currents are large at no load, the leading currents required at full load or overload are reduced, which is advantageous for the converter as regards losses in the armature as well as the field copper.

For railway service it is usual to adjust the field so that unity power factor is obtained at three-quarter to full load. In general, it may be said that it should be at a point somewhat above average load, and, in making the choice, due consideration should be given to the extent and duration of overloads.

Low reactance and large wattless currents give, in cases where the saturation of the converter is low, better compounding on overloads than high reactance and small wattless currents, but in machines where the saturation is high the reverse may be the case.

The influence of saturation and leakage may be seen in fig. 2, which shows the voltage curves of a converter arranged for 16 per cent. over-compounding from no load to full load. The total resistance drop of converter and transformer is taken to be 3 per cent., and the reactance 25 per cent., including that of the converter armature. The power factor at the converter has been assumed to be unity at full load.

The lagging current required at no load would be 63 per cent. of the full-load current, and consequently the ampere-turns of the series field should be 63 per cent. of the effective armature ampere-turns at full load, neglecting saturation in the converter. Owing to the saturation, however, the field strength required at the full-load voltage is greater than that actually obtained, as the shunt current is only increased in direct proportion to the voltage, and the difference must therefore be compensated for by means of lagging currents from the line. This would mean that the power factor would not be unity at full load, nor would the required voltage be obtained. It is therefore necessary to increase the ampere-turns of the series field, in order to compensate for the difference in shunt excitation required at full load and that actually obtained at this load. In cases of high saturation, this difference may be considerable, and would, as already pointed out, cause a diminution of the compounding. In the case under consideration, the increase in the series field amounted to 8 per cent., so that 71 per cent. instead of 63 per cent. would be necessary.

Another point which is of importance in machines with high saturation is that the leakage is increased when large leading currents are produced. This means that an increase in field current is required in order to produce the necessary flux; but, as no change is made in the field current, the result is a reduction in the amount of leading current produced by the series field, and consequently in the compounding. The difference in compounding obtained with and without allowance for saturation is shown by curves I and II, fig. 2.

The use of reactive iron in transformers, which is employed when a large amount of reactance is desired, has considerable influence on the amount of wattless current and series field required in order to obtain a given compounding, if the reactive iron is saturated, as in this case the E.M.F. of self-induction is not proportional to the current.

In order to show clearly the effect of saturated reactive iron upon the amount of series field required, and on the compounding, a transformer has been chosen in which the reactive iron is practically saturated at full load (saturation assumed to be reached at 22,000 C.G.S. lines): the reactance is 25 per cent. at this point, but is 15.5 per cent. at quarter load. The compounding curve is shown in fig. 3.

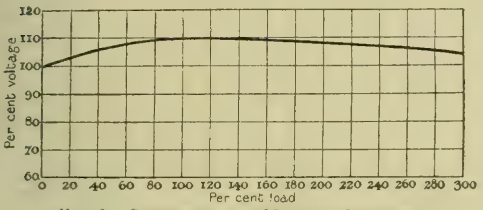

Fig. 3.—Compounding by Means of Reactance.
Reactive iron saturated at about full load.
Reactance at full load = 25 per cent. Resistance = 3 per cent.

The requirements as regards compounding are the same as in the previous case, and the transformer E.M.F. required is therefore also the same. The series field necessary to obtain the compounding is, however, much smaller, due to the high reactance at low currents; it amounts to 33 per cent., including the necessary allowance for saturation, as against 71 per cent. with the straight-line reactance. The wattless currents at different loads are shown in fig. 4, from which it will be seen that with saturated reactive iron at no load only 40 per cent., and at twice full load 45 per cent., of the value required with straight-line reactance are necessary. It will be noted from fig. 3, however, that although the same percentage compounding is obtained at full load, the shape of the compounding curve is not as good. At light loads the voltage rises very rapidly and reaches a maximum at about full load. Comparing this with curve I, fig. 2, it will be seen that in this case the voltage reaches a maximum at about 100 per cent. overload, so that the regulation in this case is somewhat better. The difference is not great, and, in cases where the design of the converter permits the use of saturated reactive iron, the advantage would seem to warrant its adoption.

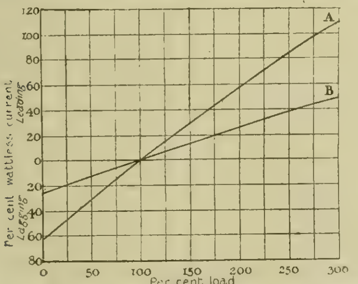

Fig. 4.—Curves showing Wattless Current required for 10 per cent. Over-compounding; 25 per cent. Reactance.

A. With straight-line reactance and 71 per cent. series field.
B. With reactive iron saturated at about full load, and 33 per cent. series field.

The difference in the shape of the compounding curve requires some consideration, owing to the unequal voltages obtained at different loads, as in extreme cases this may lead to difficulties as regards division of load between machines provided with transformers having different types of reactance.

In the case of voltage regulation being obtained by shunt control, the following conditions have been assumed:—

Voltage regulation, 15 per cent., *i.e.* ± 7.5 per cent. on either side of the mean.

Total reactance, 25 per cent.

Total resistance drop, 3 per cent.

The mean voltage required on the converter has been taken as the basis for the reactance and resistance, which are, therefore, expressed as a percentage of this voltage.

The amount of reactance must, as in the case of compounding, be determined by considerations of design of the converter, and also by the conditions desired for the supply circuit.

With any voltage variation, the value of the wattless current required with a given reactance depends on the conditions as to power factor desired on the high-tension side of the transformer. In the absence of any definite specification in this respect, the conditions most favourable to the converter are equal leading and lagging currents at the extreme voltages, as this will give minimum heating of the armature winding, which is a most desirable condition. This condition should be obtained at the maximum continuous load of the converter.

From the point of view of field heating, large leading currents are undesirable, but as it is generally possible to provide room for the field copper, this is not a limiting feature in design. In the case under consideration, the wattless current has been proportioned for minimum armature copper losses at full load. Under these conditions the wattless current required at the high voltage will increase with the load, whereas at the low voltage the wattless current is a maximum at no load. The wattless currents required at different loads for the maximum and minimum voltages are shown in fig. 5.

In the case of compounding it was seen that the wattless current and the series field required were reduced by the use of saturated reactive iron. With shunt control the wattless current required is practically the same from about full load and over, with straight-line reactance, as with saturated reactive iron.

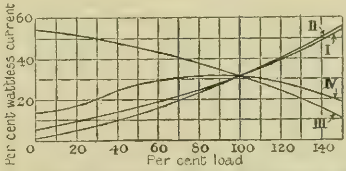

Fig. 5.—Curves showing Wattless Current in Shunt-wound Rotary Converter.

I. Leading current with straight-line reactance.
II. Leading current with reactive iron saturated at about full load.
III. Lagging current with straight-line reactance.
IV. Lagging current with reactive iron saturated.

Regulation ± 7.5 per cent. Reactance = 25 per cent.
Resistance = 3 per cent.

There is no advantage, as far as the converter is concerned, in using saturated reactive iron when the voltage variation is obtained by shunt control.

The question of power factor obtainable on converters where voltage variation is obtained by reactance control, is of considerable importance from the point of view of both the designer and the operating engineer. Power factor correction cannot be obtained at will by a converter operating under these conditions, as it is a fixed quantity for a given voltage and load depending on the amount of regulation required, as well as on the point at which unity power factor is desired. The power factor at the converter for a given load is fixed by the amount of wattless current, leading or lagging, necessary to obtain the specified regulation. The power factor on the high-tension side differs, of course, materially from that of the converter itself, as the voltage on the primary side is displaced from that of the secondary side through the introduction of the reactance. Furthermore, the magnetising current of the transformer affects the amount of wattless current on the high-tension side, increasing the current when lagging, but decreasing or increasing it when leading, depending on the relative value of the wattless current in the converter and the magnetising current.

For the case under consideration, the power factor of the rotary converter and on the high-tension side of the transformer would be as follows:—

Voltage	107·5 %	100 %	92·5 %
Power factor at converter	0·96	1·0	0·96
Power factor on H.T. side	1·0	0·96 (lagging)	0·84 (lagging)

In arriving at these figures the magnetising current has been taken as 5 per cent.

By careful consideration of the requirements as to voltage variation and power factor obtainable, it is possible to apply reactance control up to fairly large variations in voltage without serious interference with the power factor.

In cases where two distinct ranges of voltage are required, a combination of reactance control and tappings on the transformer is capable of wide application, and deserves more consideration than it has received up to the present. In many cases pressures of 400 to 440 volts are required for lighting and 500 to 550 volts for traction. The following table shows the power factor at the converter and on the high-tension side of the transformer which can be obtained without excessive wattless currents. These currents are also given in the table:—

	Max. volts 440.	Mean volts 420.	Min. volts 400.
Wattless current ...	47% (leading)	26% (leading)	6% (leading)
Full-load power factor at converter	0·9 ..	0·967 ..	0·998 ..
Power factor on H.T. side	0·99 ..	0·998 (lagging)	0·97 (lagging)
No-load wattless current	22% ..	0 ..	19 % ..

For the 500- to 550-volt range, the wattless current can be kept within the same values as the above, and the power factor would therefore be approximately the same.

By increasing the leading current at the maximum voltage, it would, of course, be possible to obtain unity or even a leading power factor at the lower voltage, which may be of advantage in special cases.

The range of voltage variation obtainable with reactance control is limited on account of the excessive wattless currents required, and the low power factor resulting therefrom. It is hardly possible to fix any definite limit, as it depends largely on the power factor permissible on the high-tension side.

The wattless currents necessary to obtain ± 7½ per cent. voltage variation, with 25 per cent. reactance may be obtained from fig. 5. These values were based on the conditions of minimum heating in the converter, and the power factor on the high-tension side of the transformer would for this reason be somewhat low. The figures are as follows:—

	Max. volts.	Mean volts.	Min. volts.
Full load—			
Wattless current ...	31%	0	31%
Power factor at converter	0·955 (leading)	1·0	0·955 (lagging)
Power factor on H.T. side	1·0	0·963 (lagging)	0·84 ..

Considerably better power factors can be obtained by increasing the wattless current, which may be done without causing any difficulties. How far the current can be increased depends on the particular design under consideration, but it is safe to assume that 50 to 60 per cent. wattless current can be carried. Fixing the limit at 55 per cent., and assuming as before a reactance of 25 per cent., the following table gives the results as regards wattless current and power factor at the different voltages:—

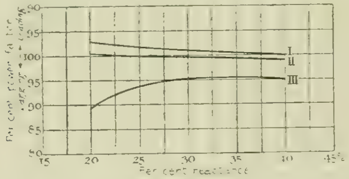

Fig. 6.—Power Factors obtainable on the High-Tension Side of the Transformer of a Rotary Converter.

Voltage regulation of ± 7.5 per cent. obtained by shunt control.

I. Maximum voltage. II. Mean voltage. III. Minimum voltage.

	Max. volts.	Mean volts.	Min. volts.
Full load			
Wattless current ...	55% (leading)	24% (leading)	6% (lagging)
Power factor at converter	0·875 ..	0·97 ..	0·998 ..
Power factor on H.T. side...	0·98 ..	0·997 ..	0·935 ..
No load—			
Wattless current ...	28% ,,	3% (lagging)	31% ..

These power factors are sufficiently high to be permissible on most systems, and indicate that the regulation considered is within the limits for practical working.

The change in power factor with varying reactance is shown in fig. 6, and it is interesting to note that no improvement is obtained by increasing the reactance above 30 per cent.

In general, it may be said that the limit of voltage variation, for which reactance control is applicable, is about ± 7½ per cent., but it should be noted that if the question of power factor is not of great importance, greater range than this can be obtained with a wattless current of 55 per cent. at full load.

A point of considerable importance in this connection is that it is possible to provide for a greater range in cases where the extreme limits are required for a short time only, as in the case of paralleling, due to the fact that larger wattless currents may be carried for short periods than would be the case for continuous operation. In such cases it may be of advantage to consider the reactance control for ranges which would otherwise be considered outside the limits as regards power factor and wattless current on the converter.

(To be continued.)

Discussion.

Mr. A. M. Taylor, in opening the discussion, said the author evidently wanted to show the advantages of reactance control over booster control for rotary converters. He (the speaker) felt that exception must be taken to the reactance-control type for certain purposes—for instance, in a substation at the distant end of the system, where both voltage and power factor might be low, it would be an advantage if some means of boosting were provided there. He was interested in the battery sub-station, and felt that what was wanted was to be able to run a rotary inverted to give a feed into the system coupled with high power factor; this would be really useful, especially if battery plant were involved. It would be useful to have an arrangement such that they could draw a large leading current both on charge and discharge from the line.

Mr. Brazil said where the regulation was 3 or 4 per cent. of the total, reactance control was much the best thing. He had made use of a method of reactance control in conjunction with a direct-current booster driven from the converter shaft, and considered that for battery charging this arrangement was much more effective, but it could be used for other purposes. The effect on power factor of a D.C. booster was the same as in the case of an A.C. booster, and it gave sparkless commutation over a wide range of load.

Mr. R. A. Chattock asked if the reactance machine would not give a leading power factor, if over-excited and with transformer tappings suitably arranged. He thought they might have to revert to the reactance type owing to its simplicity.

Mr. W. B. Woodhouse said the conditions of working referred to by Mr. A. M. Taylor were the practical ones, and he was afraid they would have to retain the booster-controlled machine if they wanted to correct power factor as well as voltage. As regarded comparative costs, he asked what the author's estimate was for a booster with a very small range of voltage and a change-over switch for changing from high to low-voltage ranges.

Mr. H. Burge said it appeared undesirable to depart from the simple converter, with its good commutating features, and it might be practicable to adopt an independently driven booster arrangement.

Dr. R. Smith thought it was agreed that booster control had been overdone in the past; difficulties of commutation prevented the designer from using the materials to the best advantage, unless refinements were introduced. As regards reactance control, he could not see how they could design a transformer to give a straight-line reactance up to 300 per cent. overload, as appeared to be suggested by the author; it must be an abnormal design. It was not only booster-control which introduced difficulties in commutation; it was only fair to state the disadvantages of reactance control, if they were going to use saturated iron, as trouble was likely to occur through sparking in that case.

Mr. Whittaker said the booster-control arrangement was perfectly satisfactory if a liberal design was adopted, but to-day reactance machines could be built to run at a speed which was out of the question for the booster type. In any case, the induction regulator type of machine was more efficient than the booster type, and to-day such machines were designed as self-contained equipments, and to meet conditions which other types could not meet.

Mr. A. M. Taylor interposed to say that he did not think the D.C. booster arrangement would influence power factor adjustment.

The Author, in replying, said the inverted rotary was rather a difficult proposition as regarded power factor correction; clearly, one could obtain a leading current from an inverted machine, as it was then acting as a generator, but it was hard to expect the rotary to do everything. The booster-controlled rotary operated very satisfactorily, but it was not possible to utilise the material to such advantage as in the reactance type. The direct-current booster gave identical conditions with the A.C. booster, and the latter had no influence on power factor. He agreed with Mr. Chattock's remarks, but it was a rather cumbersome thing to change transformer tappings. He thought the arrangement referred to by Mr. Woodhouse would save probably 6 or 7 per cent. in cost. The separately driven booster meant another motor, though it did away with interference with commutation. In regard to Dr. Smith's remarks, the paper referred to 300 per cent. load, or 200 per cent. overload, and straight-line reactance could be obtained in practice for such loads. He believed it was correct to say that reactance was used and that saturation was controlled to meet the requirements. He quite agreed that the induction regulator-control was not fully appreciated, but suggested that it would be even more profitable to investigate the booster-transformer type of control. The induction regulator controlled machine cost more than the transformer type, and the latter was considerably more efficient on high loads.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Re "Alternating-Current Work."

In the very kind review of the above book of mine in your issue of 9th inst., there are two or three points on which I hope you will allow me to comment.

Your reviewer says: "Following the recent suggestions of Dr. Drysdale, a number of remarkably sound mechanical and hydraulic analogies have been given." As a matter of fact, Dr. Drysdale is only cited as a supporter of the use of such analogies. Those (of a mechanical nature) in the book are extensions of some introduced by Prof. George Forbes, F.R.S., at the Royal Institution in 1895, and they are much simpler than, and quite different from, those usually met with.

In criticising what I say about "the indispensable commercial engineer," your reviewer changes "commercial" into "electrical," and remarks: "We are disposed to doubt the indispensability of any electrical engineer to-day who does not possess any special knowledge of either theory or practice. The existence of such gentlemen is beyond dispute, but their desirability is open to question." By "commercial engineer" I mean, of course, the man whose work is chiefly on the business side, and I quote the following from Mr. C. P. Sparks's presidential address in December, 1915:—"I believe that the commercial engineer is just as much a recognised member of our profession as a pure scientist." It is one thing to design a turbo-alternator or a tumbler switch, and quite another to sell it. The designer and the selling man are near the opposite ends of quite a long chain of other indispensable individuals.

Lastly, as there are numerous gentlemen to whom the names "Mr. Hughes" and "Mr. Bishop" might be taken to apply, I would like to particularise those who assisted me as Mr. Edward Hughes, B.Sc. Eng. (Lond.), A.M.I.E.E., of the Heriot-Watt College, Edinburgh, and Mr. Harold Bishop, Graduate I.E.E. Whatever technical merits the book possesses, they are as much due to Mr. Hughes as to myself.

W. Perren Maycock.

London, S.E.; *March 10th*, 1917.

Electric Radiators.

It seems to me that your contributor, "Experiment," misses a highly important point in his article on this subject in your issue of last week.

Your contributor is handicapped in discussing the question of ideal electric heater design, because this question cannot finally be decided until we are first clear in our minds, and all agreed, as to the most practically effective temperature to which the radiating body should be raised.

In his opening paragraph, he suggests that "real red heat" is the desirable point on the temperature scale, but later on he talks of a fireclay bar in a certain type of radiator as being a very effective source of radiation, and certainly this fireclay bar cannot be red hot.

Your contributor advocates the use of large masses of fireclay, but I would ask him to calculate the heat units that would be absorbed by these masses of fireclay in attaining the temperature at which they would commence to radiate what he terms "useful heat," and I presume by this that he means "useful quality of heat," as distinct from quantity of heat.

Of course, all electric radiators are of 100 per cent. efficiency in their output of *heat units*, but the man in the street knows nothing whatever about heat units, and only considers the *quality* of the heat, and insists on that quality (temperature) which most nearly represents the comforting glow of the coal fire, as this produces what Mr. Wordingham has termed the correct "physiological effect."

Is it not better to bow to the demands of the man in the street than yield to the dictates of pre-conceived ideas and text-book acquired doctrines so often propounded, by mere engineers and architects?

When we talk about the efficiency of an electric heater, we can only do so with reference to the purpose for which the particular apparatus was designed. A low temperature heater may have an efficiency in the neighbourhood of 100 per cent. for boiling water, but the same low temperature heating element would have no efficiency at all for making toast. This is such an obvious truth that it very seldom receives the consideration it deserves, and it has become the custom to talk in an exceedingly loose and incoherent way about the efficiency of electric heating apparatus. It also leads to great confusion of ideas that quantity of heat and temperature should be so often indiscriminately referred to as "heat."

C. Orme Bastian.

London, W., *March 9th*, 1917.

In reference to the article on radiators by "Experiment" in the issue of March 2nd, I should like to take the opportunity of acclaiming *ore rotundo* accord in support of its disclosures, for, in competition with our energetic friends the gas companies, nothing, in my opinion, should be left till absolute maximum efficiency is obtained.

The fact that heating by electricity will become general in the future is certain, but I think its certainty would be more swiftly assured if the manufacturers turned their attention more to heat output than fancy design.

When it is considered that a radiator costs so much per hour definitely, one sometimes feels ashamed of some of the devices designed to produce heat, and the writer has up to the present only found one particular make that can truly be said to give satisfaction, which is the one "Experiment" describes; it will burn trousers, skirts, coats, and furniture, in fact, everything that a coke fire would do if not placed in its proper position in a room.

Further, a real difficulty to intending clients is that they have to rely chiefly on the advice of their particular contractor, but facilities should be available for them to view various makes. This idea may be criticised, but in the interest of the electricity supply industry and a contented client it is, in my opinion, essential.

There seems, however, to be a difficulty with the supply authorities (chiefly municipal) in deciding upon opening a showroom; perhaps local opposition has a word here, or managers are loath to venture for fear of a dead loss (if the sales are not good) to the undertaking, but I would suggest that electricity supply committees or managers could approach manufacturers to meet the showroom expenditure in the various districts, relying on sales and a working arrangement for the good of all parties.

I feel sure that the time is fast arriving when it will be to the interest of the electrical industry to supply a standard piece of apparatus to all who apply.

Mains Engineer.

March 8th, 1917.

The Inspection of Munitions.

It is very gratifying to find "Commercial" adopting a saner and more reasonable attitude towards the question of inspection of munitions. He suggests that in his wisdom he has refrained from saying all he knows about the defects and deficiencies of the officers and inspectors engaged in this work, but why not have shown a little more wisdom, and refrain altogether? Most men who have had a fair amount of experience have acquired wisdom, and a few have even learnt how to ignore trivial matters, and to devote their energies to remedying the more serious ones.

I am prepared to believe that at heart "Commercial" would like to assist the authorities in the production of munitions, and in doing this he is quite safe in exposing any serious deficiency he may find in the personnel of the different departments. But his proper course would be to make his complaints to the heads of the departments, who, as he is probably aware, have requested the manufacturers to notify them of any lack of energy, ability, or tact on the part of the inspectors. In this way he would be acting patriotically, and at the same time doing useful service to the general body of skilled men who are acting as inspectors as a matter of duty, and at a considerable sacrifice. Such exposure of flagrant cases of incompetence would be welcomed, and it would be much more effective in weeding out any incompetent ones than by mere pin-pricking in the Press.

As regards the list of questions which are put forward for my deliberation, while I consider them most superficial and futile in their purpose, I will not undertake to reply to them in the way "Commercial" dictates. At the same time, I ask "Commercial" to take a wider and loftier view of the subject. Inspectors and manufacturers are alike in their fallibility, and, as is usual with purchaser and seller, are apt to look on opposite sides of the question. Lack of appreciation of each other's view leads to misunderstandings, and misunderstanding leads to biased minds. When both sides take up such an attitude it opens out the possibility of unpleasantness, and this, again, reflects on the work which is being turned out.

My advice to "Commercial" is to keep a keen eye on all inspectors, and if he finds one incompetent in his duties to inform the chief of the department of such failing. I can assure him that if his complaint is justified he will have the satisfaction of seeing the culprit relieved of his post. This would be a much more honourable course to take than to brand them all—officers and inspectors—as a lot of ignorant fools.

Albion.

THE RÖNTGEN SOCIETY.

At the meeting of the Röntgen Society on March 5th, Mr T. Thorne Baker, A.M.I.E.E., read a paper on the use of the X-ray intensifying screen. He said that before many months were past, the sensitiveness of these accelerators was likely to be increased by 200 or 300 per cent. Methods had also been evolved whereby the size of the crystals could be controlled, with the result that the grain of the intensifying screen was practically no larger than that of the photographic plate with which it was used in contact. It was advisable to have the screen above the plate, sensitive side downwards, and not *vice versa*, as some recommended. He would not say definitely whether a special X-ray plate or an ordinary plate was the better for screen work. This depended upon circumstances. A fact which needed to be taken into account was that the grain of ordinary plates was apt to be much coarser than that of good X-ray plates; the silver bromide in the X-ray plate was precipitated in an exceedingly fine form.

At the same meeting further discussion took place on the subject of sources of ultra-violet radiation in relation to treatment by ultra-violet rays Major W. J. Turrell said that spectroscopic results showed that tungsten, provided it burned steadily and evenly, was the right metal to use for ultra violet radiation. The therapeutic value of tungsten radiation consisted first in its destructive action on micro-organisms, and, in the next place, upon the erythema which it produced and which resulted in an increased blood supply and nutrition of the tissues. Since a recent meeting of the Society when this subject was discussed, he had been experimenting with tungsten powder and with pure tungsten for electrodes. The difficulty of using powder in rods was that of getting sufficient compactness. The 98 per cent. tungsten burned away very quickly compared with the pure tungsten. In his hands a 7 in. rod of pure tungsten, costing between 18s. and 20s., burned for 758 minutes, and this was a very good result; on the other hand, a rod of 98 per cent. tungsten burned only for 221 minutes, or one-third of the time. In terms of ampere-minutes, the numbers were respectively 4,489 and 1,254; accordingly, he thought it worth while, in spite of the additional expense, to go on using this pure tungsten unless some better method of preparing the 98 per cent. pure was forthcoming.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SWITZERLAND.—A Decree, dated December 21st, of the Swiss Federal Assembly amends Article 14 of the Federal Customs Tariff Law of October 10th, 1902, and provides that a statistical tax at the following rate is to be levied on all goods passing over the Swiss Customs frontier:—

For goods dutiable (declared) by weight, 2 cents. per 100 kg.
For goods dutiable (declared) by unit, 2 cents. per unit.

The tax is to be not less than 5 centimes for each consignment or each postal parcel.

The Decree is to come into force on a date to be fixed by the Federal Council, and its effect will be that the following classes of goods, which have hitherto been exempted from payment of the statistical tax, will then become subject thereto, viz.:—

"Goods subject to the payment of Customs duty.

"Goods imported or exported in the course of frontier traffic.

"Goods imported or exported in local market trade.

"Consignments of goods sent through the post."

TERRITORY KNOWN AS "GERMAN EAST AFRICA."—Regulations in regard to trading facilities in the occupied territories of "German East Africa" are published in a recent issue of the East Africa Protectorate *Gazette*. The ports of Pangani, Sadani, and Bagamoyo are declared to be open for coastwise traffic only, no direct foreign trade being allowed. This traffic will be controlled from Tanga and Dar-es-Salaam, and direct coasting trade between the three ports is not allowed, unless specially authorised by the Customs Authorities at Tanga and Dar-es-Salaam. Coasting traffic is at present limited to these three ports. [All goods entering the port of Tanga have to pay an import duty of 10 per cent. *ad valorem*—see the Review of December 22nd.]

BERMUDA.—A Government notice, dated December 15th, prescribes a new method for ascertaining the value of goods subject on importation to *ad valorem* duties. Such value is now to be ascertained by the declaration of the importer, or his agent, made or subscribed before the proper officer of the Revenue Department, and shall include the invoice cost of the goods, the cost of all barrels, cases, crates, boxes, sacks, and other external packages and coverings of every kind, and all other costs, charges, and expenses incurred in placing such goods in condition for shipment to the Colony from the port of shipment in the country from which the same were directly or indirectly imported.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

2,764. "Lighting equipment for motor cars." W. C. Fairweather (Rae). February 26th.

2,779. "Electric heaters for use with internal-combustion engines, &c." Falkirk Iron Co & C. G. Nobbs. February 26th.

2,785. "Electric lift system." Otis Elevator Co. & Waygood-Otis, Ltd. February 26th

2,788. "Apparatus producing or utilising electrical oscillations." W. H. Wilson. February 26th.

2,802. "Telephone system." B. Asserson & H. J. Carter. February 26th.

2,807. "Electric furnaces." J. O. Boving. February 26th.

2,838. "Primary batteries." M. Bonora. February 26th

2,851. "Electrolytic process to recover metal from scraps." E. Potter. February 27th.

2,865. "Electric water heater." E. C. Webster. February 27th.

2,874. "Receivers for wireless telegraphy." O. D. Lucas. February 27th.

2,878. "Processes for heating, melting, and annealing metals by electricity." H. Alexander, A. Imbrey & W. T. Vint. February 27th

2,890. "System of telephony." L. Mazza. February 27th

2,895. "Ignition systems for internal-combustion engines." Phillips Brinton Co. February 27th. (U.S.A., March 23rd, 1916.)

2,900. "Electric cable connectors." Chloride Electrical Storage Co. and H. Dean. February 27th.

2,903. "Excess wattmeters." A. W. Burke. February 27th. (U.S.A., February 24th, 1916.)

2,907. "Portable electric lamp." A. Fletcher. February 27th.

2,912. "Mercury rectifier distributing systems." British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.) February 27th.

2,991. "Spark plugs." A. L. Riggs. February 28th.

3,012. "Sparking plugs for internal-combustion engines." C. F. L. King. March 1st.

3,039. "Wireless radio-signalling by the arc system." L. Cohen. March 1st

3,044. "Electric switches for handlamps, &c." J. G. Ellis. March 1st.

3,046. "Drawn filaments for electric incandescence lamps." P. F. Guardiola. March 1st.

3,061. "Lifting magnets." A. H. Curtis & Igranic Electric Co. March 1st.

3,062. "Resistance grids." A. H. Curtis & Igranic Electric Co. March 1st.

3,091. "Carrier for supporting electric lamp, &c., shades, reflectors, &c." A. P. Rutherford. March 2nd

3,102. "Holders or adapters for carbons of electric arc lamps." N. Eales and T. L. Grimstone. March 2nd.

3,113. "Manufacture of carbon for electrochemical, metallurgical, &c., services." T. W. S. Hutchins. March 2nd.

3,125. "Apparatus for electrolytic production of copper, &c." M. V. Garin (née Bailly). March 2nd.

3,127. "Electromagnetic switches or contactors." A. West & Co. and W. L. Wise. March 2nd.

3,128. "Electromagnetic switches or contactors." F. N. Pickett and A. West & Co. March 2nd.

3,131. "Electric ignition systems for internal-combustion engines." Etablissements de Dion-Bouton Soc. Anon. March 2nd. (France, April 22nd, 1916.)

3,155. "Electrical generators and motors." J. Shepherd. March 3rd.

3,160. "Manufacture of clay, lumbago, &c., articles by electro-deposition on metal moulds." B. J. Allen. March 3rd.

3,179. "Sparking plugs for internal-combustion engines." G. Parsons and T. C. E. Rowland. March 3rd.

PUBLISHED SPECIFICATIONS.

1915.

10,226. Interconnecting the Electrical Conductors of Two Railway Cars. J. Wollenmann. July 14th.

1916.

The numbers in parentheses are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

88. Apparatus for Concentrating and Projecting Radiant Energy. S. Salto. January 3rd, 1916. (103,830.)

224. Driving and Controlling Dynamo-electric Generators. W. F. W. Rhodes & J. Firth. May 22nd, 1916. (103,835.)

1,705. Means and Apparatus for Controlling Alternating Currents such as are used in Wireless Signalling Systems. British Thomson-Houston Co (General Electric Co., U.S.A.) February 4th, 1916. (103,842.)

1,843. Alarm Thermometers. E. Gethin. February 8th, 1916. (103,848.)

2,249. Means for Passing Through the Human Body Currents Derived from the Ordinary Town Main Electric Supply. E. E. Greville. February 15th. (Cognate applications, 8,240/16 and 11,363/16.) (103,859.)

2,288. Massage Apparatus. J. C. Johansen. February 15th, 1916. (103,863.)

2,329. Means for Producing Alternating Currents. British Thomson-Houston Co (General Electric Co., U.S.A.). February 16th, 1916. (103,865.)

2,350. Electric Pocket Lamps. A. Weinmann & E. Kuhn-Frei. February 16th, 1916. (103,871.)

2,524. Method of and Apparatus for Transforming Motion into Electrical Waves or Impulses. T. B. Dixon. July 19th, 1915. (100,940.)

2,546. Electrically-operated Valves. E. C. St. John. February 21st, 1916. (103,879.)

2,580. Telephone Systems. Relay Automatic Telephone Co. & H. J. Herink. February 21st, 1916. Addition to 102,330. (103,880.)

2,956. Railway Signals. W. H. I. Welch. February 28th, 1916. (103,888.)

3,028. Combined Lamp and Shade Holder. A. A. Thornton (T. Shepherd). February 29th, 1916 (103,889.)

5,570. Storage Batteries. W. A. Crowdus. April 22nd, 1915. (100,315.)

5,777. Electrically-operated Friction Hoists. J. Scott. April 20th, 1916. (103,914.)

8,792. Construction of Electromagnet for Localising Foreign Substances which have become Embedded in the Human Body. A. J. Bergonie. June 22nd, 1915. Addition to 9,623/15. (100,746.)

10,100. Circuit-interrupting Devices. British Westinghouse Electric and Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.). July 18th, 1916. (103,947.)

10,973. Control Mechanism for the Doors of Lifts. Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.). August 3rd, 1916. (103,949.)

11,267. Apparatus for Medical Treatment by Electricity. L. Mayor. September 25th, 1915. (101,625.)

11,358. Automatic Selecting Devices for Telephone Systems. Siemens and Halske Akt. Ges. August 11th, 1916. Addition to 23,336/13. (103,952.)

12,351. Regenerative Braking Systems for Electrically-driven Vehicles. W. V. Turner & T. H. Thomas February 5th, 1916. (103,959.)

14,666. Impulse Transmission Dials, and chiefly those used in Automatic or Semi-automatic Telephones. S. Simpson. October 16th, 1916 (103,970.)

16,457. Light Reflectors for use in High-speed Submarine Cable Telegraphy. T. B. Dixon. July 19th, 1915. (102,264.)

THE

ELECTRICAL REVIEW.

VOL. LXXX. MARCH 23, 1917. No. 2,052.

ELECTRICAL REVIEW.

Vol. LXXX. **CONTENTS**: March 23, 1917. [No. 2,052.

Page
The Agricultural Electric Supply and Electric Power Committees 309
Effect of the War on Construction Contracts 310
Problems of the Moment 310
The Wire-Drawing Industries 311
Water Power in Italy 311
Irish Water Power... 311
Electric Cooking at a Y.M.C.A. Canteen (*illus.*) 312
Decimal Coinage and the Metric System 313
New Electrical Devices, Fittings and Plant (*illus.*) 316
The New Buffalo Power Station (*illus.*)... 317
War Items 319
The Principles Involved in Computing the Depreciation of Plant 320
Reviews 320
Business Notes 321
Notes... 324
City Notes 327
Stocks and Shares 330
Some Thoughts on the Capital and Labour Problem, by W. T. Wardale 331
Higher Boiler Pressures 332
The Voltage Regulation of Rotary Converters, by G. A. Juhlin (*illus.*) (*concluded*) 333
Electricity in Agriculture... 335
Correspondence—
  Electric Radiators 336
  Curious Trouble with Lead-Sheathed Cables 336
  The "Bauer" Qualimeter 336
New Patents Applied for, 1917 336
Abstracts of Published Specifications 336
Contractors' Column ... ... Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE :—4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

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NEW YORK: D. Van Nostrand, 25, Park Place.
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
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SYDNEY: The Mining & Engineering Review, 273, George Street, Gordon and Gotch, Pitt Street.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.
WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE "ELECTRICAL REVIEW'S"
ELECTRICAL & ALLIED TRADES DIRECTORY
(THE RED BOOK),

1917 EDITION

IN THE PRESS.

H. ALABASTER, GATEHOUSE & KEMPE,
4, Ludgate Hill, London, E.C. 4.

THE AGRICULTURAL ELECTRIC SUPPLY AND ELECTRIC POWER COMMITTEES.

A MOST welcome announcement is that which we received early in the week, intimating the formation of a "Committee on the development of electricity in agricultural areas" by the Council of the Incorporated Municipal Electrical Association, and we take this opportunity of congratulating the President of that body, Mr. F. M. Long, on having brought this important matter forward, and equally the Council, on the celerity with which it has given practical effect to his wishes. As our readers are, no doubt, aware, the ELECTRICAL REVIEW, "ploughing a lonely furrow," has in recent years devoted a large amount of space to this subject, and has frequently urged that the time had arrived when the use of electricity in agriculture could, and should, be treated seriously, and regarded as a factor of essential importance in the economic development and progress of our rural communities. Possibly all such suggestions would have fallen on deaf ears had not the war supervened and changed the public outlook from things parochial to things national, and particularly to those matters which are material to the winning of the war, than which—as we can now fully realise—none is more urgent than the increased prosperity and productiveness of our agricultural and allied rural industries. It is, therefore, singularly appropriate that this year's President of the I.M.E.A., whose domiciliary city, Norwich, is the centre of one of our premier agricultural counties, should have given practical shape to the various ideas and suggestions on this subject which have been made from time to time in our columns.

The present Committee is, of course, only a nucleus, with powers to add to itself representatives of the various interests which are essential to the proper organisation of this branch of the industry, which, it will be gathered by reference to the objects in view, covers a fairly extensive range to commence with. In passing, we would suggest that an early opportunity should be taken to include representatives of the company undertakings, whose interest in rural supply developments is undoubtedly as great as, and possibly greater than, that of the municipal fraternity, for although the future will probably show the necessity of forming provincial sub-committees—purely on the ground of convenience in dealing with an extremely widespread industry—yet it is essential that all the interests involved shall be amalgamated and unity of effort secured throughout the country. To us it appears that the primary objects of such an organisation are (1) the creation of a favourable body of opinion amongst the farming community in the proposed areas of supply, and (2) the provision of the necessary transmission systems to meet the demand for electricity as it arises. As regards the former, no great difficulty should be encountered, as the initial areas to be supplied will be those in the vicinity of, and intimately in touch with, towns, for the most part, and as experience teaches that propaganda of this kind is cumulative in effect, progress further afield will be facilitated in the future. The provision of transmission facilities is likely to be a much more knotty problem, however, particularly where the areas of adjoining authorities are involved, and although the Board of Trade can [illegible] the necessary facilities, and all the omens portend that the Board will in the future place a wide and favourable interpretation on its powers relating to electricity supply, much still remains to be accomplished to ensure that such transmission schemes, when required by rural communities, shall be provided expeditiously.

In addition to legislative facilities it may, for instance, be necessary, in the case of small undertakings, to invoke financial assistance in the form of guarantees in the early years, and this is a matter which should appeal directly to the Development Commissioners of the Board of Agriculture, whose *raison d'être* is presumably the support of necessary and useful developments in connection with agriculture, such as, for instance, the 50-acre electroculture experiment which will be carried out at Hereford this year.

The whole subject of electricity supply in its relation to industrial progress is, of course, attracting much more attention in official circles now than at any previous period, and it is somewhat significant that the President of the Board of Trade is appointing a Departmental Committee to consider and report on the steps which should be taken, whether by legislation or otherwise, to ensure that there shall be an adequate and economical supply of electric power for all classes of consumers in the United Kingdom, and particularly industries which depend upon a cheap supply of power for their proper development.

The scope of the Committee's inquiry is such that it must necessarily include the rural consumer, present and prospective, in its survey, and thus, indirectly, the needs of the farming industry. Rural England is, perhaps, more awake to the advantages of electricity supply than is usually supposed, as witness the recent resolution of the Ewell Parish Council which was submitted to the Board of Trade, pointing out that the Council was of opinion that one of the greatest needs of rural parishes in the South of England was cheap and reliable power, and that this would do more than anything to keep the village industries alive, and expressing a desire for a cheap supply of electricity in the parish at the earliest possible moment.

We can only add the hope that the efforts of the above Committees and of those already at work, to which attention has been drawn in our columns, will result in that widespread development of electricity supply which is undoubtedly vital to our national prosperity.

Effect of the War on Construction Contracts.

The case of the Metropolitan Water Board *v.* Dick, Kerr & Co., Ltd., decided by the Court of Appeal on March 5th, involves the consideration of a point of great interest to those whose contracts are affected or suspended by the war. The Board had employed the defendants to construct certain reservoirs for £673,000. In February, 1916, while the work was being executed, the Ministry of Munitions decreed that it should cease. Subsequently the Board claimed, in an action at law, a declaration to the effect that the contract was still subsisting, and that the defendants were bound to perform it. Mr. Justice Bray, in a judgment upon which we commented at the time, decided that this was so. The contractors appealed from his decision, which was based on this: that the engineer under the contract had power to extend the time of completion, and that, notwithstanding the order of the Ministry, the contract had not been frustrated or its completion rendered physically impossible. The Court of Appeal have reversed this decision, pointing out that, upon the authority of the decided cases, every bargain must be presumed to have been made on the footing that a particular thing, or state of things, would continue to exist. The Master of the Rolls found that the contract could not be performed after the receipt of the notice from the Ministry. "This," he said, "was not a temporary prohibition. . . ." The contractors treated it as of such a nature as to terminate their liabilities under the contract, and the fact that the restraint, which had been in force for six months at the date of the trial, has now been in existence for 12 months, is a matter to which the Court is entitled to have regard. On this ground alone he thought the appeal should succeed. Having regard to the large number of contracts which must be in a state of suspended animation owing to the war, this decision is likely to be far-reaching in its effect. Serious, indeed, would be the liabilities of contractors if they had to recommence work upon pre-war terms at such time as the Ministry of Munitions might be able to allow the resumption of work. The case may possibly go to a higher Court.

Problems of the Moment.

Men and women who are living conscientiously in these days have few idle hours. We do not pretend that this is a good thing for us, change and recreation of some kind or other being essential if we are to give our maximum efficient output during our working hours. Creatures of circumstance, however, we work under the pressure imposed by necessity; patriots, in earnest concerning a righteous conflict, we labour under the impulse of Duty. Most of us are trying to reconcile these two calls of the moment. Depleted staffs impose heavier burdens, and National Service demands add an almost irresistible appeal. The manifold Governmental restrictions of war-time—the "Thou shalt's" and "Thou shalt nots"—are themselves, if they are intelligently followed and consistently complied with, a bundle of obligations accentuating the burdens imposed by necessity, and obstructing the path of him who tries to supplement his normal activities with other service. But we have got to win the war, and though we may often be irritated because we think that some things might have been done differently, we yield to the imperative pressure of the moment and get things done. We are not suggesting that everybody is employed to the best of his ability, or upon the tasks for which he is by experience and training most fitted, but some men who are so engaged find themselves in a quandary 'twixt the calls of present duty and the appeal to change to other forms of service. So long as the call for National Service is on a voluntary basis the individual conscience must play a very important part. The electrical industries are in the main an important National Service; but there are demands from the Military and Naval Services for men from those industries, because the actual and prospective operations of the Forces necessarily have a large claim upon us all. The difficulties of reconciling the two claims are not always easily solved by those in authority, and men have to leave more or less congenial occupations, for which they thought they were best fitted to serve the national cause, and take up some other class of work, perhaps a lower class of duty in the same line of occupation and at a less remuneration, because those responsible for carrying out the provisions of the Acts decide that the emergencies of the moment or the possibilities of the situation demand the change.

For this we must blame the enemy first and foremost, and work harder to defeat him; but, second, we will ask to be allowed to remember that we live in a very human and inefficiently conducted world. The thoughts of some of our readers we believe to run along the foregoing lines just now, especially those who are placed in managerial capacities in industrial concerns and in important commercial offices; these will hardly be relieved in days of exceptional pressure when they read Press reports of speeches such as Mr. Gordon Selfridge delivered at

Gresham College the other day. Copy-book maxims on how to succeed in business are all very well in peace time, or for instilling into juvenile minds even in war time, but to tell us all in these days that "the head of the business should not be busy, because he would then have no time to see that others were busy," is to utter a platitude which everybody should have known in normal times, and will practise again when the stress of war-time passes away; but where are the heads of businesses who in these days of depleted staffs, manifold restrictions, and urgings toward business development for the future, are not busy? Of course, it makes for efficient conduct of any business of size for the heads to be able to *think* and plan while the employés develop and carry out the details of policy in their own efficiency; but in our experience most managers are thinking, planning, and *working* hard as well at present. In normal times the efficient manager knows it is correct policy not to be too much tied up with detail, but surely in these days most of us are doing many unaccustomed tasks because necessity and duty compel; maxims such as this from what Mr. Gordon Selfridge calls his "Commercial Bible" hardly help us just now—we will get on with the work which must be done, whatever it may be, and leave others to do the talking.

The Wire-Drawing Industries.

In common with almost every other controlled industry, the wire manufacturing section has had to face an increasing variety of difficulties; but, although the dislocation caused by the exigencies of the situation has in some cases proved of a somewhat serious nature, resourcefulness and perseverance have materially eased the situation. The complete control exercised by the Ministry of Munitions on all supplies of raw copper, while dispensing with a considerable amount of duplication, has doubtless reacted somewhat unfortunately, as regards fluctuations in market prices, against those firms which had bought some months ahead. So far, only Class A men in the unskilled section appear to have been called up from the most important firms, but there is likely to be a heavy pruning-out very shortly of semi-skilled men, and possibly certain classes of skilled men also. It is, perhaps, fortunate for British wire manufacturers that nearly all their most important pre-war customers are themselves engaged in the production of war material for which copper goods are largely required. The transition after the war from munition requirements to the demands of peaceful trading should, in consequence, involve the minimum expenditure of time and money.

Water Power in Italy.

A new law in regard to the partial diversion of public waterways in Italy was brought into operation on January 1st, 1917. The coal crisis in the country has demonstrated the necessity for at once utilising to a greater extent the available water powers with more certain guarantees than those comprised as a matter of urgency in the decrees issued in January and September of last year. Under the new law the duty of dealing with the problem has been entrusted to a Superior Water Council, formed in connection with the Ministry for Public Works.

The procedure for obtaining a water-power concession has been simplified. The criterion of priority, which permitted injurious monopolies, has been modified, and replaced by those of greater and better utilisation. Concessions are to be granted for a period not exceeding 50 years for diversions for motive power purposes, and for not over 70 years for those for irrigation and potable purposes. If the objects for which the concessions are issued continue, the latter will be prolonged at the normal time of expiration. The concessions which lapse will pass into the possession of the State without any compensation being payable for the water collecting and regulating works, the canals and the conduits, whilst the State will have the right of acquiring, at the then value, the machinery and installations for producing, transforming, and distributing electrical energy.

The introduction of the law has not fully met the wishes of the Associazione Elettrotecnica Italiana. Shortly before the measure came into force a conference was held, at the instance of the Association, to consider the situation created by the scheme, and a resolution was adopted expressing regret that the problem of amending the law had not been postponed until after the war, so that the questions raised could have been properly discussed and definite measures adopted with the assistance of Parliament and the country. At the same time, and recognising the urgency of providing for the increasing demand for electrical energy during the course of hostilities, the resolution submitted that the construction of hydro-electric works would be facilitated by an extension of the decree of last September so as to apply to all requests for concessions for new diversions of waterways, irrespective of the applicant. The conference finally decided to form a permanent committee on public waterways, composed of representatives of all technical, industrial, and agricultural associations.

Irish Water Power.

In a recent speech, which excited a great deal of interest in the *Times* and *Daily Mail*, Lord Northcliffe declared that the Irish problem, in his opinion, was an economic one, and suggested that the solution would be found in the development of the water power available in Ireland. He had "sought eagerly for any recent expert report on the water power of Ireland," but without success; unfortunately, he did not seek our assistance—had he done so, he would have speedily arrived at the desired end, for the subject has been dealt with on various occasions. Lord Northcliffe's enthusiastic accounts of the "white coal" resources of Ireland are unfortunately, in the absence of expert guidance, based upon supposition to a great extent, and we fear that the reality will prove disappointing to him. It is true that at certain seasons there is a great deal of energy running to waste, but the minimum flow of the Irish rivers is only about one-sixth of the ordinary maximum, and for industrial purposes, unless the hydraulic plant is supplemented (at great additional cost) with steam or gas-driven plant, is is the minimum flow that fixes the capacity of the undertaking. There are certain sites at which power could be obtained close to the sea, and therefore under highly favourable conditions; and on the Shannon, which Lord Northcliffe describes as the greatest river of the British Isles, water carriage to the sea is available. At other places transmission lines would be necessary to carry the power to suitable sites for factories. A valuable feature is the fact that in many cases the rivers are fed from large lakes which could be utilised for the storage of water, greatly improving the possibilities. On the other hand, there are vested interests to be dealt with, such as navigation and fishing rights, compensation for the disturbance of which would involve heavy outlay; moreover, in many cases the hydraulic works would be very costly. That there is a good deal of water power available in Ireland appears to be the fact; but whether it could be developed profitably is, except in a few instances, very doubtful, and we fear that those who build their hopes on Lord Northcliffe's optimistic guessing are doomed to suffer a painful disillusionment.

ELECTRIC COOKING AT A Y.M.C.A. CANTEEN.

THROUGH the courtesy of the British Electric Transformer Co., of Hayes, we are able to illustrate the very complete electric cooking installation which has recently been supplied by them for a new Y.M.C.A. canteen in North London. This canteen is a spacious structure, standing apart from the works, and containing a general dining room and smaller rooms reserved for the works staff and administrative purposes; the architect was Mr. A. Alban H. Scott, of Lincoln's Inn, W.C.

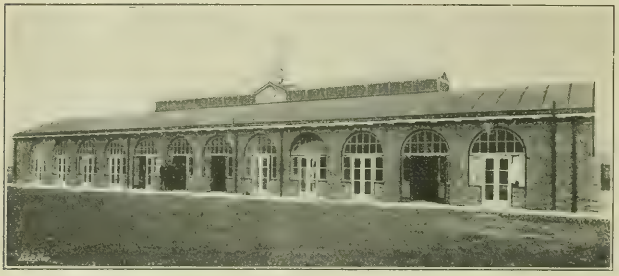


Fig. 1. Y.M.C.A. "Electrical" Canteen in North London.

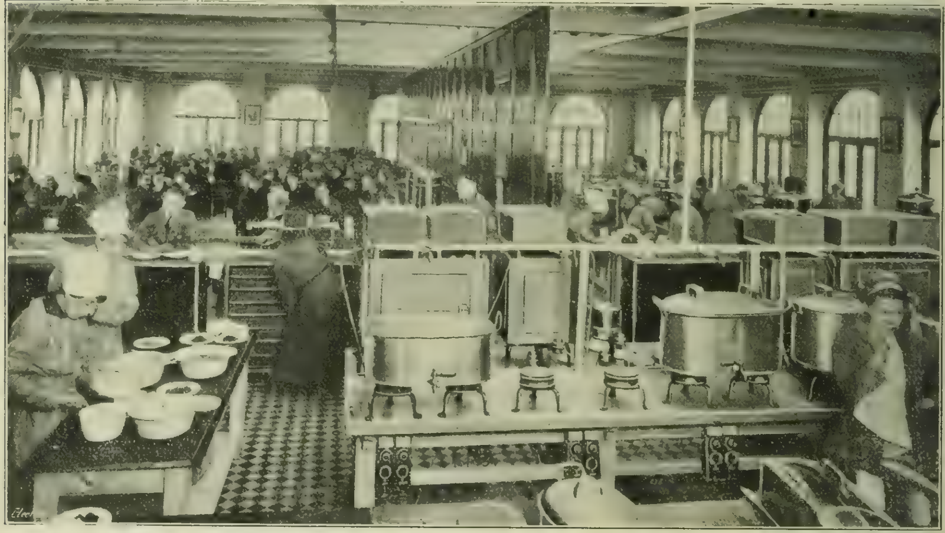


Fig. 2. Interior of Dining Hall with Electrical Cooking Apparatus in the Foreground.

Some idea of the interior can be gathered from fig. 2, which shows the large hall from behind the cooking apparatus, which it will be noted is in the hall itself—there, of course, being no objection to such a situation in the case of electrical cooking apparatus, owing to the absence of smoke and fumes, and absolute cleanliness of electrical cooking operations.

The principal cooking apparatus is concentrated on a large table, which carries two double and two single "Tricity" ovens, and a number of "Tricity" boiling plates, for cooking vegetables, &c. In addition, a carving table and four hot cupboards adjacent to the counters are installed.

The ovens are of the well-known Tricity pattern, with bright, polished exteriors, each single oven having a top and a bottom heater plate of the ribbed type, while the double ovens have two top and two bottom heaters.

The heaters are each controlled by adjacent "high-low" type switches giving 900 or 250-watt loadings, and are coupled to standard control panels arranged round the edge of the table, each panel containing a fuse, D.P. switch, lamp indicator, and plug connection.

The ovens are provided on the top with hoods for simmering puddings, sufficient heat being available for this purpose from the top oven heater.

In all, 14 plain boiling plates have been supplied, the majority being fitted on the table; each plate has two working loadings giving 225 and 850 watts, with near-by control by means of "high-low" switches, and coupled to a standard control panel, as in the case of the ovens. For use in connection with these plates, there have been supplied four large boilers (26 in. × 15 in. × 12 in.), fitted with wire baskets and draw-off taps, for cooking potatoes, vegetables, puddings, &c.; three similar boilers,

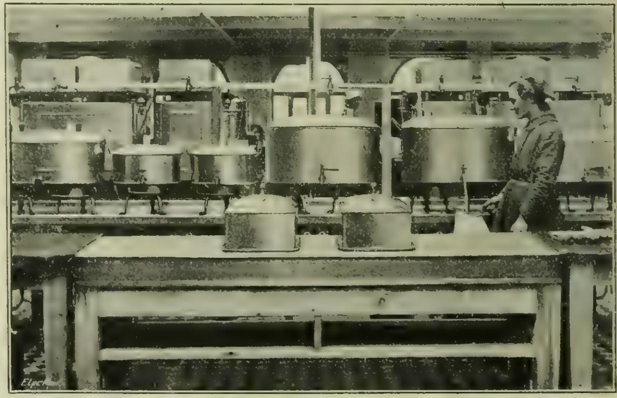


Fig. 3.—Electrical Boilers and Carving Table.

each of 10 gallons capacity, for boiling water for making tea: three ham boilers; also six saucepans of 6 to 12 pints capacity. Two cover plates are provided for standing over the boiling plates, so that several utensils can be heated at the same time.

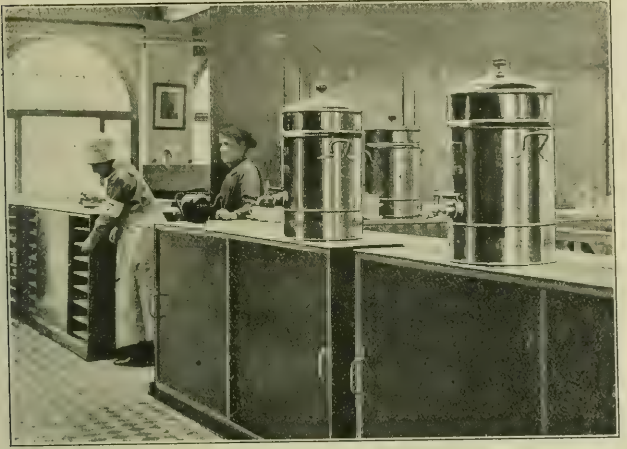


Fig. 4.—"Tricity" Hot-cupboards at a Y.M.C.A. Canteen.

The carving table, 6 ft. 6 in. × 2 ft. wide and 5 ft. high, is fitted with two tinned copper meat dishes and nickel-plated covers, and with 1½ kw. of heaters of the maker's new "Flamingo" (red hot) pattern. The four hot cupboards, each 7 ft. long, 3 ft. 3 in. high, and 1 ft. wide, which form part of the counter enclosing the cooking space, are built up of sheet steel, with angle-iron frames. Three of these are fitted with eight shelves to take plates of meat and vegetables—(64 in each), in order to facilitate serving, while one has five shelves for warming-up food supplied by the men themselves.

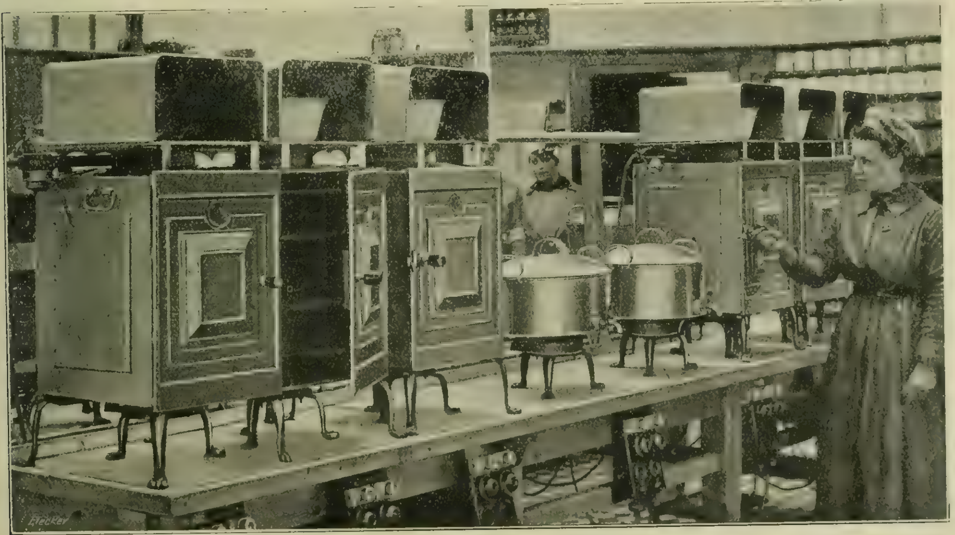


Fig. 5. "Tricity" Ovens and Boilers at a Y.M.C.A. Canteen.

Each hot-cupboard is heated by elements of the "Flamingo" type, with a total loading of 3 kw., controlled by three switches. This apparatus is all operated on 120 volts, the ovens and boilers being balanced on either side of a 240-volt three-wire system of supply, which is introduced through a cast-iron distribution box installed under the cooking table, the outgoing circuits being carried in conduit, with flexible armoured connecting cables to the apparatus. Special heat insulated urns are provided on the counters for keeping the tea warm for serving.

The water for kitchen requirements is obtained from a small Beeston Domestic coke-fired boiler, and an Ideal boiler, working in conjunction with a small electrically-driven centrifugal circulating pump, supplies the hot water required for heating the building.

The canteen is under the charge of a lady superintendent, who is assisted by a staff of voluntary and paid workers, and at the present time about 150 hot meals are supplied at midday and a similar number of light meals in the evenings. Very few firms indeed can boast of such an excellently situated and well-equipped establishment in connection with their works, and both the promoters and users are, in this case, to be congratulated on a happy result.

DECIMAL COINAGE AND THE METRIC SYSTEM.

Our readers will remember that in the autumn of 1915 we devoted a considerable amount of space to the advocacy of drastic reforms in our currency and weights and measures—reforms which, in our opinion, are long overdue, and for which the present circumstances afford the most favourable opportunity imaginable. We showed that, as a result of a series of questions which we addressed to a large number of manufacturing firms in the electrical and allied industries, the replies were in a majority of four to one in favour of the adoption of decimal coinage and of metric weights and measures in this country, and we endeavoured to demonstrate by detailed argument and illustration that the change was desirable in the interests of our manufacturing industries and trade, both internal and external; that it presented no serious difficulties; that the cost and disturbance to manufacturing operations would be vastly less than was alleged by the opponents of the scheme, and that in view of the general reorganisation of our industries and the fierce trade war that would follow the cessation of hostilities, it was imperatively necessary to proceed with the matter without loss of time. That the opportunity to do so is ideal and unique is obvious, for the people of this country have been roused from lethargy by the German attempt to break up and destroy the British Empire, and are ready to receive and consider new ideas; the prices of commodities have been inflated to 50 or 100 per cent. above their normal value, so that the slight change required to decimalise our coinage would be a mere flea-bite; and the reorganisation on an enormous scale of factories and workshops that have been employed for the manufacture of munitions would greatly facilitate the introduction of metric measures on the return of peace, when, moreover, prices will be falling, so that the adoption of metric weights for ordinary commercial transactions would take place in a time of flux. Further, some millions of our fighting men will be returning from the front, where they have acquired a familiarity with decimal coinage and the metric system which, beyond all doubt, will have dispelled their latent aversion towards foreign methods, and will exert a tremendous influence upon public opinion at home.

Arising out of our articles on this subject, correspondence followed, both in our pages and privately, the latter continuing at intervals for over twelve months, and it has become clearly manifest that public interest in the matter is steadily growing. One of the most important developments of the past year in this relation was the formation of the Manchester and District Decimal Association, under the patronage of the Lord Mayor of Manchester and many other distinguished leaders in industry and commerce, with Mr. Harry Allcock as hon. secretary. A particularly significant feature of this movement is the fact that amongst the vice-presidents and on the Council are many of the most prominent men at the head of the textile industry in this country, including the chairman of Council, the hon. treasurer, and the hon. secretary of the Textile Institute (it has always been maintained by opponents of the metric system that our textile manufacturers could not, and would not, adopt metric measures). The Chambers of Commerce of this country have for many years repeatedly passed resolutions calling for the adoption of the decimal system, and quite recently many of our Borough Councils and Corporations have likewise expressed their views in favour of the reform, and it will be remembered that the Council of the Institution of Electrical Engineers included it in its programme recommended to the Board of Trade Committee on the Electrical Industries after the War, while the B.E.A.M.A. similarly commended it to the attention of the Committee. The Associated Chambers of Commerce of the United Kingdom have gone further still, having drafted two Bills relating respectively to decimal coinage and to the adoption of metric weights and measures, which they have circulated to Chambers of Commerce for criticism or approval; and, lastly, we may remind our readers that the Institution of Civil Engineers has arranged to hold a discussion on the subject next Tuesday evening (March 27th), to which members of the Institution of Electrical Engineers and other kindred associations are invited.

In these circumstances, it will be admitted that the subject is very much alive at this time, and it may be useful to discuss briefly some of the points which crop up when this very important matter is under consideration.

In the first place, the proposal to adopt decimal coinage claims attention. This, it is urged by the Decimal Association—which for many years has carried on the campaign with admirable persistency, though hampered by want of funds—should be carried through before the conversion of our weights and measures to a rational system, so that the public may become familiarised with the modified coinage first; we say "modified" advisedly, for our present coinage can be decimalised with the greatest ease, and without altering the value of the sovereign or of any of our silver coins, whilst the change in the bronze coins would not exceed 4 per cent. (this need occasion no loss to the public, as the Government would call in all existing bronze coins and pay for them at the true equivalent rate). We have contended that the sovereign shall be permanently retained as a fundamental standard, thus maintaining continuity with past records, and we are pleased to note that the Coinage Bill of the Association of Chambers of Commerce endorses this view ("Clause 4. The sovereign shall remain as hitherto the 'essential unit' of value. The florin, the tenth part of the said sovereign, and the hundredth part of the said florin (hereafter called the 'British cent') shall become Coins of Account . . ."), though we do not necessarily agree with the nomenclature contemplated in the Bill.

We do not propose to dwell at length on the subject of decimal coinage, as its merits are so generally conceded: the whole world, with the exception of the British Empire (and not by any means the whole of that), Siam, and Persia, has already adopted decimal coinage, and the opposition to the change in this country is weak and of little weight. The saving in time and labour that would result from the reform would be enormous, and would be particularly appreciated in commercial circles; it would, for instance, be possible to adopt adding machines of the same pattern as are used in other countries, instead of the more complicated type required to deal with our factors 20 and 12, and the casting up of columns of figures without mechanical aid, the calculation of interest, &c., would be immensely facilitated. The very fact that we reckon so largely in percentages itself affords proof that the handiness of the decimal system is already fully appreciated in this country, and we feel sure that there would be no greater difficulty in adopting it than has been experienced elsewhere. We hope, therefore, that this most salutary measure will be pressed forward and carried into effect with as little delay as possible.

Turning to the metric system of weights and measures, we find that the opposition to their compulsory adoption is far more serious and weighty than in the case of coinage. The objection which is perhaps most frequently advanced is that the change from our existing units will be very costly to engineering manufacturers, involving the scrapping of tools, jigs, templets, patterns, drawings, and measuring instruments, and the adoption of new standard designs for machines, &c. While there is a proportion of truth in this view, it is so small a proportion that it would be more correct to describe the statement as almost entirely erroneous. No alteration would be required in workshop plant, and no alteration would be compulsory, for the draft Metric Bill expressly states that compulsion would apply solely to sales and purchases, and not at all to manufacturing processes. Take the case of a dynamo maker who preferred to continue manufacturing to British measures; he would not be affected by the Bill except in the compilation of his catalogues and price lists, and as a very large number of manufacturers already embody metric equivalents in their lists, the only effect of the change would be the omission of the British measures—actually a saving in the cost of printing and binding! Needless to say, we do not suggest that he would be pursuing a wise policy in thus depriving himself of the benefits of the metric system in his workshops; we only wish to show that the passing of the Bill into an Act would not necessarily put him to any expense—though we should think that he would soon find it to his advantage to adopt metric units, on account of the handicap which he otherwise would impose upon himself by his adherence to obsolete practice.

So far as existing drawings and designs are concerned, it cannot be too strongly emphasised that no changes in dimensions will be necessary—*it is only the names of the dimensions that must be altered* in order to put the metric system into force. We have shown conclusively that measurements usually stated in thousandths of an inch can be expressed in hundredths of a millimetre to a closer degree of approximation than can be worked to in the shops. A mil is very nearly equal to 2½ hundredths of a millimetre, and hence if dimensions stated in mils are expressed in terms of the nearest hundredth of a millimetre the maximum error cannot be half a hundredth of a millimetre, and the average error will be ¼ of 0·01 mm., or 0·1 mil. Now, it has been proved by extended investigations conducted by the National Physical Laboratory that in practice the accuracy of measurement attained in the workshop is seldom as close as half a mil, and the accuracy of the dimensions of the finished work is still lower, the error averaging more than 1½ mils.

or 7½ times the maximum error that need occur in figuring the drawings in hundredths of a millimetre. (We use both vulgar and decimal fractions of set purpose.) But the great majority of dimensions of machinery do not require anything like so high a degree of accuracy—frequently the nearest millimetre would serve perfectly well, and the cases in which the equivalence must be carried beyond $\frac{1}{10}$ mm. are comparatively few. In proof of this statement we cite the actual example of a dynamo spindle, which we discussed very fully in our issue of November 12th, 1915; out of the 28 dimensions, expressed in tenths of a millimetre, 18 were correct to less than one mil, 24 to less than two mils, and not a single dimension need have been figured beyond the nearest tenth of a millimetre. For very fine work (which, in English units, invariably necessitates measurement to the fourth place of decimals), the hundredth of a mm. serves all ordinary purposes, giving a maximum departure from true equivalence of $\frac{1}{5}$ of a mil (0·0002 in.). Under modern conditions, the use of limit gauges being almost universal, a tolerance, rarely less than one mil, and often much greater, is always specified, so that in such cases to go beyond the hundredth of a millimetre would be mere pedantry. Working to gauges, jigs, and templets, the operator has nothing to do with the figured dimensions at all, and therefore no trouble can arise from the use of the metric system on drawings; those who have to take measurements direct from drawings are, *ipso facto*, shown to possess a reasonable degree of intelligence, and, therefore, readily become accustomed to the use of the new units. That this is so is abundantly proved, if, indeed, at this date proof is needed, by the fact that in innumerable engineering workshops on both sides of the Atlantic, jobs are in progress to both English and metric measures, and no trouble has resulted. It may be interesting to quote here some statements published in the "Correspondence" columns of the *American Machinist*, emanating from readers who disagree with the strongly hostile attitude of that journal towards the metric system:—

"I have worked in shops using the two systems for the past 20 years, and I have yet to hear the first complaint from a practical shop point of view against the metric system. At the works where I am at present, the tool makers and machinists, when they have a job to do where the dimensions are given in inches (such as locating holes in jigs, &c.), invariably transpose them to millimetres, as there is less chance of error in reading measuring instruments in millimetres than in inches, notwithstanding the fact that an equal number of measuring tools are provided for each system. I have had a number of apprentices under my charge from time to time, and I have found that in every case they grasp the method of reading the instruments in the metric system in about as many minutes as they do the other system in the same number of weeks." "Shop calculations are much simpler with the metric system." "I have also observed that it is much easier for draughtsmen to visualise sizes in millimetres than in fractions of an inch. J. Pearman, of Walthamstow.

"A good many of our manufacturers are already using the metric system in filling foreign orders; and I believe that it has become so much the international standard that no foreign buyer asks for any other." "It did not take me long to become perfectly familiar with such of the dimensions as we used. It was certainly not over a month or so before I could think in centimetres as readily as in inches—without any translating of one into the other." W. B. Greenleaf, of Plymouth, Mich.

"While we are talking about the 'cost' and the 'confusion' likely to accompany the adoption of the metric system in this country, the system is being adopted here and there practically without the slightest confusion, and at a cost so nominal, that it is not to be considered. Orders from other lands for materials made to metric dimensions are being taken and filled almost daily by many of our leading industries. It appears to take us no longer to handle an order from France than one from England, the one in metres and the one in inches, the one to be paid for in francs and the other in pounds, shillings and pence. While some learned professor is telling us how 'impossible' it would be for us to work in metrics without the utmost disturbance and at great expense, we are busily engaged in doing exactly that thing, without any appreciable disturbance, and at an expense readily absorbed by the selling price."—*Valve World*, quoted by H. V. Haight, of Sherbrooke, Quebec.

"The metric system was established in Sweden about 1888, to the exclusion of all other systems of measurement. . . . At the time when this law was passed I was connected with the Gothenburg Mechanical Works, employing between 1,000 and 1,200 men. The lines of manufacture were steam engines, steam boats, rolling stock for railroads, bridges and other structural work, paper-making machinery, agricultural implements, &c. The change from inches to millimetres was immediately started. All new drawings were made in the metric system, and when an old drawing was to be used the dimensions in inches were enclosed by parentheses, and the dimensions in millimetres added. At that time Swedish, English, and Prussian inches were used in shop work. It was a relief to throw them out and use millimetres. In this shop the metric system reduced the number of errors in the drafting room and the cost of manufacture.

"The change was carried through with practically no expense whatsoever. The taps in the Whitworth system were kept, as they had to be used for repair work. Later on metric taps were gradually substituted. The only direct outlay was for scales, as a greater number had to be procured at once than were required for replacing worn ones. This extra expense did not amount to $200.

"It is surprising to see how the use of the metric system is spreading in this country [U.S.], and the time seems to be drawing near when this adoption will be general. Carl F. Jeansen, Ordnance Engineer, Washington Navy Yard, D.C.

The following quotations from other sources may also be of interest:—

"It is surprising with what facility the average soldier becomes accustomed to French money. Everything out here is bought and paid for on the decimal system. The men and officers receive their pay in French money. I have seen bills made out and paid by officers' orderlies which show that they are quite at home in the French system. . . . Everybody out here has become familiar with decimal money, weights, and lengths, and knows roughly the ratios between them and corresponding British measures. The present opportunity is one which ought not to be missed. C. F. France, in *Nature*.

"We who live and do business on the Continent of Europe are, perhaps, better able to judge than the great mass of people in England of the enormous advantage this change would bring to England and English post-war trade and commerce with foreign countries. It would also doubtless be greatly appreciated in England itself after it had been given a short trial, entailing as it would the abolition of our present complicated and well-nigh incomprehensible system of weights and measures. The present moment would appear to be a very favourable one for the change."—J. T. Trewhella, in the *Bulletin* of the British Chamber of Commerce for Italy.

"Two years ago American factories worked under (as we do to-day) the 'foot and inch' measurements: then orders for millions of shells and other war materials came from countries who used the metric system, and their orders were as described in their specifications.

"The engineers in America now find it easier to work on the 'metric' measurements than to reduce them to the 'foot and inch,' consequently the workers as well as the employers have a very extensive and practical knowledge of its use, and it has been a revelation to them to find how much simpler it is compared with the 'foot and inch' and its unwieldy fractions. There is now very little doubt that by the end of the war it will have become their standard measure in America.

"This is an important point for consideration, as to whether England should not at once decide on adopting it, for if the Americans use it as their standard, it will greatly influence the markets of South America, where only the metric system is in use: it would also handicap us in competing with America in countries where we now find considerable difficulty in doing trade, on account of our different measurements." T. B. Callard, of Chesham Bois, Bucks, in the *Times*.

"The question of introducing the metric system into the United Kingdom after the war is receiving close attention. We sincerely hope that means may be found to do this, as, apart from its inherent convenience and superiority over the existing system, its adoption, more particularly as regards weights and measures, would undoubtedly tend to facilitate and to augment trade with many foreign countries, particularly the South American Republics. *Review of the River Plate*.

We could go on to quote from the utterances of numerous authorities in commerce, finance, and engineering as to the pressing need for the reform that we are advocating, but considerations of space forbid it, though we possess abundant material. We can only deal with a few of the stock arguments with which the proposal is met. Arguments about the inaccuracy of measurement of the earth-quadrant are irrelevant; the metre, as we know it, is the distance between two points on a certain metal bar, and no one cares a doit about its relation to the earth's circumference.

With regard to the effect on standards, such as those of the British Engineering Standards Committee, a point on which Dr. C. C. Garrard laid stress in a letter to the *Times Engineering Supplement*, it is a mistake to suppose that, as he suggests, they would all have to be scrapped. They need not be altered at all, though, as they came under revision (and standards, if they are to be of any use, *must* be revised from time to time) they could be modified if it were found desirable. Steel rails, for example, could be sold by the metre or metric ton as easily and conveniently as by the yard or ton, and, in course of time, on the reissue of the specifications, the dimensions of the treads, flanges, &c., could be refigured in millimetres. It should be borne in mind that no standards ever are, or ever can be, *exact*; allowance is invariably made for variation from the specified dimensions, and this, in the case of steel rails, covers a range of 1 per cent. (by weight). Hence it is not necessary to employ equivalents precise to the tenth of a millimetre in such tables. In figuring to the nearest millimetre, the maximum error is only $\frac{1}{50}$th of an inch, and the average error $\frac{1}{100}$th inch. As a first step, the metric equivalents may be added to the English measures, and eventually the latter will fall out. In this connection it is interesting to note that the Newcastle Local Section of the Institution of Electrical Engineers has adopted unanimously a resolution urging the Standards Committee to prepare modified specifications in readiness for the adoption of the metric system, and to state new standards in even metric measurements. Now, Tyneside is one of our principal engineering centres.

Another point of importance in this relation is the fact that many "standards" are merely nominal, and might just as well be denoted by letters or numbers as by figured dimensions, as the latter are not used in practice. Take, for example, the case of steel conduit; the outside diameters are specified with limit gauges having tolerances varying from 2 to 8 mils, but the inside diameters are nominal, and are determined by the weight, which must fall between limits affording a range of 10 to 18 per cent. The thicknesses of dielectric and lead sheathing for copper conductors are mostly stated in mils; but a variation of 10 per cent. below the standard minimum thickness is allowed, and the thickness may exceed the specified value at pleasure. Similar latitude is met with in scores of cases in the standard specifications, indicating plainly that the substitution of metric units would not usually necessitate any modification in the actual sizes. The standards for the heads of small screws (Report No. 57) are all based on mm. and converted to mils, using the nearest mil.

Having examined many of the B.E.S. specifications, we have come to the conclusion that no difficulty need be anticipated in adapting them to the metric system, with practically no breach of continuity or inconvenience to manufacturers or users of the materials dealt with. On the other hand, there is undoubtedly a difficulty in connection with rolled and drawn metal sections, such as rods and bars, shafting, &c., of which during the transitional period it might be necessary to carry stocks in both dimensions; these, as well as drills, would eventually have to be provided to even metric sizes—but in very few other cases would even measures be necessary. The wire and sheet gauges need not be altered, and their metric equivalents are already given in the tables. In this connection we would enter a plea that in giving equivalents in the two systems, the figures be confined to the necessary and sufficient limits. Fine work may be measured and wrought to the ten-thousandth part of an inch, and that is the extreme limit with hardly any exceptions; there is never any need, therefore, to carry the English equivalents beyond the fifth place of decimals, which enables the fourth to be correctly defined, and it is rarely necessary to go beyond four places. Similarly in giving metric equivalents of English measures, it is sufficient to give at most three decimal places. The foregoing applies to small length measurements in terms of inches and millimetres, but when larger sizes are in question, still fewer decimal places will often suffice, and when dealing with areas, volumes, and weights, five significant figures (giving a minimum accuracy of the order of one part in 10,000) meet all practical requirements. We refer, of course, to workshop conditions.

As regards the textile industries, which are usually held up as inveterate opponents of the metric system, we have already mentioned that in Manchester leading textile authorities are actively supporting the movement towards its adoption. Metric measures have actually been employed in the Department of Textile Industries of the Bradford Technical College during a term by way of experiment, under Prof. A. F. Barker, Director of the Department, who reported that "were it a necessity to change from the various English to the metric measures, such a change would be made as easily as the transition from the Leeds to the Bradford, or Bradford to Manchester trade; in fact, greater changes have already been introduced into certain trades with little disturbance. . . . It was truly surprising how quickly one adjusted oneself to the new conditions." In Germany last year, a committee of German cotton-spinning organisations, representing 96 per cent. of the 12,000,000 spindles in the Empire, unanimously decided to recommend to the Imperial Government the introduction of the metric system of numbering yarns, the present time being considered favourable for making the change.

In conclusion, to those who are opposed to the metric system on the ground that they consider the English units superior, we would say: if you asked a "metric" country to adopt our measures, what answer would you expect to receive? Would any such country entertain for one moment such a suggestion? If not, why?

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

New Electrolysers.

The use of electrolysis for the production of sterilising liquid has proved highly successful during the war, on board ship and in hospitals and laundries, and Messrs. Vincent Roberts & Co., of Leeds, who have acquired much experience in this connection, have recently introduced improved types of apparatus designed to facilitate and extend the employment of electroylsed brine and sea-water. Their patent electrolyser, which is illustrated herewith (fig. 1), consists of a rectangular box of porcelain divided by the electrodes into a number of compartments, so arranged that the brine entering at the highest point at one end flows down under and over the electrodes until it passes out at the lower end, charged with hypochlorite of soda. The illustration shows a complete installation, comprising the brine dissolver and agitator on a strong wooden stand, automatic supply tank, slate storage tank with liquor level and stone tap, and the electrolyser with its switchboard and accessories.

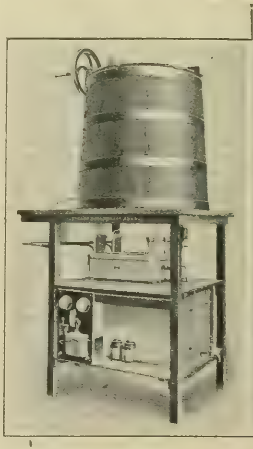


Fig. 1.—Laundry Electrolyser.

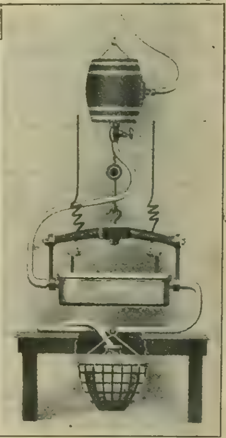


Fig. 2.—"Reuss & Roberts" Electrolyser for Ship Use.

The strength of the solution, with a constant current, is regulated by the rate of flow of the liquid, which can be adjusted to suit requirements, and kept there by means of the automatic feed tank, which is provided with a float valve and adjustable feed valve set to deliver 12 gallons of brine per hour. The current required is 8 to 10 amperes at 110 volts, and the product contains 3 gm. of available chlorine per litre (= 0·3 per cent.). Besides its property of sterilising clothing, &c., the liquid has the power of bleaching all vegetable fibres, without destroying the material, and does not curdle soap, but rather saves it by promoting lathering. Tests made by the medical officer of the L.C.C. Asylum at Bexley show that with the electrolysed product diluted to a strength of 0·5 per thousand, any fabric can be bleached and sterilised with safety and economy.

Of course, the type of apparatus referred to could not be used on board a ship, owing to the movement of the latter; but fig. 2 shows a new patent type which meets the conditions, the whole apparatus being suspended from above, and the connections made with flexible tubing, so that the process can be carried on continuously, independently of the ship's motion. The electrolyser itself can be set at the proper inclination by moving the suspension hook towards one or other end of the beam which is pivoted on it; the porcelain spouts at the ends serve as pivots, as well as inlet and outlet, and thus enable the vessel to be inverted for cleaning. The automatic brine tank also has to be slung, to prevent interference with the action of the float controlling the feed; and the collecting tank is slung below the rest of the apparatus, to prevent the liquid from being churned up in contact with air. which would tend to decompose it.

Wadsworth Lifts and Transporters.

Messrs. Wadsworth & Sons, Ltd., of Bolton, manufacture a great variety of lifts, hoists and transporter gear, of which we illustrate typical examples. Wadsworth lifts are built for either continuous or alternating-current working, and for the following methods of control:—(1) Hand-rope; (2) switch-in-car; (3) semi-automatic ("up," "down" and "stop"), pushes on landings and in car, and (4) full automatic push control from landings and car.

The first and second systems are suitable for slow and fast speed. goods and passenger work respectively; the semi-automatic type is generally used on light goods' lifts, and occasionally for passenger work, while the complete automatic type is for passenger work.

We illustrate a Wadsworth undertype lift machine in fig. 4: with the exception of the motor, it is manufactured throughout by the firm, as also over-type machines for similar work.

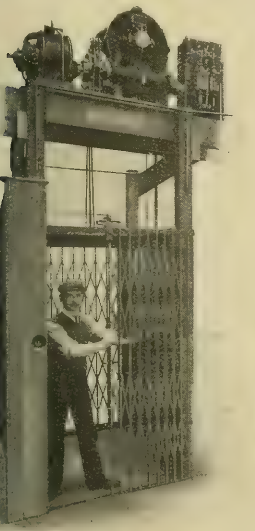


Fig. 3.—Electric Lift: With Overtype Machine.

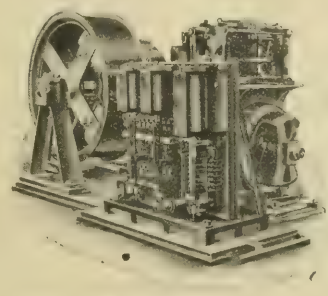


Fig. 4.—Standard Electric Lift Gear.

Fig. 5.—Transporter in Messrs. Lever Bros.' Works.

The lifts are fitted with collapsible gates or hinged doors, which are provided with the firm's improved electromechanical lock.

Fig. 3 shows a lift fitted with collapsible gates and with hoisting gear mounted above. Messrs. Wadsworth also supply a patent belt-driven lift in which the belt movement "on" or "off" is electrically operated by a switch in the car, this arrangement placing the belt-driven lift on the same plane as the car-switch controlled electric lift. The absence of hand-ropes and chains is an obvious advantage, and the doors can be fitted with safety mechanism preventing starting unless the doors are closed and bolted.

Fig. 6.—Five Electric Transporters at Port Sunlight.

Figs. 5 and 6 illustrate Wadsworth transporters in use. These are built in sizes ranging from 3 cwt. to 80 cwt., and for any speed. and can be arranged to travel any distance in a straight line.

These transporters are rope or motor-driven, one handle controlling all motions, the handle movement corresponding to the movement required of the transporter. Two types of transporter carriage are supplied; one of rigid construction, suitable for short-distance travel where fast speed is not really essential, and one, arranged with swinging pulleys, to allow of goods being picked up or deposited at each side of the traveller beam. The carriage is provided with safety catches to automatically arrest the carriage at each end of the travel without exerting any strain on the stop blocks.

Messrs. Wadsworth are also makers of warehouse jib cranes friction hoists for electric or belt drive. and hand lifts.

THE NEW BUFFALO POWER STATION.

Recent issues of the *Electrical World* and *Power* describe the new steam power station of the Buffalo General Electric Co., which has come into being through the curtailment of Niagara power imported into the United States from Canada.

The supply to the Buffalo Co. from Niagara sources is said to fall at least 25,000 h.p. below requirements. The new plant will provide sufficient energy to carry all peaks at present and to meet additional load demands for some time. The new station is built on the bank of the Niagara river about seven miles north of Buffalo, and has an initial equipment of three 20,000-kw. horizontal turbine sets, while a 35,000-kw. set is on order for starting up early next year. The ultimate capacity of the station is given as 210,000 kw. Particular interest attaches to this installation, as it has been designed with a view to competing with the power now purchased by the company from Niagara hydro-electric sources.

Construction was begun in January, 1916, and the first turbine was in commission on November 20th of the same year.

The building is a steel frame structure, with outside walls of brick, consisting of a boiler-house with overhead bunkers, turbine and switch houses; the foundations rest on 167 concrete caissons sunk to bed rock.

Coal is received by railway, and dumped into hoppers, each holding several car loads, which discharge into crushers, which are in duplicate, and each of which feeds a bucket elevator for lifting the coal to a belt conveyor running above the coal bunkers. Two 30-in. wide belt conveyors run over the bunkers; the conveyor and elevator, and crusher feeding the latter, are provided with emergency push-button control at several points.

The completed design provides for an external coal yard with travelling bridge crane and a storage capacity of 50,000 tons, which will be connected by belt conveyors with barge unloading hoists on a coal wharf on the river side. The overhead bunker capacity is 2,500 tons, fuel being spout fed to the stoker hoppers below.

Five double-ended Babcock boilers are installed at present, the firing aisles being arranged across the building, so that both ends are accessible, with a central connecting gangway running the length of the building. The boilers are designed to supply steam at 275 lb. working pressure, with 275 deg. F. superheat; each has 11,400 sq. ft. of heating surface, and is fired by two 15-retort Sanford Riley stokers, one at either end, the ratio of heating surface to grate area being 36 to 1.

The stokers are of great size, the furnace width being nearly 24 ft., and the combined depth 13 ft. 4 in., giving a total grate area of 319 sq. ft. The distance from the top of the grate to the front header is 10 ft. 10 in., and from the top of the grate to the rear header 6 ft. Each stoker is driven by a 25-h.p. Sturtevant engine through link belt chains. Forced draught is supplied to the stokers by three fans, each driven by 300-h.p. geared turbines, the air being normally drawn from the main generator system.

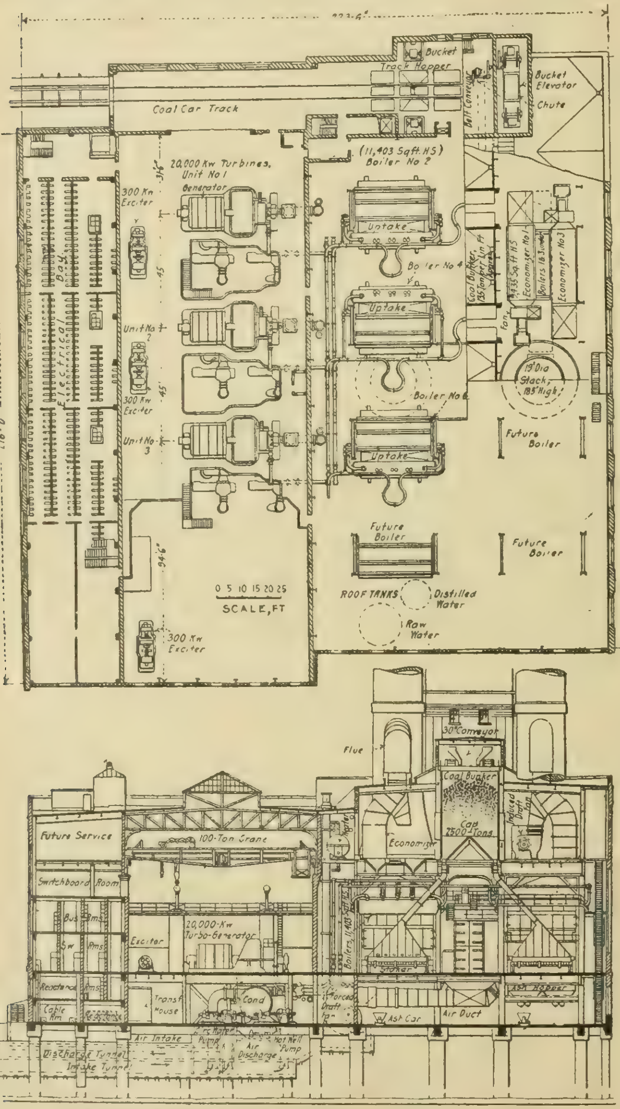
The boiler setting walls are of firebrick, covered by ¼-in. asbestos millboards and magnesia blocks 4 in. thick, the whole being enclosed in airtight steel casings, with removable panels. The boiler fronts are of steel plate lined with 2⅝-in. magnesia.

When burning coal at the rate of 700 lb. per hour per stoker retort it is expected that each boiler will show an actual evaporation of approximately 140,000 lb. of steam per hour.

Each boiler is provided with a Green economiser of 9,435 sq. ft. heating surface in 576 12-ft. tubes, designed for a working pressure of 225 lb. The economisers are arranged in pairs over the firing aisles of the boilers, and are cased in steel with asbestos heat insulation; the soot is withdrawn by an ejector system. An induced-draught fan is installed at the exit of each economiser, giving a static pressure of from 2.5 in. to 1.5 in., the power required varying between 18 H.P. and 130 H.P. The fans discharge into two superposed brick-lined steel stacks each 18 ft. in diameter inside and 185 ft. high above the grates.

The make-up water for the plant is obtained from the Niagara River, and distilled in an evaporating plant with a capacity of 15 tons of distilled water per hour; the guaranteed evaporation is 2.5 lb. per lb. of steam supplied. The apparatus includes a feed heater, a heat exchanger, a desuperheater, three evaporators, a condenser, and a special distiller for furnishing drinking water, with an aerating filter.

The use of distilled water was justified by the intention to run the boilers at high rates of evaporation, towards which absence of scale was a necessity.



Plan and Elevation of the new Buffalo (U.S.A.) Power Station.

The three turbines are of the single-cylinder horizontal Curtis type running at 1,500 R.P.M. The steam guarantees were: at 7,500 KW., 11.85 lb. per unit; 10,000 KW., 11.05 lb.; 15,000 KW., 10.25 lb.; and 20,000 KW., 10.60 lb.; the turbine rated capacity per sq. ft. of floor area is 24 KW.

Three 300-KW. exciters are installed, each coupled to an induction motor and steam turbine, the governing of the latter being so arranged that the turbine will pick up the load if the motor fails. The main turbines exhaust into 33,000 sq. ft. Westinghouse condensers, each of which has two 25,000 gal. centrifugal pumps driven by geared turbines, two turbine-driven hot well pumps, and one double Le Blanc dry-vacuum pump, also turbine driven. The condensate from the turbines is delivered to three 10,000-H.P. Cochrane horizontal heaters, which use the exhaust steam from auxiliaries, enough of which are run non-condensing to supply the necessary steam to give a normal water temperature of 160 deg. F., which is best suited for the economisers.

The exhausts are those from the turbines driving exciters and forced draught fans; boiler feed, low service, hot well, condenser water circulating and air removal pumps, which are, of course, free from oil, also the exhaust from the stoker engines, which is passed through an oil filter. The drips from the high-pressure steam piping and condensation from the station steam heating system are also led to the heaters, and should the water level in the latter fall below a fixed point, distilled water is allowed to enter through a float valve, while in emergency raw river water can be introduced.

Three 1,000-gal. per min. three-stage pumps driven by turbines force the feed water either direct or through economisers to the boilers, which it enters at 270 deg. F., the amount of water being automatically governed by apparatus controlled by the rise and fall of steam pressure in the pipe lines. Duplicate steel steam and feed pipe lines are installed, with cast steel fittings, valves, &c. The condensers are spring supporter, with no expansion joint between condenser and turbine, but rubber expansion tubes are provided in all water connections, &c., to the condenser. The stokers are provided with electric tachometers having two scales, showing speed of shafting and pounds of fuel per hour; stoker air pressure is also indicated, and recorders are installed for feed and flue gas temperatures and CO_2.

A 10-in. low pressure connection is provided on each main turbine to take surplus exhaust steam from the auxiliaries beyond that required for water heating. Solenoid-operated trips are connected with the main throttle, auxiliary throttle and vacuum breaker of each unit, so that the opening of the main generator circuit simultaneously shuts off all steam from the machine and destroys the vacuum.

The complete permanent testing plant is a feature of the station; a rotating dry vacuum pump is installed to allow of tests on the main condensers, which are operated with hydraulic dry vacuum pumps, and a gasometer to allow of volumetric tests being made. The testing plant for the station auxiliaries includes a 1,400 sq. ft. surface condenser, with a weir for measuring condensate, &c. An automatic coal sampling plant is installed in the coal elevator tower with a crusher, for each elevator.

The three alternators are each two-pole self-ventilating machines rated at 22,222 K.V.A., supplying three-phase, 25-cycle current at 12,000 volts direct to the bus-bars and outgoing lines. The electrical bay extends the entire length of the building, and has six floors containing the main switchboard equipment, of which a feature is the provision for a great number of outgoing feeders.

Each generator is connected through disconnecting and non-automatic oil switches to a reactor bus, and from the latter through 2 per cent. synchronising reactors and oil switches to a common synchronising bus, also through 5 per cent. generator reactors and non-automatic selector oil switches to sectionalised feeder buses in duplicate, one generator having its own feeder-bus section for 12 feeders. Each feeder has an automatic oil switch, and provision is made for feeder reactors. A length of 45 ft. per generating unit is provided in the electrical bay, and is separated by concrete walls from adjoining spaces. The neutral connection of the Y-wound generators is grounded through an oil switch and 5-ohm resistance. The generator leads are varnished cambric insulated, carried in concrete-cased fibre duct, and connected to strap-copper buses, all main conductors beyond being of strap-copper separated by barriers. The main control board is of the Westinghouse vertical panel type. Direct current for oil switch operation and emergency service is supplied by a 60-cell battery of 200 amp. rating for one hour.

The late Mr. Henry G. Stott was the consulting engineer, and the Stone & Webster Construction Co. were the designers and constructors, under his direction, of this plant.

WAR ITEMS.

Power Station Volunteers.—At Philadelphia (Co. Durham), a power station platoon is being formed in connection with the County Volunteer Regiment.

Exports to Liberia.—The "London Gazette" for March 16th contains a lengthy list of persons and bodies to whom exports to Liberia may be consigned.

Trading with the Enemy.—The "London Gazette" for March 16th contains additions to, and corrections in, the lists of persons and bodies with whom trading is prohibited in Argentina and Uruguay, Bolivia, Brazil, Chile, Netherlands, Norway, Spain, Venezuela, &c.

Loans for New Works.—The Local Government Board explain that, by arrangement with the Treasury, they cannot sanction loans for new works except those of pressing necessity either for reasons of public health or on account of war requirements.—*Times*.

Station Staff Separation Allowances.—The Shoreditch B.C. Electric Lighting Committee has reported that the rate of Government separation allowances payable to wives and families of men serving with H.M. Naval and Military Forces having recently been increased in view of the additional cost of living, the question has arisen as to whether, in cases where the increased separation allowance is received by dependents of officers and men in the Council's employ, the Council's allowance should be correspondingly reduced. The Committee recognises that the increase in the allowances has been made solely on account of the increased cost of living, and recommends that, notwithstanding any increase in separation allowances in consequence of increased cost of living, the Council's present allowances to wives of men on active service be continued in all cases at the rates now being paid.

Restriction of Electrical Imports.—We learn from the *Journal* of the Tramways and Light Railways Association that the Board of Trade requested the B.E.A.M.A. to collect in detail and without loss of time the essential requirements for the home trade of the following electrical accessories for twelve months ahead:—

Bells (electric) and relays for same.
Adaptors for lampholders.
Fans (electric) and parts thereof
Lampholders (with and without switches).
Electric lighting accessories, porcelain with metal fitments.
Cut-outs, round and oblong.
Ceiling roses, two-plate.
Counterweights, pulleys and rings.
Wall switches, tumbler and rotary.
Reflectors, metal and glass.
Brass and copper component parts for electric lighting accessories.
Electro-medical apparatus or material.
Telephone relays.

The secretary of the B.E.A.M.A. wrote to secretaries of the Tramways and Light Railways Association and of the Municipal Tramways Association, under date January 12th, 1917, stating: "In order that your members may not experience undue inconvenience through shortage, it is essential that they should provide this information as quickly and accurately as possible."

Birmingham Electrical Engineers Volunteers.—The services of the Birmingham Electrical Engineers (V.), attached to the Royal Naval Volunteer Reserve, are highly appreciated by the Admiralty, and their usefulness is fully recognised. Probably engineers throughout the country will be interested to know what the Corps is doing. Recruits are drawn from the following skilled trades: Turners and fitters (with experience in screw-cutting), electrical instrument makers and repairers, wiremen (with experience in turning and fitting), armature winders, coppersmiths, acetylene welders, blacksmiths, moulders (metal), carpenters and joiners, and mechanical draughtsmen. They are sent to depôt ships, where they are engaged in experimental and constructional work. Fifteen months ago the Corps made arrangements with the Admiralty whereby members were accepted for periods of temporary service, and the scheme was started by 10 Volunteers being sent to H.M.S. *Vernon* at Portsmouth. The numbers gradually increased, and the Admiralty was so pleased with the work done that it opened two more depôt ships—H.M.S. *Defiance*, at Devonport, and H.M.S. *Actaeon*, at Sheerness—to Birmingham recruits. Seventy Birmingham men are now on board these three depôt ships, but altogether 170 men from the Corps have served varying periods since January, 1916. Recruits skilled in the above trades are still needed urgently, and they can enrol either for continuous service or for service at regular intervals for not less than two weeks at a time. The pay for temporary periods of service is 17s. 6d. per week, with food and uniform, and for those who enrol for continuous service separation allowances will be available. Travelling expenses are paid by the Admiralty. The Corps provides a splendid opportunity for those who wish to do their duty to the country, but who are under or over military age, are physically unfit for military service, are discharged from the Army as unfit, or have been badged by the Ministry of Munitions. In the latter case the men may serve in periods, but they must obtain their employer's written permission to do so.

Mr. David Shanks, J.P., is Commanding Officer, and Mr. S. Thos. Pemberton, A.M.I.E.E., is Company Commander and Adjutant. Full particulars of the movement can be obtained from the latter at 8, Church Street, Birmingham.

Exemption Applications.—At the Shoreditch Tribunal, Mr. R. J. Jacobs, aged 30 years, of 94, Leonard Street, E.C., electric pocket-lamp manufacturer, came under review under the new Order, being under 31 years of age. He said he had been in the trade some time, but started this business in July, 1915, with the patriotic motive of trying to capture the German trade in these things. Mr. Harwood said he wished to point out that he started 12 months after the war. Captain Fisher said it was clear that that was the time when the electric pocket flashlamp came so much into use. In reply to Mr. Harwood, Mr. Jacobs said he got his machinery from America. He employed from 60 to 65 hands, but of these only four were males, two men and two boys. When he got the full amount of machinery he required he would be employing 100 persons. The demand was now much greater than it had ever been before. His brother, who was three years older than himself, had gone, and he was the only one left who could carry on the business. The Tribunal decided that it was a very necessary and prosperous business, and allowed another six months' exemption.

At Batley Tribunal, Mr. S. D. Jones, of the Corporation electricity department, applied on behalf of 14 men at the works. It transpired that one or two of the men were leaving and getting work elsewhere. The Chairman of the Tribunal questioned whether they had any right to do so, and Mr. Jones replied that the electricity works of Batley was not a certified or controlled place. They supplied power to munition works, but the Munitions Department would not give them a certificate as a controlled undertaking. A member of the Tribunal remarked that men between 16 and 61 were not allowed now to change situations without permission of the Director of National Service, and the Chairman added: "If anybody is retained, it should be in a place like yours." Mr. Jones said he had lost his chief assistant, who had gone away with the permission of the Council, and he had advertised and could not get a man to fill the position. The Military Representative said these men who were leaving would have to be followed up. Mr. Jones said he could not spare R. Greenwood (19), single, the junior engineer, as there was nobody to replace him. He was competent to take charge of machinery in the absence of the chief engineer. The Tribunal thought so young a man ought to be spared. Eventually the following were the decisions:—Conditional exemption, J. Brown, 35, single, stoker; A. Reid, 41, married, engine fitter; J. D. Mosley, 40, married, cable jointer; S. Wadsworth, 36, married, stoker. Temporary exemption to May 15th: H. Hesling, 30, married, engine driver; P. M. Maxwell, 31, single, mains superintendent; F. Crossland, 37, married, jointer's mate. Grace to May 1st: R. J. Greenwood, junior engineer; A. Russling, 23, single, station superintendent. Disallowed, without grace: J. Ainscough, 36, married, shift engineer; I. Gill, 30, married, labourer. Adjourned for medical examination: S. J. Kench, 26, single, clerk; J. Allerton, 39, married, general labourer; J. Monoghan, 33, married.

At Faversham, the Corporation appealed for W. J. Lloyd (29), engine driver and switchboard attendant at the electricity works, and H. J. Gregory (28), switchboard attendant. The Military Representative asserted that there had been sufficient time to get substitutes or to train men for the work, but the electrical engineer (Mr. Sommerville) replied that when he consulted the Labour Exchange there was not a man available. A final two months was granted in each case to give an opportunity to train other men.

At Folkestone, 12 employés were appealed for by the Electric Light Co., and conditional exemption was granted to the engineer-in-charge of the power house, two fitters, a commercial and analytical clerk, a stoker, and a confidential clerk. The others were exempted unless and until substitutes could be found.

At Hastings, the Corporation electricity department claimed the retention, as being indispensable to the running of the works, of E. A. Down (18, in B1), junior engineer, and J. G. Francis (18, B1), apprentice in the meter test room. Mr. R. F. Ferguson said that the works were run with a staff down to the absolute limit, and men capable of doing the work could not be got. Two months were allowed in each case.

At Oxford, the Military appealed against exemption granted last May to W. G. Payne (29), electric fitter and wireman with Messrs. Hill, Upton & Co., electrical engineers. For the firm it was stated that Payne was engaged nearly the whole of his time on Government contracts, and often for seven days a week. He was the only skilled man on the present work of installing the electric light at Christ Church, and at Pembroke, for the Royal Flying Corps, and when that was finished he had other military work at the base hospital and New College. Out of 24 men, the firm had only four left, and they had 11 female employés. Captain Fox said that the man's qualifications would make him useful in the Army. The certificate was withdrawn, with a month's grace.

At Gloucester, the Corporation electricity department appealed for two tramway motormen. It was stated that there was a considerable shortage of motor men, and that it was impossible to obtain candidates for instruction. The Military contended that both men could be spared if the Westgate Street route was again closed down. One of the men was conditionally exempted, and the other appeal was refused.

At Bexhill-on-Sea, the Corporation applied for exemption for two shift engineers at the electricity works, aged respectively 21 and 22. Mr. Frost stated that substitutes had been advertised for, and out of three applicants only one was of use to them. A woman, he added, would be no good. The appeals were respited for a month for substitution.

The Military applied, at Reigate, for a review of exemption held by R. Partridge (34), electrician, with Messrs. Tamplin & Makovski, electrical engineers. Mr. Makovski said that Partridge was his principal outdoor man, and they had a large amount of Government and public work on hand. He told the Tribunal that last May one of his employés was called up, but he was sent back and told to wait. He hung about until November, and he then got his Trade Union to get him badged. He was now with a competitive firm hanging lights at Holborn, work which his own firm should have done. The Tribunal cancelled the certificate, and gave temporary exemption until June 13th.

At Aldershot, on March 12th, a review was made of the case of F. Woodley (27), electrical engineer, with Messrs. Burch & Vertue. It was claimed by the firm that he was engaged entirely upon electrical work in the Aldershot Command, and that he was doing National Service. The Chairman (Mr. W. T. Robertson, J.P.) said that if the man's services were so valuable to the military, it was up to the military to find a man to do the work. The exemption was withdrawn.

At Stratford-on-Avon, an appeal was made by J. Clifford (27), formerly an electrical turbine worker at the works of the British Thomson-Houston Co., Ltd., at Rugby. It appeared that he left when de-badged, and recently was given 14 days in which to obtain work of national importance, the idea being that he could get reinstated at Rugby, in which case he would be given exemption. It was stated that the B.T.H. Co. were willing to reinstate Clifford, providing the Tribunal granted exemption. This was conceded, but the Military threatened an appeal.

Before the Dartford Rural Tribunal, the Military appealed against exemption held by F. W. Montgomery, electrician with the Wallpaper Co., on the ground that he was now in an uncertified occupation. The firm urged that it was most important that a competent man should be in charge of their large plant, as two men had been electrocuted. It transpired that, by arrangement, the firm had released all men who could be spared, and the Tribunal dismissed the appeal.

The British Mechanical Electric Vehicles, Ltd., applied at Southport Tribunal for exemption for J. E. Stott, Group 40, passed B 1, manager and designer of electric trucks. A director of the firm said their's was the first British company of that kind, and the Ministry of Munitions had given them permission to manufacture these trucks for railway and shipping companies. There were some 3,300 of such trucks in use in America, but under 300 in Great Britain, and he came from Australia to start the industry in England. Exemption to April 16th granted.

Mr. A. S. Black, Corporation electrical engineer, appealed at Southport, on Friday, for W. Johnson, nearly 41, a skilled man engaged in the maintenance of consumers' installations; J. Hesketh, storekeeper, C 2, and R. A. Twist, meter tester, B 2. The appeal for Twist was refused, and others were given exemption to June 1st.

THE PRINCIPLES INVOLVED IN COMPUTING THE DEPRECIATION OF PLANT.

On March 12th Messrs. Gill and Cook's paper was read and discussed before the Newcastle Local Section of the Institution of Electrical Engineers.

Mr. **Gill**, in introducing the paper, said its object was to arrive at a solution of the principles by which the cost of depreciation could be arrived at. They were, at the moment, concerned with the ascertainment of depreciation, and not how it was to be met. It was an actual cost, and there should be some common method of arriving at it.

Mr. F. G. C. **Baldwin** thought the paper solved many of the difficulties that had confronted them for several years. He was especially pleased to see it stated that depreciation affected the design of plant. There was a general tendency amongst those who controlled capital to look first to capital cost and then to charges. He agreed that it might be advantageous to spend extra capital to reduce annual charges. Too often that was disregarded. Engineers should be a little more interested in the financial aspect of the business than at present.

Mr. **Turnbull** referred to the Telephone Arbitration, and pointed out that in that case the "straight-line" method of deprecation was accepted. He also referred to the way the railway companies had treated the question, and asked Mr. Gill's opinion in regard to "negative" depreciation. In the case of the adoption of the sinking-fund method, he thought some allowance should be made in the early years of an undertaking.

Mr. A. C. **Hovey**, speaking from a gas engineer's point of view, thought there should be greater co-operation between the accountancy and the engineering departments. He mentioned that large gas undertakings, on going to Parliament for new powers, were being severely dealt with, especially in respect of anything they asked for in regard to improved methods of finance. In some cases the renewals funds had been struck out, and would not be allowed in future. They were very necessary and important funds, and it seemed a great pity they should have been done away with.

Mr. **Beard** said he thought the sinking-fund method must be the right one; he was of opinion, however, that there might be some difficulty in arriving at the "life" of some plant. He did not see how the economic life of plant could be estimated; also, the amount to be put to depreciation fluctuated year by year, and by altering it they were able to keep the rate of interest more uniform, paying more to depreciation one year and less the next.

Mr. **Nicholson** commented on one of the "essential conditions" in the paper, that the plant should be charged with a yearly sum sufficient, *inter alia*, to provide the money to enable the company to take advantage of improvements, and take out of commission, when desirable, plant which still had some years of life left in it, and questioned the effect of the operation on the sinking fund.

Mr. **Gill**, in reply, said that while there was difficulty in estimating the life of plant, it was not more difficult than to estimate the life of a person; and yet insurance societies throve on the latter. In the case of plant upon which money had to be spent to bring it into commission, the cost should be charged to revenue. As to the engineer's knowledge of finance, it seemed to him that the engineer ought to endeavour to appreciate his responsibility in regard to finance more. It was he who ultimately selected the plant, and the plant was put down on his calculations and estimate, and the engineer, in putting down the plant, practically settled the dividend; therefore the dividend was fixed, depreciation was really fixed because it depended on the kind of plant put down, and the operating costs were fixed. If the engineer was going to do his duty he must take up the question of finance. As to the suggestion that some allowance might be made in the early days of an undertaking, some such course was often pursued, but it hardly touched the principle of the paper. The way to do was properly to estimate the depreciation, and then carry it forward as a debit.

REVIEWS.

The Emission of Electricity from Hot Bodies. By Prof. O. W. Richardson, F.R.S. London: Longmans, Green & Co. Price 9s. net.

This work is one of the monographs on physics edited conjointly by Sir J. J. Thomson and Prof. Horton. In its 300 pages it gives a very complete account of what is known at present on the emission of electricity from hot bodies, a subject which has of late years received much attention, and which is making wonderful progress. There are many difficulties encountered in its investigation, and the author states that the absence of a satisfactory and comprehensive theory of conduction for conductors of the metallic type, and the interpretation of the facts bearing on the true nature of the contact potential difference between metals are not the least. Then there are experimental troubles of various kinds, and the difficulties of the correct recognition of results.

Prof. Richardson puts the electronic theory of conduction and its inference with regard to electronic emission in a succinct and convincing way. He says: "According to theory, the conductivity of metals arises from the presence in them of an atmosphere of electrons. These are supposed to be in violent motion, like the molecules of a gas according to the kinetic theory of gases. The effect of an applied electric field is to superpose on the haphazard heat motion of these electrons a definite average velocity of drift in the direction of the electric potential gradient. This drifting of the electrons constitutes the electric current. The energy of the heat motion of these internal 'free electrons,' as they are often called, will increase with rising temperature; and one might expect that at sufficiently high temperatures this energy would be great enough to carry them out through the surface of the hot body. From this standpoint, the escape of negative electricity from hot bodies is closely analogous to the escape of the molecules of a vapour from a solid or liquid during evaporation. It is, in fact, a kind of evaporation of electricity."

In the first chapter the author discusses considerations of a general character, and gives a historical review of the subject. Elster and Geitels' investigations of the 'eighties of last century are gone into. Then the theory of ions, the properties of the gases drawn away from the neighbourhood of incandescent bodies, the specific charge of the ions, general experimental methods, relation between the currents and electromotive force and gas pressure, and the electron theory are discussed in turn with a view to a better appreciation of the more detailed work which follows.

Some idea of the difficulties involved in the investigation of electronic emission can be glimpsed by the fact of the existence of the two schools of thought with regard to the magnitude of contact difference of potential between metals whose surfaces are free from gas and in a good vacuum. One school has it that these differences are accounted for by chemical action between metals and the surrounding atmosphere, and the other looks upon them as the intrinsic properties of the metals affected. Most of those who have experimented have up to recently favoured the chemical theory. But in 1912 the author showed that in all experiments hitherto performed secondary actions occurred which enabled the results to be explained on the intrinsic theory just as well as on the chemical. And, moreover, a lot of new evidence has lately come to hand which actually favours the intrinsic theory.

There is a long and comprehensive chapter on the temperature variation of electronic emission. The author and many others have experimented in this field, and although there is much difference of opinion in the final interpretation of the experimental results, there is none as to the fact of the general character of the variation of the rate of emission of the electrons by various hot bodies with temperature. In all cases experimenters have found that, under stable conditions, the rate of emission of electrons increases extremely rapidly with increase of temperature. Towards the end of the chapter there are a few pages on the emission of electrons from various compounds, and on photoelectric emission. Because with the high rise of temperature all substances give out light, an emission of electrons from hot bodies owing to the action of light occurs, even when there is no external source of light illuminating them. The author calls this the autophotoelectric effect. Hence, it is of the utmost importance to settle whether thermionic emission is due to photoelectric action or not, and the investigation is very troublesome. The author states that all the indications available point to the conclusion that the autophotoelectric currents are smaller than the observed thermionic currents, although an absolute verdict is impossible at present.

There is much interesting work on the effect of gases on the emission of electrons, the cases considered being the emission from platinum in an atmosphere of hydrogen, and the effects of various gases on the emission from tungsten; then there is a discussion on the relative importance of various factors in causing emission, and an analysis of the chief causes of confusion. The chief factors are: (1) the escape of electrons owing to the purely thermal increase of their kinetic energy, (2) the liberation of electrons as one of the products of chemical action, and (3) the complete photoelectric emission. The relative claims of purely thermal effect and of chemical action are dealt with at some length. The question is most involved. The author details experiments he has made on tungsten, and gives it as his considered judgment that they definitely exclude chemical action as the cause of the emission from this substance. This is supported by the results of Langmuir, who finds that with tantalum, molybdenum, carbon, and platinum, as well as tungsten, the emission is increased with progressive elimination of gaseous contamination and corresponding freedom from liability to chemical action.

Chapter V deals with the energetics of electron emission, involving the kinetic energy of the emitted electrons, latent thermal effects, and heat liberated during electron absorption.

Other subjects dealt with are the emission of positive ions by hot metals, the effect of gases on the liberation of positive ions by hot metals, and the emission of ions by heated salts.

In the last chapter, the author has included a short account of the results of some experiments he has recently made on the electrons liberated by chemical action. Part of the cost of this investigation was defrayed by a Government grant through the Royal Society.

There is no doubt whatever that the work under review is a valuable addition to the literature of the subject. It gives a most comprehensive statement of what has been so far accomplished; it states the results of investigation of many workers of the past; and it brings up experimental research to practically the present moment. The author has a pleasant habit of being able to summarise where necessary, and to expand where necessary. His judgment is always keen.

Electrical Measurements and Testing: Direct and Alternating Current. By Chester L. Dawes. New York, U.S.A.: John Wiley & Sons. Price 3s. net.

The Wiley "Technical Series" includes a loose-leaf laboratory manual, and this series of 40 sheets comprises the section on electrical testing. Each sheet gives detailed experimental instructions as to the apparatus to be used and the procedure to be adopted, and concludes by putting a number of questions relevant to the experiment performed. Occasional notes and cautions are included to prevent beginners falling into the usual errors, and most of the sheets give clear and workmanlike directions which, if followed, would lead to satisfactory results. Clearly-drawn diagrams are used to illustrate the text, and in most cases these would suffice to ensure that suitable instruments were used and correct connections made.

The most important experiments described are those which deal with such essentially practical questions as potential drop in feeders, commercial potentiometers, operation of the various types of D.C. and A.C. generators and motors, transformer connections, and the operating characteristics of rotary converters. Some elementary sections are devoted to connections for batteries, bells, gas lighters, &c., but the majority of the sheets deal with real electrical engineering problems.

The method of numbering the sheets appears to be unduly complicated, and, although there is much that is useful and satisfactory, it is probable that most electrical engineering laboratories possess similar sets of instruction sheets, and will not be tempted to adopt Mr. Dawes's methods in preference to their own.

The experiments have apparently been chosen to illustrate Timbie's "Electrical Measurements in Alternating and Direct Current," and Karapetoff's "Elementary Electrical Testing"—two books which are common enough in the States, but seldom seen in this country. It is, therefore, very likely that, whereas Mr. Dawes's students at Harvard will "enthuse" over this manual, it will attract little attention, and less sale, on this side of the Atlantic.—P. H. S. K.

BUSINESS NOTES.

Patents and Alien Enemies.—Application has been made by Messrs. Edward Bennis & Co., Ltd., to the Board of Trade to avoid or suspend Patent No. 5,041/13, granted to L. & C. Steinmuller, for travelling grates for furnaces.

Trade Announcements.—Messrs. Simplex Conduits, Ltd., of Birmingham, have recently enlarged the accommodation at their showrooms and warehouses at 113-117, Charing Cross Road, to give the trade an improved "Simplex Service" in London and the South of England. The warehouse on the basement will continue to carry the stores of conduits and fittings, and on the ground floor the showrooms are being extended as time and convenience permit. On the first floor of the building there will be the offices of Mr. L. M. Waterhouse, the managing director, of Mr. Bennett, the London and South of England manager, and of the general office staff of the London sales department. On the second floor there will be a trade counter for accessories, such as electric light fittings, heating and cooking apparatus, lamps, and cables. Stocks are warehoused on the upper floors.

Messrs. John Moores & Co., New Bailey Street, Salford, have removed to Brougham Street Works, Blackfriars Road, Salford.

Dissolutions and Liquidations.—Anchor Electric Co., Ltd.—This company is winding up voluntarily, with Mr. T. T. Rankin, of Anchor Electric Works, Chadwell Heath, Essex, as liquidator. Meeting of creditors March 30th, at 5, Lincoln's Inn Fields, W.C.

Coventry Magneto Repairing Co., 9a, Fleet Street, Coventry.—Messrs. W. V. Wakefield & C. F. H. Foster have dissolved partership.

Condensing Plant.—The Mirrlees Watson Co., Ltd., Glasgow, have recently received orders for 69 sets of condensers, practically all for war-service work, aggregating approximately 1,400,000 lb. steam duty per hour.

Catalogues and Lists.—Messrs. Dick, Kerr & Co., Ltd., Abchurch Yard, Cannon Street, London, E.C.—Card giving prices of Britannia drawn-wire lamps.

Messrs. Brayshaw Furnaces and Tools, Ltd., Mulberry Street, Hulme, Manchester.—Illustrated circular showing several views of furnace installations supplied by them. In their new demonstration room at the works they have put down their latest types of furnaces for the heat-treatment and annealing of steel, the melting of metal, &c.

Swedish General Electric, Ltd., 5, Chancery Lane, London, W.C.—Current Stock List No. 10, giving particulars of electric motors, from ¼ to 50 h.p., that they have in stock.

British Thomson-Houston Co., Ltd., 77, Upper Thames Street, London, E.C.—Handbook No. 2 in the company's series of incandescent electric lamp handbooks. In the course of its 68 pages it gives very full information and technical data relating to lamps for battery service (20 volts and below) for automobiles, general batteries, flashlight lamps and surgical lamps, and dimensional drawings of all lamps and the lamp caps. Electrical traders and trade users can have copies of the handbook on applying to the company's L. and W.S. department.

Messrs. S. G. Leach & Co., Ltd., 26-30, Artillery Lane, London, E.C.—Illustrated price list (LM 5), giving particulars of portable and stationary air compressors.

Bankruptcy Proceedings.—W. D. Birkett, factor of electrical goods, Whitley Bay. Trustee released, March 2nd.

Book Notices.—"*Journal* of the Institution of Electrical Engineers." Vol. LV, No. 264. March, 1917. This issue contains the following papers:—"Frequency Changers," by Mr. R. Townend, and "Telegraph Poles in New Zealand," by Mr. J. Orchiston.

LIGHTING AND POWER NOTES.

Barnsley.—Proposed Loan.—The T.C. has approved the recommendation of the Electricity Committee to apply for permission to borrow a further £4,000 in connection with extensions at the electricity works. The extra expenditure, it was reported, had become necessary owing to the abnormal period, but the outlay would be justified.

Bedford.—Plant Extension. The Electricity Committee reported that the B. of T. had given its consent to the supply of electricity to a works outside the borough, and that the L.G.B. had sanctioned the following loans without a public inquiry:—Buildings, £8 450; boiler house plant, steel chimneys, pumps, turbo-generator, engine room accessories, switchgear, and transformers, £20,711; mains, £1,502; mechanical stokers, £1,140; coal bunkers, £900: a total of £32,703. Consent has been obtained from the Midland and London and North-Western Railway Companies to the laying of cables across their respective bridges.

Brighouse.—Year's Working.—There has been a gross profit of £1,013 on the working of the electricity undertaking for the year ended March 31st, 1916.

Bristol.—Price Increase.—The T.C., on the recommendation of the Electricity Committee, has increased the charges for electricity to general consumers, as from the last readings for the current quarter, by a further 8½ per cent., thus making altogether an advance of 33½ per cent. on the scale charges for both light and power.

Canada.—Sir Adam Beck, in giving information relating to the Ontario hydro-electric system for the year ending October 31st, 1916, says that the total average H.P. used in the system was 109,583, at an average cost of $9.10 per H.P. The total receipts were $2,038,792. As regards the Severn system, the total expenses, including generating, amounted to $54,438, and the revenue to $94 691.—*Canadian Engineer.*

Clayton.—At a special meeting of the D.C., last week, a letter was submitted from the Yorkshire Electric Power Co., intimating that March 20th was the date for hearing objections against the company's Bill for powers to supply certain districts, including Clayton, with current, and asking that, in view of the strong opposition of the Bradford and Halifax Corporations, the Council should send a representative to give evidence in support of the Bill. It was decided, after discussion, not to send a representative, but to send a copy of the Council's resolution agreeing to support the company's Bill.

Continental.—France.—La Societe des Forces Motrices de la Durance is the name of a new undertaking which has recently been formed in Lyons (9, Rue Grolee), with a capital of £600,000, to establish a plant to utilise three waterfalls on the River Durance in the generation of electrical energy for lighting and power purposes.

Italy. A Supreme Council for Public Waters has now been established as the chief administrative authority in all matters connected with the development of water power in Italy. The chief duties of this new organisation are:—(1) to draw up a list of all the public waters of Italy; (2) to examine and verify existing rights; (3) to discuss and decide on schemes submitted for concessions to develop and apply public waters for use as motive power and in factories.—*Board of Trade Journal.*

Cronton.—The electrical equipment of the Hulton Co.'s new collieries at Cronton, near Rainhill, is now practically completed.

Cuddington.—E.L. Proposals.—The Epsom R.D.C., after discussing the E.L. schemes of the Wimbledon T.C. and the South Metropolitan Electric Tramways and Lighting Co., has decided to consent to the prov. order for the latter, subject to a sealed agreement. The company proposes to supply energy to South Cuddington, whereas the Wimbledon Corporation could not supply without a guarantee, for at least two years, of 20 per cent. per annum on the outlay incurred.

Dublin.—The Electricity Supply Committee has reported that the estimate for the ensuing year requires no demand on the rates. The secretary reports that, after making allowance for the small income from temporary premises of consumers affected by the Rebellion of last year, the net loss to the undertaking amounted to £7,000. A serious item was the special amount for extra capital charges entailed by the calling in of one of the loans, and the compulsory issue of Corporation stock to meet same.

Folkestone.—The T.C. has decided to have a permanent system of electric lighting installed at the Museum.

India.—The Madras Administration P.W.D. Report for 1915-16 states that the necessity for economy owing to the war has restricted the operations of the Department. As regards electrical schemes and works, the Coimbatore and Pykara hydro-electric schemes were both under consideration, the former for the supply of electricity to the town of Coimbatore, from the Siruvani River, and the other for the supply to Ootacamund from the Pykara Falls. The latter has been held in abeyance pending some decision regarding the Siruvani scheme, the possibilities of which had to be further considered in view of the decision of the South Indian Railway to erect large workshops at Podanur. There are quite a large number of installations in progress or under consideration, chiefly in connection with public buildings and offices in Madras. During the year under notice the number of consumers increased from 1,777 to 2,009, and the electricity consumed from 4,704,000 units to 5,586,609 units. With a view to meeting the increasing demand in Madras City, extensions of the alternating-current system were projected for the suburbs of Kilpauk and Royapuram, but the schemes have been indefinitely hung up, owing to the impossibility of getting materials from England on account of the war.

An accident having occurred by which a visitor was nearly electrocuted at a friend's house lately, owing to a leakage of the electric current to a bath tap, the Mysore Government has now ruled that no interior wiring for power and light in Bangalore and Mysore shall be carried out by a contractor who is not the holder of a licence issued by the Electrical Department.—*Indian Textile Journal.*

Leigh.—Messrs. Speakman have had a generating station built at their Woodend Collieries, where developments are taking place in connection with the opening of new mines.

London.—Poplar.—The interconnection of the Council's undertaking with that of Hackney was completed on February 12th, and a supply for the northern district has been taken since that date, materially assisting in reducing the pressure on the Poplar undertaking in meeting the demands of Stepney. The Stepney Electricity Committee wrote expressing appreciation of the help the Poplar Committee had rendered during the abnormal difficulties which it had, and is, experiencing with regard to the steam supply at Limehouse.

The electrical engineer's report for the December quarter shows that the total units sold were 6,231,591, an increase of 218,590 units over the corresponding quarter last year; the net surplus income is £4,224, a decrease of £921. The net profit from April 1st to December 31st is £7,519, as compared with £8,503. The net surplus estimated in March last was £5,383, and the £7,519 is due almost entirely to the lower coal prices actually obtained than were estimated for.

The Electricity Committee has approved the sale of two 500-kw. Willans reciprocating sets for £2,500; their removal will make room for another large turbine generating set at a later date without extension of the station. The sale of these sets necessitates the provision of a new converter, and the engineer is to provisionally accept a firm tender subject to sanction.

Woolwich.—At the B.C. meeting last week, held to consider the annual estimates, the Electricity Committee reported that no loss is anticipated for next year, the only amount necessary to be raised being the approximate deficit at March 31st in respect of the present year—namely, £2,986. The chairman of the Finance Committee stated that the electricity department seemed to have turned the corner, and its income balanced its expenditure.

L.C.C.—The Finance Committee recommends the Council to sanction the borrowing of £5,141 by the Islington B.C. for electricity purposes; the Council's application was for £5,499.

Westminster.—The Contracts Committee of the Council reports having considered the contracts with the Charing Cross, the Metropolitan E.S., and the St. James's E. L. Companies for the supply of electrical energy to the Council's buildings. The Committee went into the question of the advisability of substituting gas lighting in the buildings now supplied with electricity, but it was decided, having regard to the high cost of labour and materials and the circumstances generally brought about by the war, that it is inadvisable to pursue the question further at the present time; the three contracts are therefore to be continued.

St. Pancras.—It has been agreed to remove the two old Babcock boilers at the destructor works when the new Niclausse boiler at the electricity works is installed. The Finance Committee anticipates that the profit from the electricity department for the year ending March 31st will be upwards of £10,000.

Monaskweven (Co. Kildare).—E.L. Scheme.—A public meeting has taken the initial steps to provide electric lighting for the town, a scheme submitted by Mr. Griffiths, electrical engineer, being approved. Mr. Griffiths has already obtained the County Council's permission for the erection of the necessary poles.

Morecambe.—Proposed Loan.—The T.C. has agreed to apply for sanction to borrow £6,000 for the extension of the electricity works after the war.

Newcastle-under-Lyme.—Female Labour.—As an outcome of suggestions made at the Tribunal, the T.C. has referred to the chairman of the Electricity Committee and the electrical engineer, with power to act, the question of introducing female labour at the electricity works.

New Zealand.—Hydro-Electric Schemes for the North Island.—The Minister of Public Works states that investigations are being made in connection with proposals to install hydro-electric power in the North Island. It is thought that three generating stations will be necessary, on account of the large and rough area over which it would be essential to run transmission wires. Surveys are being made in the Auckland district for the purpose of harnessing the Waikato River: the other two stations will probably be located in the Manawatu and Waikaremoano districts. It is also stated that, at a conference held recently of about a dozen local bodies in the Auckland district, including the North Shore boroughs, it was unanimously decided to urge the Government to provide hydro-electric power in the Province of Auckland, owing to its substantial increase of population and rapid development. It is estimated that if an up-to-date scheme, costing from £200,000 to £300,000, were introduced, a saving of no less than £50,000 a year could be effected in Auckland and suburbs.—*Board of Trade Journal.*

Rotherham.—Proposed New Power Station.—The Council has decided to make application to the L.G.B. for sanction to borrow £400,000 for the erection and equipment of a new power station.

Surbiton.—Price Increase.—Subject to the consulting engineer, Sir John Snell, being satisfied that the existing conditions justify an alteration, the D.C. has decided to increase the maximum charge for electricity supplied in the district from 7d. to 8d. per unit.

Swansea.—The electrical engineer reports that the approximate cost of the necessary cable, &c., for the supply to the new pumping station of the waterworks department at Cwmbwrla would be £1,200, of which the waterworks department has agreed to pay 7 per cent. per annum, or 20 per cent. of the capital outlay, by way of payment for energy consumed. The electrical engineer suggests that the charge should be 1⅛d. per unit, varying on a sliding scale agreed upon, the actual amount depending on the load factor of the plant.

Taunton.—Price Increase.—The T.C. has decided to increase the charges for electricity by a further 8½ per cent., making altogether an advance of 33½ per cent., on the scale charges for both lighting and power.

Worcester.—The city electrical engineer has recently pointed out the necessity of increasing the boiler plant, and advised the installation of a new boiler, at a cost of £4,350, which would result in a considerable annual saving and facilitate the work of cleaning the existing boilers. The Electricity Committee decided to postpone the matter, but the Council has referred the question back for further consideration.

The Electricity Committee recommends that the price of electricity for lighting be increased from 4½d. to 5d. per unit, and that it be made obligatory on consumers on the rateable assessment tariff to put in a heating or cooking device capable of consuming one or two units per hour, according as the rateable value is below or above £30.

Weymouth.—Loan Sanction.—The L.G.B. has given the T.C. permission to borrow £5,560 for cables, and £1,050 for switchgear and boosters.

TRAMWAY and RAILWAY NOTES.

Atherton.—The South Lancashire Tramways Co. has applied to the U.D.C. for consent to take up the rails in Bag Lane, and the Council has decided to consider the matter at its next meeting.

Dublin.—Messrs. John J. Clancy and John O'Connor, M.P.'s, have joined in the representations that are being made to the B. of T. for the taking over by the State of the Dublin and Lucan Electric Railway, and Sir A. Stanley has promised to intimate to them the nature of any objections that may be lodged. The claim of the railway employés to better conditions is one of the reasons influencing those who wish to have the line taken over.

Glasgow.—Accident.—On Saturday night a Corporation tramcar collided with another at Glasgow Cross, causing it to leave the rails and knock over an electric section box on the pavement. Some of the connections in the box were broken, with the result that the car became electrically charged, and several of the passengers suffered from shock, and were unable to leave until assisted by officials, who were protected by rubber gloves.

Hull.—Tramway Power Supply.—It is proposed, owing to the age of certain of the plant in the Osborne Street tramway generating station, to transfer a part of the load to the electricity department's Sculcoates Lane plant, where it is intended in the near future to install an additional 5,000-kw. turbine set. It is proposed then to lay the necessary cable and install converting plant at Osborne Street, the old plant in which will be disposed of by degrees.

Keighley.—War Bonus.—The offer by the Corporation War Bonus Committee of a bonus of 3s. to employés over 21 years of age and of 1s. 6d. to employés under that age, has been declined by the tramway workers, who have now put in an application for a war bonus of 6s. per week and to have themselves put on the same scale of wages as applies in Bradford. It is understood that they intend to take the matter to arbitration if the demand is not complied with promptly.

London.—L.C.C.—The Finance Committee recommends that the question of expediting the repayment of the debt in respect of obsolete capital expenditure outstanding on the horsed tramways be postponed for a further three years, or earlier if and when there is any surplus available after the renewal funds shall have been made up to the full amount necessary on the basis agreed upon.

Owing to unforeseen circumstances the Bakerloo service over the L. & N.W. line to Watford will not be available on April 2nd, as announced, and it is expected that there will be a further delay of about a fortnight.

Newcastle-on-Tyne.—When the estimates were considered by the City Council, last week, Councillor R. Mayne (chairman of the Tramways Committee) announced that it might be found possible to open the reserve fund and find some money, if the Council desired it, to prevent any increase in the rates.

Rawtenstall.—Recently Councillor Barnes asked how the Tramways Committee's application for a sum of £3,000 for tramway purposes during the year was made up. Ald. Coupe replied that there was an all-round increase in expenditure, and they had to pay more interest on money borrowed and more rates, the interest, &c., showing an increase of about £1,500. They wanted each year to bear its own burden, instead of carrying the extra cost over and allowing it to accumulate.

South Lancashire.—Female Employes.—The women employés on various tramway systems which were affected by the award of the Committee on Production have given notice that they will cease work at the end of 21 days, failing an extension of the award to them.

Southend-on-Sea.—Female Labour.—The efforts which have been made to secure male drivers have only resulted in six being appointed; as 33 more drivers are required to maintain the service, arrangements have been made for the instruction of women drivers. In future all drivers, while being instructed, are to receive wages at the rate of 3d. per hour during a period not exceeding 14 days, and subject to the condition that they continue in the Corporation's service upon becoming qualified to drive. The wages of women drivers are fixed at 6d. an hour, and a woman inspector is to be appointed to supervise all female conductors and drivers.

Southport.—Ald. Griffiths, in moving the adoption of the Tramways Committee's minutes, referred to the vast increase in working expenses, and said that in spite of this they had not raised their fares. If they found it necessary to raise the fares to not more than 1d. per mile, he hoped they would have the support of the public.

TELEGRAPH and TELEPHONE NOTES.

P.O. Tube Railway.—Up to March 31st last a total of £355,497 had been spent on the underground railway which is being constructed in London for the conveyance of mails. At that date the unexpended balance of the authorised expenditure on the undertaking was £744,503.—*Daily Telegraph.*

Storm Damage.—Great damage was done by recent gales to telegraph and telephone wires on the moors around Huddersfield, and between Huddersfield and Manchester and Huddersfield and Brighouse. On the Manchester Road over Standedge Hill at Marsden, four telegraph poles were completely broken off about a yard from the ground, and many others were forced out of the perpendicular, with a breakage and intermixing of wires which made communication between Huddersfield and Manchester by that route quite impossible. Residents expressed the opinion that the gale was the worst for 30 years.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—U.D.C. Electricity Department. Battery of accumulators, complete. See "Official Notices" March 16th.

Birkenhead.—April 3rd. Corporation Electricity Works. Washed and unwashed rough slack and coke breeze for a year. The Electrical Engineer, Craven Street.

Bray.—April 3rd. U.D.C. Stores for electric light works. See "Official Notices" to-day.

Dundee.—March 28th. Corporation. Twelve months' supply of electrical stores, &c. Specifications from the Electricity Department, Dudhope Crescent Road.

Glasgow.—April 5th. Corporation. Turbo-alternators (15,000 KW.), transformers, and condensing plant for the new generating station at Dalmarnock. Particulars from Mr. W. W. Lackie, Chief Engineer and Manager, 75, Waterloo Street, Glasgow.

Hull.—April 12th. Electricity Committee. Cooling towers. See "Official Notices" to-day.

London.—St. Pancras.—April 12th. B.C. Arc lamp carbons. See "Official Notices" March 9th.

L.C.C. The Council is recommended to invite tenders for the provision of cables and switchgear in connection with the supply of additional power in the Woolwich district.

Manchester.—March 26th. L. & Y. Railway. Various stores, including (32) signal, telegraph, and electric fittings, (33) signal, telegraph, and electric light wires, for 12 months. Mr. Waring, Stores Department, Osborne Street, Manchester.

April 3rd. Turbo-alternator and condensing plant for Stuart Street generating station. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall.

Spain.—April 20th. Municipal authorities of Segovia. Concession for the electric lighting of the town. New invitation of tenders.

Warrington.—April 11th. Electricity and Tramways Committee. One 3,000-KW. turbo-alternator and surface condensing plant. See "Official Notices" March 16th.

April 11th. Electricity and Tramways Committee. Motors and transformers. See "Official Notices" to-day.

CLOSED.

Australia.—P.M.G.'s Department, N.S.W. :—

20,000 glazed earthenware conduits, two ducts; 5,000 ditto, three ducts; 9,000 ditto, four ducts; 5,000 ditto, six ducts; £4,439.—Brunswick Brick, Tile & Pottery Works Pty., Ltd.

P.M.G.'s Department, South Australia :—

10 miles twisted-pair, insulated wire, £22 15s. per mile; 30 miles ditto, £33 10s. per mile; 30 miles ditto, £23 15s. per mile; 5 miles ditto, single, £11 5s. per mile; 8 miles twisted conductor wire, £13 15s. per mile; total £2,111.—Callender's Cable & Construction Co., Ltd.

Tenders.

Barnsley.—Electricity and Lighting Committee. Supply of 50 tons of coal per week, delivery between February 16th and June 30th: Messrs. J. Wilby, Ltd.

Government Contracts.—List of new contracts placed during February, 1917 :—

War Office.

Electric cable and wire.—Callender's Cable & Construction Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Hooper's Telegraph and India-Rubber Works, Ltd.; St. Helens Cable & Rubber Co., Ltd.
Electric cells.—Premier Accumulator Co., Ltd.
Air-compressor sets.—Broom & Wade, Ltd.; Lacey-Hulbert & Co., Ltd.
Conduits and fittings.—Barton & Sons, Ltd.; Credenda Conduits Co., Ltd.; Eureka Conduits & Fittings Co., Ltd.; General Electric Co., Ltd.; J. Griffiths & Sons; Oriental Tube Co., Ltd.; Simplex Conduits, Ltd.
Motor-converters.—Bruce Peebles & Co., Ltd.
Electric light fittings.—Edison Swan Electric Co., Ltd.; Johnson and Phillips, Ltd.; G. Roe & Sons.
Generating sets and parts.—Aster Engineering Co., Ltd.; W. H. Dorman and Co., Ltd.; R. A. Lister & Co., Ltd.; A. Lyon & Wrench, Ltd.; Petters, Ltd.
Generators and dynamos.—Siemens Bros. Dynamo Works, Ltd.
Wire and copper-covered rope.—B.I. & Helsby Cables, Ltd.
Electric torches and parts.—British Ever Ready Co., Ltd.; Etandem Co., Ltd.
Steel wire.—W. Bain & Co., Ltd.; R. Johnson & Nephew, Ltd.; Lancashire Wire Co., Ltd.; Longford Wire Co., Ltd.; Whitecross Co., Ltd.
Works services.—Electric light installation at Hilsea: Foot & Milne, Ltd. Electric light installation at Montrose: Edmundson's Electricity Corporation, Ltd. Extensions to electric lighting at Northolt: C. Cooper and Co.

India Office Store Department.

Alternators.—Lancashire Dynamo Co., Ltd.
Engines.—Parsons Motor Co., Ltd.
Fans.—J. Stone & Co., Ltd.
Switches.—Siemens Bros. & Co., Ltd.

H.M. Office of Works.

Engineering services.—Bramley electric lighting plant: Johnson and Phillips, Ltd.

Post Office.

Telegraph apparatus.—Automatic Telephone Mfg. Co., Ltd.
Wood arms.—W. F. Holloway & Bros.; Rudder & Paynes, Ltd.
Telegraph cable.—W. T. Glover & Co., Ltd.; I.R., G.P. & Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; Telegraph Construction and Maintenance Co., Ltd.; Union Cable Co., Ltd.; Western Electric Co., Ltd.
Dry cells.—Siemens Bros. & Co., Ltd.
Clamps.—Walls, Ltd.
Instrument cords.—B.I. & Helsby Cables, Ltd.
Iron terminals.—Walls, Ltd.
Telephone mouthpieces.—North British Rubber Co., Ltd.
Cable distribution plugs.—B.I. & Helsby Cables, Ltd.
Stay-rods.—Bullers, Ltd.
Insulator spindles.—Bayliss, Jones & Bayliss, Ltd.; Bullers, Ltd.; F. W. Cotterill, Ltd.; Guest, Keen & Nettlefold, Ltd.
Telephones.—Automatic Telephone Mfg. Co., Ltd.
Copper binding wire.—B.I. & Helsby Cables, Ltd.
Copper strand wire.—T. Bolton & Sons, Ltd.; B.I. & Helsby Cables, Ltd.; Shropshire Iron Co., Ltd.

London.—Poplar.—The B.C. has accepted a tender at £745 for a Bessemer petrol wagon for the Electricity Department.

Swansea.—T.C. Electrical pumping plant for the Waterworks Committee, £651: Messrs. Mather & Platt.

FORTHCOMING EVENTS.

Institution of Civil Engineers.—Tuesday, March 27th. At 5.30 p.m. At Great George Street, S.W. Lecture on "The Decimal System of Coinage, Weights and Measures," by Mr. Harry Allcock.

Institution of Electrical Engineers (Birmingham Local Section).—Wednesday, March 28th. At 7 p.m. At the University, Edmund Street. Paper on "Machine Switching Telephone Gear," by Mr. F. R. McBerty.

Royal Institution of Great Britain. Thursday, March 29th. At 3 p.m At Albemarle Street, Piccadilly. Lecture (II) on "Modern Improvements in Telegraphy and Telephony: Telephony," by Prof. J. A. Fleming, F.R.S.

Greenock Electrical Society.—Thursday, March 29th. At 7.45 p.m. At 22, West Stewart Street. General meeting.

Association of Mining Electrical Engineers (Lancashire, Cheshire and North Staffs. Branch).—Joint meeting with the Colliery Managers' Association. Saturday, March 31st. At 3 p.m. At the Technical College, Stoke. Paper on "The Electrification of a Group of Collieries," by Mr. H. Green.

NOTES.

Easter Holidays.—We shall be glad if our correspondents and advertisers will take note that the Electrical Review for April 6th will appear on the morning of April 4th. All matter for inclusion in that issue must therefore reach us much earlier than usual. An announcement respecting the closing times for advertisements appears in our advertisement pages to-day.

Government Measures to Assist Trade.—The decision of the Government to increase the number of His Majesty's Trade Commissioners from four to 16 is most welcome. It is one of those measures that ought to have been adopted many years ago. We have argued for it for a long time, ever since we first saw the possibility of usefulness proved by existing officials in the same class—not without hope latterly, we confess. One Trade Commissioner for the vast Canadian territories! Four for the entire British Empire! Now we are to have 16, and the industries of the Empire should feel the benefit in a very short space of time. We trust that the appointment of the new Commissioners will not be delayed—we believe that Sir Albert Stanley will see that they are not—for we need to do everything in reason to be ready to assist trade development throughout the whole of our Dominions for their and our own industrial benefit immediately the situation improves. In announcing the above important step at the meeting of the Association of Chambers of Commerce, on Tuesday, Sir Albert also made other equally acceptable statements. He repeated what we have now become accustomed to from most lips of authority—namely, that the key industries must be secured to the country. Further, that there must be improvements introduced respecting the generation of electricity (doubtless he had in mind the appointment of his Departmental Committee); that our transportation facilities must be reformed; and that a big financial institution could render great assistance in connection with the industrial extensions of the future. It appears, in the last-named connection, that a scheme has been completed, which the Government will support and encourage, to establish a British Trade Corporation to facilitate and establish large credit banks for the purpose of developing British trade. That Corporation would receive a charter; it would not unduly interfere with the operations of existing banking institutions, but would do work which could not very well be done by them. Its Board would consist of representatives of industry and commerce, and associated with it would be experts from various industries who had a very wide knowledge of the world and its affairs. Attached to the Corporation would be an Information Bureau and Intelligence Department.

Legal.—Munitions Court Case.—Before the Tees and Darlington Munitions Tribunal, at Stockton-on-Tees, last week, four electricians were charged with having refused to work a reasonable amount of overtime. Fines of 10s. were imposed. One of the defendants observed that "the man who is prosecuting can come in at 8 o'clock and leave at 5." He added that he worked 79 hours one week. The Chairman: But the next week you put in 63 hours. Defendant: Yes, I had a right to; I was five days in bed over the job. The Chairman said the Tribunal were pleased to see that the defendants had been working well lately, their time-sheets being the best they had seen for a considerable time.

British Thomson-Houston Co., Ltd., *v.* Duram, Ltd.—Judgment was given on Tuesday dismissing the plaintiffs' appeal in this patent action, the Court confirming the decision of Mr. Justice Astbury as to want of subject-matter.

Training for the Air Services.—With a view to affording to young men below the age of 18 a preliminary training for the Air Services, the Aeronautical Institute has decided to establish a course of instruction covering a working knowledge of aviation motors, and of the function and construction of the various parts of the aeroplane concerned with its sustentation, propulsion, and evolution both in flight and on the ground. The course will last about three months, and will entail a full-day attendance five days a week. It will be independent of any other organisation, whether Governmental or not, and will not be a guarantee that any of its students will be granted commissions in the Air Services. Full particulars can be obtained from the Hon. Secretary of the Aeronautical Institute, 3, Arlington Street, London, S.W. 1.

Electrical Excavating Data.—Electrically operated excavators are being used on a large drainage scheme in Idaho, U.S.A. Energy is obtained at a pressure of 44,000 volts from an overhead line; the average power consumed is 0·88 KW.-hour per cubic yard of material excavated, varying with the material excavated, being as low as 0·39 KW.-hour in light sandy loam, including all line and transformer losses.—*Canadian Engineer.*

The J.I.E. and Engineering Students.—The Council of the Junior Institution of Engineers, on January 25th, passed a resolution having reference to extending the advantages of membership to apprentices at approved works and students of such technical schools and colleges as may be approved by the Council from time to time. Such students would be admitted at a reduced subscription, be permitted to attend all meetings and visits, and, by means of the existing J.I.E. "Engineers' Register," would be assisted in obtaining employment in engineering works when their course of technical study had been sufficiently advanced.

A Committee has been appointed to prepare the preliminary details of such a scheme for further consideration.

The activities of the Institution—by Juniors for Juniors—are already well appreciated, and the spirit of comradeship existing in its ranks has become proverbial throughout the engineering profession. No other Institution even in its "Student" or "Graduate" Section offers quite the same advantages to its members. Informal discussions upon engineering subjects take place every Friday evening, from October to May inclusive. Papers presented by specialists are read and discussed monthly in London, Manchester, Sheffield, and Birmingham; and each month, even under the present unfavourable conditions, a visit is paid to works containing features of engineering interest. In this way students at recognised engineering schools and colleges and apprentices in engineering works may obtain a grip of the essentials of their future work which study alone can never give.

Before proceeding to consider and discuss the matter the Committee is anxious to obtain, more particularly from principals and professors of technical schools and from works managers, promises of support and comment. Communications are therefore invited, in order that the Committee may be guided by the experience of others to whom the project is of interest either directly or indirectly.

Electric Furnaces for Treating Steel.—Speaking in the discussion on the heat treatment of steel at the Institution of Mechanical Engineers, on Friday last, Sir Robert Hadfield, F.R.S., said that even the very best gas-fired or coal-fired furnaces did not enable steel makers to get the uniform temperatures that were absolutely necessary for them. Steel was a most delicate material, far more delicate than most people imagined, and he hoped that before long we should have some form of electrically-heated furnace for the purpose. There was no doubt whatever that with an electrically-heated furnace it was possible to get more uniform control over variations in temperature, and he believed that the electric furnace was coming. Considerable attention was being given to this matter in America, and he hoped we should not be behind in this country. One direction in which this end might be the more easily attained was in the production of cheaper electric power. He hoped to live to see the day when we should have large furnaces—not laboratory furnaces—heated electrically, because in that way it would be possible to get a more uniform quality of steel, simply because the crystals of the steel could be controlled in a better manner.

Foreign Trade.—THE FEBRUARY FIGURES.—The official returns of imports and exports during last month contain the following electrical and mechanical figures:—

IMPORTS.	*February,* 1917.	*Inc. or dec.*	12 *months,* 1917. *Inc. or dec.*
Electrical goods, &c. ...	107,340	+ 10,846	+ 67,998
Machinery	509,725	− 103,966	− 87,158
EXPORTS.			
Electrical goods, &c. ...	270,910	− 27,698	+ 63,453
Machinery	1,808,324	+ 283,671	+ 791,801

L.C.C. Committees.—The L.C.C. is recommended to confirm the appointment of the following Committees for 1917-18:—

Highways Committee.—Sir John Benn, D. Davies, W. H. P. Gibson, G. M. Gillett, A. O. Goodrich, F. C. Harrison, W. Haydon, D. Hazel, G. H. Hume, W. Hunt, J. Little, H. Marks, W. A. Nicholls, A. H. Scott, H. Ward, A. W. Yeo.

Stores and Contracts Committee.—W. H. Ecroyd, W. C. Johnson, Miss A. S. Lawrence, H. Marks, H. Parsons, I. Salmon, H. R. Taylor; the Asylums, Education, Fire Brigade, Highways, Main Drainage, and Parks Committees have each to elect a representative.

Volunteer Notes.—FIRST LONDON ENGINEER VOLUNTEERS.—Headquarters: Balderton Street, Oxford Street, W.

Monday, March 26th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30—8.

Wednesday, March 28th.—Instructional Class, 8.15. Platoon Drill, Platoon No. 2

Thursday, March 29th.—Platoon Drill, Platoon Nos. 5 and 6. Ambulance Class by M.O., 6.30. Signalling class.

Friday, March 30th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Recruits' Drill, 6.30—8.30.

Saturday, March 31st.—Commandant's parade, 2.45. Uniform for drill in Hyde Park.

Sunday, April 1st.—Special work at Bombing School. Parade Clapham Common Station (City & S.L. Tube Ry.), 9.45 a.m.

(By order), MACLEOD YEARSLEY, *Captain and Adjutant.*

Educational Facilities for British Prisoners of War.—At a Conference of Examining Bodies in Great Britain, held last week at the Board of Education under the presidency of Mr. A. T. Davies, C.B., chairman of the British Prisoners of War Book Scheme (Educational), it was unanimously decided to approve certain proposals for the encouragement and recognition of the studies pursued by prisoners during their internment. Various examining bodies (including most of the Universities) have already intimated their willingness to recognise work done and examinations passed in camps, and to extend to the men, on their return, facilities for sitting for examinations under conditions which will take account both of their special circumstances and their needs. It is intended that the decision arrived at shall be communicated, as soon as possible, to the various internment camps in enemy and neutral countries. In the meantime, it is suggested that friends of student prisoners when writing to them, should draw their attention to the steps in this connection which are being taken on their behalf.

B. of T. Departmental Committee on Electric Supply.

The President of the Board of Trade having intimated to the L.C.C. that he proposes to appoint a Departmental Committee to consider and report what steps should be taken, whether by legislation or otherwise, to ensure that there shall be an adequate and economical supply of electric power for all classes of consumers in the United Kingdom, particularly industries which depend upon a cheap supply of power for their proper development, and having expressed a desire that Mr. G. H. Hume should represent the Council on the Committee, it has been agreed to nominate Mr. Hume, on the understanding that the Council is in no way committed as to its policy in the matter.

Linking-up Electricity Works.—A conference was held last month at the Ealing Town Hall, when the chair was taken by Ald. Peal, chairman of the Ealing Electricity Committee, who explained the reasons actuating the Ealing Borough Council in moving in the matter of bulk supply. After considerable discussion, it was elicited that the Ealing Borough Council was in favour of laying down, on co-operative lines, a large bulk supply power house on the bank of the river, of such capacity as would enable it to deal with the non-peak supplies for the whole of the western area. The Council would accept responsibility for a share of the capital required. The chairman of the Barnes U.D.C. expressed the opinion that his Council would be prepared to confer further on the above lines. It was suggested that the Ealing representatives should ask all the neighbouring authorities to meet at Hammersmith to consider the proposals, with the view of instructing the engineer to prepare a draft scheme.

The Metric System.—At a meeting of Newcastle-upon-Tyne Local Section of the Institution of Electrical Engineers on March 12th, the chairman (Mr. H. W. Clothier) said it would be remembered that at their last meeting Mr. Maccall raised the question of the metric system in connection with engineering standards and specifications, and, after discussion, proposed that a recommendation from the Section be sent to the British Engineering Standards Committee that they should draw up their specifications with a view to the possible future adoption of the metric system. At that Section's Committee meeting, which had just been held, the following resolution had been passed—"That this Local Section being of the opinion that the use of the metric system may be made compulsory in a few years, request the Council to approach the British Engineering Standards Committee with a view of the latter preparing modified specifications in readiness for this change, and that wherever convenient new standards be made in even metric measurements." The suggestion was formally approved.

At the annual meeting of John Wright & Eagle Range, Ltd., last week, the chairman (Mr. H. J. Yates) said the need of the metric system in this country was never so clamant as now. Instead of waiting for dilatory legislation, let every merchant and manufacturer in the country make an immediate start by having all dimensions and weights in his next catalogues expressed in the decimal system as well as in the present method. This would gradually familiarise people with the new system. It was also essential that catalogues should be in the customer's own language, and that prices should include delivery in his own country.

At the meeting of the Association of Chambers of Commerce of the United Kingdom on Wednesday, the Executive Council's Bills for decimalising our coinage and weights and measures were approved, and it was recommended that the Government should address inquiries to the Governments of Russia and the United States with a view to bringing about the adoption of the metric system in all the civilised countries of the world.

Bavarian Canal Scheme.—The Bavarian Diet has adopted a Bill for the construction of a canal from the Main to the Danube. The canal will begin at Aschaffenburg and end at Passau (near the Austro-German frontier). Bavarians expect the canal to be of the greatest importance in the future.

The Engineers' Club.—On Tuesday night, at Manchester, Mr. J. Drummond Paton opened a debate on "German Banking." The annual general meeting takes place at the Club on Tuesday next, at 6 p.m. The annual club dinner follows at 7 p.m.; a presentation will then be made to Mr. Edmund L. Hill, the late honorary secretary.

Light Alloys for Aircraft.—The Advisory Committee for Aeronautics has appointed a Light Alloys Sub-Committee to advise Government Departments on questions relating to light alloys, to institute research for the development and improvement of such alloys, and the methods of working them, and to assist in the removal of difficulties which may arise in their production and use

Institution and Lecture Notes.—Engineering Standards Committee.—The chairman of the Committee, Sir John Wolfe Barry, K.C.B., F.R.S., has accepted the invitation of the Council of the Institution of Civil Engineers to give the "James Forrest" Lecture on Wednesday, May 2nd, at 5.30 p.m. As the initiator of the organised movement of standardisation in this country, the lecturer has very appropriately taken as his subject "The Standardisation of Engineering Materials and its Influence on the Trade and Prosperity of the Country."

The growth of the principle of standardisation has been due in great measure to the steady work of the Engineering Standards Committee during the past 16 years, covering, as it does, most of the branches of engineering practice. The lecturer intends to draw particular attention to the new and important step taken by the Committee, which has for its object the furthering of British trade abroad through the wider dissemination in the British Dominions and in foreign countries of the British Standard Specifications translated into French, Spanish and Russian. No doubt the dimensions and weights involved will be expressed in terms of the metric system; to use the English units would obviously be futile.

Mention will also be made of the local Standards Committees which are being formed in some 12 countries abroad, and, lastly, of the fact that, when the necessary arrangements can be completed, British Standard Specifications will be available to the public, both in their English and foreign editions, at a flat rate of 1s. each, or its equivalent in foreign moneys.

In connection with this new development we are informed that the appeal which the Committee has lately issued to the engineering industry of the country has, so far, resulted in the receipt of contributions amounting to over £12,000 from the leading technical institutions, trade associations, and manufacturing firms, and that H.M. Treasury has quite recently intimated the intention to ask Parliament to grant the Committee a sum of £10,000 for this special purpose. There can be no doubt as to the benefits which are bound to accrue to British trade and to the country at large through the widening of the scope of the Committee's activities now proposed, and we confidently expect that all those who are interested in the development of the export trade of the country will co-operate with the Committee in every way, and thus ensure the complete success of this important movement.

Institution of Electrical Engineers.—At the monthly meeting of the Scottish Local Section at Edinburgh on Tuesday last, Mr. G. A. Juhlin read his paper on "Voltage Regulation of Rotary Converters."

Association of Mining Electrical Engineers.—At a meeting of the West of Scotland Branch, in Glasgow, Mr. Matthew Baird, jun. (Hamilton), read a paper on "The Installation, Care, and Maintenance of Electrical Plant," and Mr. A. F. Stevenson (Glasgow) introduced a discussion on "Cable Protection Devices."

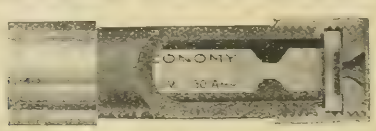
Books for Naval Engineers.—Any readers who have no further use for their text-books on dynamo design and construction, and will kindly lend these to engineers in the Royal Navy, will greatly help them to spend many a long hour usefully. The books will be returned in good condition. They should be sent, in the first instance, to the Electrical Review.

The Siemens Shares.—From an advertisement that appears in this issue, it will be seen that the Public Trustee has extended the time for sending in tenders for the shares in Siemens Bros. & Co., Ltd., from April 2nd to June 14th.

Gas Fatality.—An inquest was held at Leeds, on Monday, on John William Naylor (33), electrical engineer, and his wife, Ida Naylor (29), 39, Bristol Road, Leeds, who were found dead in bed on Friday. Death was due to coal gas poisoning. Verdict, "Accidental death."

Scientific and Industrial Research.—In the Civil Service Estimates relating to Education, Science and Art for the year ending March 31st, 1918, published on Monday, provision is made for a Grant in Aid of scientific and industrial research of £1,000,000. This will be paid to the account of the Imperial Trust for the encouragement of scientific and industrial research. The expenditure of the Trust will be audited by the Comptroller and Auditor-General, but any balance remaining on the account will not be surrendered at the close of the financial year. Grants will be made by the directions of a Committee of the Privy Council over an agreed period to approved trade associations for research, to supplement the funds of the associations, and payments in respect of such grants will not be liable to surrender by the grantees at the end of the financial year.—*Morning Post*.

Refillable Fuses.—Referring to the article in our issue of March 9th (page 261) on this subject, we pointed out that the report of the Bureau of Standards contained no illustration of the type of fuse chiefly concerned—that of the Economy Fuse and Manufacturing Co., of Chicago. Mr. D. A. Dawson, of Belfast Electricity Works, has kindly pointed out that the fuse is illustrated in American advertisement pages, and we are thus enabled to reproduce the accompanying figure from the *Electrical World*, which clearly shows the construction of the fuse.



Fire.—Hazelbeach Hall, near Northampton, was recently destroyed by fire, due, it is reported, to an electric iron which was left by a servant with the current on. The iron had been in use between 1 and 2 p.m., and the fire was discovered about 8.30 p.m., and, owing to the distance—13 miles—to be traversed by the fire brigade, the building was gutted before the fire was got under control. It is a great pity that large country houses are not equipped throughout with electric fire alarms, and that electric irons are not always provided with thermal cut-outs.

Electric Stabiliser.—Mr. Orville Wright has invented a new type of electric stabiliser for aeroplanes, which consists of a pendulum swinging in a liquid bath and controlling the supply of current to a small propeller placed just above the pilot's head.—*The Car*.

Appointments Vacant.—Meter-tester for the Borough of Salford Electricity Department; electrical engineer (£1,200 to £1,500) for the L.C.C. Tramways Department: the L.C.C. is also inviting applications for the posts of operation superintendent and development superintendent. See our advertisement pages to-day.

Electrical Artificers.—The Admiralty has established a new Continuous Service Rating of Electrical Artificer 5th Class, with the relative rating of leading seamen, and pay at the rate of 3s. a day. The decision is announced in the *London Gazette* for March 16th.

Electricity Supply in India.—Commenting on the growing importance of public electricity supply, and the efficient conditions of management obtaining in company-owned undertakings, *Indian Engineering* points out that with municipally-controlled concerns the case is different, especially in India, as the decisions of the managing committee in both engineering and economic questions are largely governed by political considerations. Our contemporary, therefore, suggests that every municipal electricity supply undertaking should have at least one expert on the committee of management, nominated by the Government, and that all such undertakings should be obliged to run on the principle of a dividend-paying concern.

Inquiries.—Makers of arc welding plant and of the Kenrick electric iron are asked for.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The Bexhill-on-Sea Electric Light Committee has appointed Mr. R. C. Carter as assistant engineer at £150 a year.

On Saturday last officials and workmen of the Blaenavon Co., Ltd., presented a gold watch to Mr. Rowland Jones, manager of the electric plant, on the occasion of his departure for Sheffield; Mrs. Jones was presented with a gold bangle.

The General Purposes Committee of the Stoke Newington B.C. has recommended that the salary of Mr. H. Large, chief assistant in the electric lighting department, be increased to £180 per annum, and that he receive an honorarium of £25 for his services as acting borough electrical engineer. Small increases were recommended to other members of the electricity staff. It was further recommended that consideration of the salaries of Mr. S. Hann, borough electrical engineer, Mr. E. G. McKenzie, sub-station assistant, Mr. S. Bone, and Mr. F. Rayner, who are serving with H.M. Forces, be deferred until their return.

In succession to Mr. Arch. Page, who has been appointed assistant general manager of the Clyde Valley Electrical Power Co., the Glasgow T.C. Electricity Committee has appointed Mr. R. B. Mitchell, superintendent of street mains, as assistant electrical engineer, at £600 per annum, rising by annual increments of £50 to £800 per annum. Mr. G. L. Black, district mains superintendent, was appointed mains superintendent at £300, rising to £500.

General.—The *Times* states that Sir William Crookes, O.M., F.R.S., has been elected a Foreign Member of the Swedish Royal Academy of Science.

On 10th inst., at Stretford, Mr. W. Reginald Chilton, of the works power department, British Westinghouse Electric and Manufacturing Co., Ltd., was married to Miss Blanche May Molyneux, of Manchester. The bridegroom was the recipient of a handsome case of cutlery, presented by his colleagues.

Mr. C. Hamilton Wickes, H.M. Trade Commissioner for Canada, who is now in this country, is, as on previous occasions, interviewing in London, at the Offices of the Department of Commercial Intelligence, representatives of firms who make appointments with him. Immediately after Easter he will visit trade and industrial centres in the provinces for the same purpose. Firms in the electrical and engineering industries who desire to have the benefit of his advice, and the information at his disposal, concerning British trade with Canada, should communicate with the Controller-General of the above Department, at 73, Basinghall Street, E.C.

Mr. James Bastian, who for many years represented the Bastian Meter Co., Ltd., and the Dussek Bitumen Co.

throughout the United Kingdom, and has latterly held the position of sales manager for the Bastian Electric Co., Ltd., has accepted an appointment under the Ministry of Munitions.

Roll of Honour.—Second-Lieutenant Cyril D. McCourt, whose death while leading as bombing officer in France is announced, was 34 years of age. He gained an Institute Scholarship at the City and Guilds of London Central Technical College, and, after gaining his diploma in chemistry, he served for a brief period as private assistant to Prof H. E Armstrong, F.R.S. In 1903 he was appointed chief chemist to the Morgan Crucible Co., Ltd., which post he resigned six years later in order to collaborate with Prof. W. A. Bone, F.R.S. (then of the University of Leeds), on the industrial applications of the new principle of incandescent surface combustion, which collaboration speedily resulted in the many important inventions comprised under the "Bonecourt" system of surface combustion. In pursuance of this work, Mr. McCourt became successively managing director of Radiant Heating, Ltd., and chemist and technical adviser of the Bone court Surface Combustion Co., Ltd., and, later on, also of the Commercial Laboratories, Ltd. He was subsequently appointed consulting chemist to the Morgan Crucible Co., Ltd., which position he held up to the date of his death. He carried out numerous researches on ore concentration, on refractory materials, on the applications of surface combustion, and on problems of furnace construction.

Rifleman A. Wood, who has been killed in action, was formerly employed in the meter department of Messrs. Ferranti, Ltd., Hollinwood.

Private Reg. Ormerod, Seaforth Highlanders, has been wounded in Mesopotamia, and is now in hospital. He was on the staff of the British Westinghouse Co., Ltd., Trafford Park.

A Military Medal for gallant service whilst in France with an anti-aircraft battery, has been awarded to Driver Bass, of the Dover Corporation tramway staff.

Sergeant Wm. Boden, East Lancs. Regiment, who had since 1907 been on the Burnley Corporation electricity staff, has died at Plymouth from pneumonia. He had only just recovered from shrapnel wounds.

Corporal E. Jackson, formerly with Mr. R. F. Winder, electrical engineer, of Leeds, has been mentioned by his commanding officer for the second time for distinguished conduct in the field.

Private J. H. Dowson, Machine Gun Corps, who was electrician at Thornley Colliery (Co. Durham), has died from wounds received in Macedonia.

Private James Smith (23), East Lancashire Regiment, reported killed in action, was employed as clerk to Mr. Cowell, tramways manager, Blackburn.

Private S. Mugg, of Durham, who was formerly an electrician with Messrs. Laidler, has died whilst on military service.

Private John Marriott, R.A.M.C., who was employed with Messrs. J. W. & R. Graham, electricians, Huddersfield, has just been awarded the Military Medal for gallantry and devotion to duty on the battlefield.

Obituary.—Mr. C. K. Hamilton.—We regret to record the death, which occurred on March 15th, of Mr. C. K. Hamilton, who was a member of the staff of Messrs. W. T. Glover & Co., Ltd., for some 15 years. For the greater part of that period he represented the firm in the South of England. Mr. Hamilton had been in failing health for the past two or three years.

NEW COMPANIES REGISTERED.

India-Rubber Manufacturers' Association, Ltd. (146,506).—Private company. This company was registered on March 15th, as a company limited by guarantee, with not more than 100 members, each liable to £1 in the event of winding up, to protect the interest of india-rubber manufacturers in the United Kingdom, to collect status information, &c. Annual subscription, £10. The first members of the committee of management are:—J. T. Goudie, Leyland & Birmingham Rubber Co., Ltd., Leyland, near Preston; P. Bate, Castle Rubber Co., Ltd., Warrington; P. A. Birley, Chas. Mackintosh & Co., Ltd., Cambridge Street, Manchester; J. H. C. Brooking, St. Helens Cable & Rubber Co., Ltd., Warrington; R. Eccles, F. Reddeway and Co., Ltd., Pendleton, Manchester; J. Henderson, Ancoats Vale Rubber Co., Ltd., Ancoats, Manchester; D. Moseley, David Moseley & Sons, Ltd., Ardwick, Manchester; J. Tinto, Irwell & Eastern Rubber Co., Salford, Manchester; F. Webster, Avon India-Rubber Co., Ltd., 39, King Street West, Manchester. Registered office: 16, Deansgate, Manchester.

E. Reader & Sons, Ltd. (146,472).—Private company. This company was registered on March 14th, with a capital of £20,000 in £1 shares, to take over the leasehold Phœnix Works, Nottingham, and to carry on the business of engineers, founders, smiths, boilermakers, electrical engineers, &c. The subscribers (each with one share) are:—A. Ogilvie, 108, Brampton Road, St. Albans, engineer; S. H. Pearce, 23, Kellett Road, Brixton, S.W., engineer; H. W. Spencer, 1, Longton Avenue, Sydenham, S.E., engineer; M. F. Stevens, 2, Rookfield Close, Cranmore Way, N. 10, engineer; A. A. Mackintosh, 24, Loraine Road, N., engineer. The first directors are to be appointed by the subscribers. Solicitors: Mills & Morley, 38, Lincoln's Inn Fields, W.C.

Sentinel Co., Ltd. (146,485).—Private company. This company was registered on March 14th, with a capital of £5,000 in 496 pref. shares of £10 each and 800 ord. shares of 10s. each, to carry on the business of electricians, electrical, mechanical, motor, telephone heating, ventilating, and general engineers, manufacturers of scientific, time recorders, signals, surgical, nautical, optical, and other instruments, &c. The subscribers (each with one share) are:—J. F. J. Malone, 86, Rothbury Terrace, Newcastle-on-Tyne; H. L. Riseley, Westfield House, Gosforth, engineer; F. E. Hannay, 61, Osborne Road, Newcastle-on-Tyne, solicitor; E. Hannay, 5, Beach Road, South Shields, solicitor. The first directors are J. F. J. Malone, H. L. Riseley, F. E. Hannay, and F. Hannay. Solicitors: F. F. Hannay, North-Eastern Bank Chambers, South Shields.

National Time Recorder Co., Ltd. (146,424).—Private company. This company was registered on March 12th, with a capital of £10,000 in £1 shares, to carry on the business of manufacturers of time recording machines and clocks, electrical engineers, &c. The subscribers (each with one pref. share) are:—G. W. Lowe, Rosenau, St. Peter's Road, St. Margarets-on-Thames, sales manager; A. T. Brown, 65, [illegible] Road, Forest Gate, E., engineer. The first directors are A. C. Krause (chairman and permanent governing director), F. W. Lowe, S. B. Causer, and A. T. Brown. Solicitor: N. G. Driver, 20, Warwick Court, Gray's Inn, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Central Electric Supply Co., Ltd. (53,080).—Capital, £100,000 in £5 shares. Return dated February 27th, 1917. All shares taken up, £100,000 paid. Mortgages and charges: £500,000.

Alpha Electrical Co., Ltd. (138,040).—Capital, £2,000 in £1 shares. Return dated December 31st, 1916. Three shares taken up; nothing called up. Mortgages and charges: Nil.

Alliance Electrical Stores, Ltd. (111,884).—Capital £25,000 in 47,500 pref. ord. shares of 10s. each and 1,250 def. ord. shares of £1 each. Return dated February 16th, 1917. All shares taken up; 10s. per share called up on seven pref. ord.; £3 10s. paid, £24,996 10s. considered as paid on 47,493 pref. ord. and 1,250 def. ord. Mortgages and charges: Nil.

Vaughan Engineering Works, Ltd.—Second mortgage debenture for £2,500, dated March 8th, 1917, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Morris & Whitham, Ltd.

David Bridge & Co., Ltd. (106,016).—Capital, £25,000 in 16,000 pref. and 9,000 ord. shares of £1 each. Return dated February 5th, 1917. 15,830 pref. and 4,170 ord. shares taken up, £20,000 considered as paid. Mortgages and charges: £8,800, secured by debenture trust deed. Also charge on land to guarantee a perpetual yearly rent charge of £54 on buildings erected on other land.

British Electrical Export Co., Ltd. (138,028).—Capital, £2,000 in £1 shares. Return dated March 10th, 1916 (filed January 9th, 1917). 103 shares taken up; £103 paid. Mortgages and charges: Nil.

Bogota Telephone Co., Ltd. (69,059).—Capital, £45,000 in 20,000 pref. and 25,000 def. shares of £1 each. Return dated November 3rd, 1916. 18,200 pref. and 18,607 ord. shares taken up; £27,807 paid on 9,200 pref. and 18,607 ord.; £9,000 considered as paid on 9,000 pref. Mortgages and charges: Nil.

Robert W. Blackwell & Co., Ltd. (63,446).—Capital, £50,000 in £1 shares (reduced from £250,000 in May, 1916). Return dated January 13th, 1917. All shares taken up; £18,338 paid, £31,662 considered as paid. Mortgages and charges: Nil.

Bullers, Ltd. (62,020).—Capital, £400,000 in £10 shares (20,000 pref.). Return dated December 27th, 1916. 15,000 ord. and 15,000 pref. shares taken up; £150,070 paid on 7 ord. and 15,000 pref.; £143,930 considered as paid on 14,993 ord. Mortgages and charges: Nil.

British Battery Co., Ltd. (137,965).—Capital, £1,000 in £1 shares (800 pref.). Return dated January 2nd, 1917. 800 pref. and 199 ord. shares taken up, £999 paid. Mortgages and charges: £1,000.

Burmah Electric Tramways & Lighting Co., Ltd. (75,090).—Capital, £200,000 in £5 shares (20,000 pref.). Return dated January 4th, 1917. All shares taken up. £100,000 paid on the pref., £100,000 considered as paid on the ord. Mortgages and charges: Nil.

London Electron Works Co., Ltd.—A. Taylor, of Thames House, Queen Street Place, E.C., ceased to act as receiver or manager on February 19th, 1917.

CITY NOTES.

The Alby United and Nitrogen Products Companies.

The annual meetings of the Alby United Carbide Factories, Ltd., and of the Nitrogen Products & Carbide Co., Ltd., in which it holds a quarter interest, were held in London last week, Mr. A. E. Barton presiding. Speaking at the Alby United meeting, the chairman said that the Odda Works were producing at the rate of nearly 90,000 tons of carbide per annum, and the demand was so insistent that they were quite unable to cope with it. Of that quantity, 57,000 tons was delivered under a pre-war contract for conversion into cyanamide. The demand for carbide for lighting had been maintained, while the demand for industrial purposes, such as oxy-acetylene welding and cutting, &c., had exceeded all anticipations, and there was every indication that this would prove permanent, and would increase very considerably under normal conditions. The North Western Cyanamide Co. paid 15 per cent., as against 10 per cent. for 1915; the Alby United Co. now held a controlling holding in that company. Nitrogen Products & Carbide Co. had reached the profit earning stage. The Alby United Co. was erecting at Newcastle an electrode factory. They consumed a very large quantity of electrodes (about 4,000 tons a year), and this was a matter which had given the directors a great deal of anxiety. Prior to the war they were purchased in Germany and Austria, but since the war commenced they had been purchasing them in America. Shipping, however, was not an easy matter in these times, and they therefore decided some few months ago to build works in England. They were starting with a capacity of 5,000 tons, which was afterwards to be increased, and this would mean a saving when these electrode works were completed about six months hence, of about £15,000 a year to this company. There was no doubt that the factory would be considerably enlarged in the very near future, because he firmly believed that after the war there would be in England a very big production of steel by electric processes. It was going ahead very rapidly now, and he thought it would consume very large quantities of electrodes, so that he had every hope that this would be quite a profitable branch of their business, in addition to giving them a supply to meet their own requirements.

At the meeting of the Nitrogen Products Co., Mr. Barton said that the Swedish factory had worked continuously during the year producing both carbide and cyanamide, which were meeting with a ready sale in that country at satisfactory prices. The English factory for the production of nitric acid and nitrate of ammonia by their catalytic process had commenced working, but it would not attain its full output for some weeks. This was the first plant of the description to be erected in great Britain, and as the greater part of it was entirely new in design it spoke volumes for the ability and resource of British manufacturers that they had been able to undertake such work under very difficult conditions. The plant erected by their licensees in France has been running for some months; further factories were being put up there, and an installation was well under way in Italy. This company, with the large water power at its disposal, would be in a unique position to assist not only this country, but the whole world, by the production on a large scale of a cheap nitrogenous fertiliser. The harnessing up of the Aura water power was being proceeded with. They expected to be able to make a substantial further distribution for the year ending June, 1917. He was convinced that within the next ten years the whole of the company's 1,000,000 H.P. would be used in the direction of nitrolin for both chemical and fertilising processes.

London Electric Supply Corpn., Ltd.

Mr. R. H. Benson presided at the annual meeting held in February. The report for 1916 then adopted showed that the profit was £55,214, against £77,688 for 1915. After paying debenture interest and sinking fund charges, and 4 per cent. on the preference shares, £7,068 remained to be carried forward. The number of units sold was 49,810,105, as against 50,757,584. Total costs per unit sold .80d., as against .64d., owing to coal and wages costs. Average receipt per unit sold (lighting and power) 1.02d., as against .96d. for 1915. Expenses of generation increased 73 per cent. compared with 1914 owing to the war, viz., from £67,693 to £127,897, while the units sold increased by 7 per cent. An accident to the generating station during the year caused considerable damage and a temporary stoppage of the supply. Mr. Benson said that the year had been a bad one for everybody whose profit depended mainly on cost of coal and wages. To their great regret, in spite of all efforts to economise in generation and to increase the price charged, the net result was 4 per cent. paid on the preference shares instead of 6 per cent., and nothing on the ordinary shares. Coal had cost 10s. per ton more than in 1915. The situation of the generating station on the river at Deptford, which enabled them to use the cheapest coal, sea-borne, and the best for their purpose, was not so economical now that they had to rely on rail-borne coal plus the cost of lighterage and handling, beside a varying, and not always satisfactory, quality. The riverside position of their station, which in normal times was their greatest source of strength, was, owing to the war, their weakness, though only temporarily, and they hoped it would not last much longer. Later, the speaker referred to the general question of power supply. He said that two remedies were possible for the much-harassed enterprise of producing electrical power in the London district; one was amalgamation or "association," as the Act of 1908 called it, combining plants so as to reach the utmost economy in generation (as yet no company had seen its way to amalgamate under that Act); the other was to profit by the example of our American cousins, abolishing fixed rates and taxes as a charge, or clog, on industry and production, and to substitute a share of the profits to the municipal authority instead. The initiative for a better state of things here could not come from within the companies, but must come from above. Necessity was the mother of invention, and though it might be temporarily impossible to obtain an increased price for power commensurate with the increased cost of generation, still, the tendency was for the price as well as the quantity of units sold to increase. Whenever the cost of coal began to go down again, and good seaborne coal was obtainable instead of irregular supplies of indifferent coal, involving the expense of selecting and sorting, their prospects would rapidly change. Mr. R. S. Bain, the managing director, said that during the year 2,419 H.P. of motors had been connected for industrial supply purposes, making the total at the end of the year 18,102 H.P., while 800 H.P. had been received since. While the receipts increased by over £8,000, the expenditure increased by nearly £31,000, coal being responsible for over £20,000. Steamers becoming almost unobtainable and freights six times the pre-war rate, they had to get rail-borne coal, and the nearest docks for such were at Poplar, which meant trans-shipment across the river, a costly and difficult proceeding.

Metropolitan Electric Supply Co., Ltd.

Mr. A. W. Tait presided at the annual meeting on March 13th. He said that the gross revenue increased by £48,708, or 21 per cent. The units sold increased by 4,750,388 (or 24 per cent.) to 24,595,118. The gross revenue was the largest since they lost the Marylebone area, but they were living in exceptional times, and a large part of the increase was for power for important purposes, particularly in the Western area, and part was attributable to the increased charges for supply to cover part of the great increase in cost of generation. They believed that with proper development the Western area would continue to show an increasing revenue. A large amount of revenue had been lost owing to the lighting restrictions, but they hoped that with the improved offensive and defensive measures now available against air attacks, the restrictions would be gradually relaxed, and that some of the revenue would be regained during the current year. There was also a certain loss of revenue due to the Summer Time Act, which Act looked like becoming permanent. In the expenses, the only item that showed any serious advance was coal, and this they would naturally expect in consequence of the larger output. There was an increase of 25 per cent. on the average price paid per ton in 1915, and they must expect further substantial advance this year while abnormal conditions prevailed. At present they held a reasonable stock, and were well covered for future supplies. There were also increases in costs of materials, labour, and insurance. The amount put to depreciation and reserve was £40,000, as compared with £27,000 in the previous year. They had written £4,047 off stores account, as they had consolidated and cleaned up certain of the stores, and had reorganised the sales department in the London area. A certain amount of old stock had been got rid of, and some further charge in this respect would occur in the present year, though the amount would not be considerable. Certain revisions and alterations were being made in the system of administration which would lead to greater efficiency and economy, but this process must necessarily be gradual, so that there would be no interruption in the proper development and operation of the business. They had at present fairly large capital commitments in connection with the installation of a further 4,000-KW. turbine and new boilers at Willesden station, which would increase economy in generation and enable them efficiently to supply the increasing demand, particularly in the Western area. Further plant was also being installed at Acton and Ironbridge for the same reason, and additional mains were being laid. Including the £40,000 added now, the depreciation and reserve fund stood at £377,358. The amount appropriated had not been arrived at by any process of taking certain percentages on the various items of capital expenditure, based upon the assumption of their probable life, but it had been considered a reasonable provision for a company whose assets were of such magnitude, to set aside for the purposes of depreciation and reserve. He hoped that they would be able to regard this amount as a minimum contribution to that account, and he would be pleased if they were able as time went on to increase it substantially. Mr. Harrison Cripps, when presiding in March, 1915, dealt fully with the schemes then under consideration for the consolidation of the electric supply undertakings of London, and he expressed the belief that a proper combination of the present companies would reduce costs and would ultimately be of advantage to the consumer. He could only reiterate that belief on behalf of the new members of the board, and hope that when the proper time arrived for the negotiations to be taken up again the subject would be approached with a broad give-and-take spirit by all the London supply companies and by the L.C.C. The board as reorganised had only been in harness since October last, but certain progress had been made and economies effected. So far there had been no difference of opinion as to the proper policy to be pursued with regard to the development of the company's areas and the general operation of the business. All the members of the board had one object in view—the efficient development of their areas, and particularly that in the west. The chairman paid a tribute to the work of the staff during a difficult time, especially the general manager, Captain Rendell. They had recently appointed Mr. Markby to the post of chief engineer, and they felt confident that he would be an able successor to Mr. Highfield, with whom he had been associated for many years in the company's service. Mr. Markby had been seriously ill, but he was recovering. Mr. Highfield's continued connection with the company as consulting engineer would be of the greatest possible value. Mr. Cunliffe Owen, the secretary, had also rendered good service, doing everything possible to assist the reorganisation of staff which was now taking place.

Bruce Peebles and Co., Ltd.

Mr. F. E. Andrews presided at the annual meeting, at Edinburgh, on March 16th. After referring to the nature of the work of the year, he said that in order to cope with the increased business, and to expedite and improve the output, they had, as opportunity offered, continued the rearrangement of the works with marked results as regards efficiency, but owing to the abnormal times the management of such a manufacturing concern had been one of continual difficulty; materials and labour, fuel and transport, all had been a source of anxiety, without mentioning the ever-varying prices. The turnover was larger than in any similar period of their existence, the volume of orders obtained was greater, and the value of work sent out from the shops was also appreciably greater. They had always given careful and special attention to export trade to the Colonies and other countries, as they had always attached very great importance to this part of the business. They had been very anxious that, if possible, none of this trade, which had been so assiduously fostered by them, and on cultivating which they had spent appreciable sums of money, should pass into the hands of foreign competitors. He was glad to say that up to the present they had been able to keep closely in touch with all their customers abroad, and had managed to retain a certain portion of their business with them, though, naturally, nowadays the acceptance and execution of orders for export presented considerable difficulties, and were always subject to the permission of the Ministry of Munitions. It was, therefore, all the more gratifying that in spite of all obstacles, and under the onerous conditions prevailing at the present time, they had been able to do so well in that direction. With reference to the company in which they, in conjunction with several other electrical manufacturing firms, were interested for dealing with business in Russia, offices had been opened there under a well-known engineer, the company was getting steadily to work, and they anticipated that after the conclusion of hostilities it would be of considerable use to them, and fully justify their expectations by helping them to obtain a reasonable share of the trade in electrical plant in that country. They had taken advantage of present circumstances in order to push their machinery in a neutral country where previously they had done little or no work; they had already obtained several good orders, and he had every hope that later on this nucleus would enable them to build up a quite satisfactory business there. After briefly alluding to the company's war relief fund, Mr. Andrews dealt with the accounts. The gross profit from manufacturing and trading amounted to £24,469, compared with £13,945 in 1915, and £11,649 in 1914. The total gross profit for 1916 was £26,249, as compared with £14,916 for 1915. They had a balance of £11,930 to be carried to the credit of profit and loss account, but this was subject to the Excess Profits Duty and Munitions Levy for 1915 and 1916, the amounts of which it had not yet been possible to finally determine. These taxes were obviously a considerable burden, and this company was very hard hit by them, for they were based on the average profits of the years immediately preceding the war. During those years the electrical manufacturing industry was emerging from a long period of depression, and in their own particular case they were just making good headway after a time of misfortune. However, money had to be raised for prosecuting the war, and they therefore must bear cheerfully that portion of the financial burden which fell upon their shoulders. The question of goodwill had already been discussed on previous occasions, and would be carefully considered and duly dealt with when the opportunity offered. After much uphill work, the balance sheet had been gradually and steadily put into a fairly healthy condition. Last year he told them that the question of a reorganisation of the capital account would have to be dealt with at the proper moment. That time had now arrived, and the matter had been receiving the careful attention and consideration of the directors. A scheme was being formulated which the board considered fair and just to the holders of the different classes of securities. The future held many problems for all, but especially for engineering works such as theirs—problems of export trade and of output, of organisation and of labour—all of which they would face and overcome in the way engineers always overcame every difficult problem presented to them. They looked forward to the future of the company with every confidence.

Oxford Electric Co., Ltd. Sir Henry Mance presided at the recent annual meeting. In his financial memorandum, read by the secretary, it was stated that the cost of fuel had been £600 more than in 1915, though the units generated had decreased by 6 per cent. In the cost of coal the increase of the year was 20 per cent.; compared with the pre-war period the increase in cost was nearly 40 per cent. The gross profit was less than for 1915 by £1,500, and the decrease in the amount available for distribution was £1,600. Sir Henry said that compared with the results obtained by other provincial electric lighting companies who, like themselves, depended mainly upon lighting load, they might congratulate themselves that the reduction on the ordinary shares was not more serious. The colleges were practically all closed, and the lodging-houses most of them empty; the Daylight Saving Bill had probably caused a loss of £1,000, and restricted lighting affected their revenue very appreciably. The demand for power, heating, and cooking helped them to some extent, and the hospitals made up for the loss of one or two colleges. They had incurred no capital expenditure, and had practised economy wherever possible. The prohibitive price of copper and the difficulty in obtaining cable compelled them to adopt a conservative policy in regard to the extension of mains, except for military purposes. They had made a modest increase in the price of current. In regard to the future, they would have to wait until the end of the war before they could expect to see any considerable increase in their business.

Automatic Telephone Manufacturing Co., Ltd. Profit for 1916, after estimating Excess Profits Duty and contingencies, £56,450, plus £6,774 brought forward. Directors' fees require £2,450; depreciation on patents, goodwill, buildings, plant and machinery, £10,000; written off underwriting commission on shares, £4,000; written off preliminary expenses, £2,000; dividend on preference shares, £12,000; dividend of 5 per cent. (less tax) on the ordinary shares, £18,000; carry forward, £14,774. No orders have been taken for new Post Office public exchanges, the Department having necessarily to curtail work of this description. The exchanges at Portsmouth, Paisley, and Blackburn were, however, completed and put into use during the year, and continued to give satisfaction. Several smaller exchanges for works have also been completed, and one for a public institution. Meeting: Liverpool, March 26th.

British Insulated and Helsby Cables, Ltd. The profit for 1916, after making provision for estimated liability for Excess Profits Duties to date, was £300,466, plus £160,096 brought forward = £460,562. This total is dealt with as follows: Directors' and debenture trustees' fees and remuneration to Works' Committee, £5,915; interest on first debenture stock, £22,500; interest on second debenture stock, £10,000; dividend on preference shares, £30,000; depreciation on buildings, plant, machinery, &c., £25,000; special depreciation on plant and machinery, £20,000; transfer to reserve account, £70,000; transfer to special reserve account, £8,500; transfer to first mortgage debenture stock redemption account, £5,000; 15 per cent. dividend and 5 per cent. bonus on the ordinary shares, £100,000; carrying forward, after making provision for estimated liability for Excess Profits Duties, £163,647. The business has been well maintained during the year. Meeting: Liverpool, March 26th.

Windermere & District Electricity Supply Co., Ltd.—Receipts from sales of current during 1916 fell off by £544. Charges for lighting current were increased by 10 per cent. in July last. The Diesel oil plant has been in use during nearly the whole year, and has worked well, and as the result of a favourable contract for fuel oil made towards the end of 1915 there has been a considerable reduction in expenses. Keswick Electric Light Co. has again had smaller sales of current, and has only been able to pay 2 per cent. on account of arrears of interest on its debentures. The present high price of fuel may cause a considerable increase in expenses this year, and the directors do not expect to be able to declare an interim dividend on the preference shares in October. The revenue balance was £1,656, plus £148 interest on Keswick debentures. 2 per cent. is to be paid on the preference shares, and £63 is to be carried forward.

Edison Swan Electric Co., Ltd.—Mr. C. J. Ford explained at meetings of different classes of shareholders, on 14th inst., that the company must have more working capital available in order to take advantage of opportunities for increased trading, and the scheme of arrangement submitted was prepared with that as its main object. He explained the details of the scheme, and said that though the concessions made to the debenture-holders for giving up their right to £200,000 of security would place upon the company an additional charge for interest and sinking fund of £6,468, that was far more than compensated for by the benefit that would accrue from the additional working capital secured.

Prospectus.—*Shropshire and Worcestershire and Staffordshire Electric Power Co.*—With the consent of the Treasury, this company is offering for subscription an issue of 50,000 7 per cent. redeemable cumulative preference shares of £1 each at par. The plant installed at the end of 1916 was 20,325 KW., and a further set of 8,000 KW. will be in service in the course of a few weeks. The gross revenue for 1915 was £75,936, for 1916 £158,000 (approx.), and the estimate for the current year is £210,000. The list closes on March 27th.

Gateshead & District Tramways Co.—The revenue for 1916 was £77,333, and after deducting expenses, including renewals £3,000, the balance is £35,136, plus £4,239 brought forward. There is put to special reserve £7,500, to reserve £5,500, to sinking fund for redemption of mortgages £2,540, 6 per cent. pref. dividend £757, 5 per cent. pref. dividend £6,000. After paying a dividend of 12s. per share, and a bonus of 8s. per share on the ordinary shares, £3,579 is to be carried forward. The special reserve stands at £17,500, and to this £6,239 there has been charged Excess Profits Duty for 1914 and 1915.

British Aluminium Co., Ltd.—The directors recommend placing £60,000 to depreciation and £75,000 to reserve. Final dividend at the rate of 12 per cent. per annum on the ordinary share capital, making 10 per cent. for the year £26,926 is to be carried forward.

Hadfields, Ltd.—The directors propose to add £85,000 to the reserve and renewals account, and to carry forward £185,695. In addition to the interim dividend of 1s. per share paid in July on the ordinary shares, a further dividend of 4s. per share (making the rate the same as last year) is to be paid, together with a bonus of 1s. per share, all free of tax.

Canadian General Electric Co., Ltd.—Quarterly dividend, 2 per cent. to March 31st on the common stock, and a half-yearly dividend of 3½ per cent. on the preference stock.

Browett, Lindley & Co., Ltd.—According to the "Financial Times," this company is recommending a dividend on the ordinary shares for the first time since 1900. The rate is to be 4 per cent. In June last 50,000 ordinary shares were written down from 20s. to 15s.

Manila Electric Railroad & Lighting Corporation.—Dividend, 1½ per cent. ($1.50 per share) for the quarter on the common capital stock.

Waste Heat and Gas Electricity Generating Stations, Ltd.—The annual meeting was held in Newcastle-upon-Tyne on March 14th. Mr. F. S. Newall, presiding, said that the amount of waste gas, heat, and steam which they had received during the year had, under the exceptional circumstances, been well maintained. It had been slightly less at some parts, and rather more at others. By becoming the intermediary between coal owners and iron masters, the power companies, who were the authorised distributors of electrical power in their respective areas, had been able to utilise the whole waste heat and gas in the most efficient way possible by converting it into electrical power. The power thus generated in the company's stations had been invaluable to the power companies, and through them to the manufacturers in the districts, and particularly when the price of coal had been so high.

Veritys, Ltd.—According to the "Financial Times," 7 per cent. per annum (7s. per share) is to be paid on the preferred ordinary shares for half-year, making 7 per cent. for year; £1,517 forward. Last year, 6 per cent. for the year, £1,084 forward.

Isle of Wight Electric Light & Power Co., Ltd.—After paying the preference dividend and putting £2,000 to renewal fund account, £338 is to be carried forward.

Doulton & Co., Ltd.—A dividend of 5 per cent., less income-tax, is announced on the preference shares for 1915.

Simplex Conduits, Ltd.—Dividend 10 per cent., and bonus 10 per cent., both free of tax, for 1916.

Mirrlees Watson Co., Ltd.—Dividend for 1916, 10 per cent., less tax, putting £17,500 to general reserve and carrying forward £6,960.

British Electric Transformer Co., Ltd.—Dividend on ordinary shares for 1916, 7½ per cent. per annum, carrying forward £5,781.

STOCKS AND SHARES.

Tuesday Evening.

The very excellent character of the news from the Western Front provided great encouragement not only to the man with money to invest, but also to him who is already the holder of shares and who has been a little doubtful as to whether he ought to sell or to hold. In the latter case, the news of the capture of Bapaume and Peronne had the direct result of causing a fair number of previous selling orders to be cancelled, and the Stock Exchange complaint is now that there is very little stock about to supply the felt want. Undoubtedly, when the market in the new War Loan stocks opens, there will be a warm welcome for it; and unless conditions change rapidly the stock, we venture to predict, will command a premium from the outset.

Electric lighting shares are firm, with the rest of the investment departments. The approach of Summer Time carries no terrors with it this year. City of London ordinary are 10s. better. Counties recovered their dividend, and so did Westminsters. There is a scarcity of floating supply; and although buyers are not paying what they deem fancy prices, they are open to temptation at current quotations. The trouble, however, is to get shares.

The difficulties of the supply companies were well put the other day at the meeting of the Bournemouth & Poole Electric Co., but the chairman pointed out that the falling-off in the amount of lighting was compensated to a large extent by increased sales for heating and national work. The tone of the market is good throughout, but business remains quiet.

Home Railway stocks further benefited by the strength of Consols. The premier security—Consols occupying that position until the War Loan dealings start—has crossed 54, demand coming largely from holders who have had their American securities commandeered by the Treasury. The money thus released has overflowed into other investment departments, including that for Home Rails; and during the past few days a feature has been the buying of low-price stocks, from which it would appear that the spirit of speculation is by no means dead, even amongst Home Railways.

The Undergrounds are slow to recover from the depressing effect induced by the speech of Lord George Hamilton at the meeting of the Underground Electric Co. However, Metropolitans are better, though there remains a dullish tendency in the income bonds of the holding concern. Quite a feature is the advance of most of the debenture and preference stocks, these putting on several points in most cases during the past week, while still the buyers lament that they have to go unsatisfied.

This week's dividend record embraces the declaration of 15s. per share on British Insulated & Helsby Cable shares, including the bonus. The profit for the year came to £300,000, and £163,600 was carried forward, being £3,600 more than was brought into the accounts. The Henley's Telegraph Works board recommend a final dividend on the ordinary shares of 10 per cent., making 15 per cent. for the year (not 13 per cent., as given in our "City Notes" last week), together with a bonus of 10s. per share. The Western Telegraph Co. has declared the usual quarterly dividend of 3s. per share, free of tax; and the Automatic Telephone Co. is going to pay 5 per cent. on the ordinary shares for the year. British Westinghouse repeats the previous performance of 7½ per cent. on the preference shares.

Save in the last-named, no particular changes have resulted from these declarations, but the market for all good industrials is a strong one. British Westinghouse preference rose 3/16 to 50s. on the hope of an increased dividend next time. The rise in Edison Swan debenture stocks which we mentioned last week has been fully maintained. Castner Kellner are 1/16 lower.

Mexican industrials are harder, and British Columbia stocks attracted buyers because of an unexpectedly good dividend declaration by the Grand Trunk Railway of Canada, which helped to spread optimism far beyond its own immediate circle. Rio Tramways bonds are again higher. Brazilian Tractions are depressed, and show a fall of 1½ on the week. In the home group, North Metropolitan debenture is 2 points down at 87.

Telegraph stocks and shares are quiet. Marconis keep steady at 2⅝. Globe preference gave way a little.

The rubber market is by far the most active in the Stock Exchange, and buying has been resumed on a large scale, principally by the provinces. With the price of the material showing a slight improvement and dividend declarations being very satisfactory, a bout of speculative activity is once more a feature, the only fly in the ointment being the possibility of an increase in the Excess Profits Duty in the forthcoming Budget. People who declare that speculation is impossible under the present Treasury regulations evidently do not know their rubber share market. Baser metal shares have benefited by a rise in the price of tin, but there is very little going on amongst the copper issues.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1914.	Dividend 1915.	Price Mar. 20, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary ..	5	5	3⅜	—	7 8 2
do. do. do. 4½ Pref..	4½	4½	3 3/16	—	7 1 2
Chelsea	5	4	3	—	6 19 4
City of London	9	8	11½	+ ½	6 19 2
do. do. 6 per cent. Pref.	6	6	9⅞	—	6 1 6
County of London	7	7	10¼xd	+6/9	6 16 7
do. 6 per cent. Pref.	6	6	9½xd	+ ¼	6 6 4
Kensington Ordinary	9	7	5¼xd	—	6 11 7
London Electric	4	3	1	—	Nil
do. do. 6 per cent. Pref.	6	6	9½	—	6 6 8
Metropolitan	3½	3	2 5/16xd	—	6 9 9
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 4 0
St. James' and Pall Mall ..	10	8	6⅛xd	+ ⅛	6 10 8
South London	5	5	2⅞	—	6 19 0
South Metropolitan Pref. ..	7	7	21/-xd	—	6 13 4
Westminster Ordinary	9	7	5¾xd	+ 3/16	6 1 9

Telegraphs and Telephones.

	Dividend 1914.	Dividend 1915.	Price Mar. 20, 1917.	Rise or fall this week.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	94	—	6 7 8
do. Def.	30/-	33/6	22	—	6 16
Chile Telephone	8	8	6 15/16	—	5 15 3
Cuba Sub. Ord.	5	5	7½	— ¾	6 13 4
Eastern Extension	7	8	13¾	—	*5 16 4
Eastern Tel. Ord.	7	8	137	—	*5 16 1
Globe Tel. and T. Ord.	6	7	11½	—	*5 19 2
do. Pref. ..	6	6	9⅝	— ⅛	6 4 8
Great Northern Tel.	22	22	84½	—	6 7 6
Indo-European	13	13	46½	—	6 19 9
Marconi	10	10	2⅝	—	3 9 2
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord. ..	10	10	2⅛	—	4 14 1
United R. Plate Tel.	8	8	6 9/16	+ 1/16	*6 2 0
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13¾	—	*5 16 4

Home Rails.

	Dividend 1914.	Dividend 1915.	Price Mar. 20, 1917.	Rise or fall this week.	Yield p.c.
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1¼	1	24	+1	4 3 4
do. District	Nil	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A" ..	Nil	Nil	5/6	—	Nil
do. do. Income	6	6	80	— ¼	*6 5 0

Foreign Trams, &c.

	Dividend 1914.	Dividend 1915.	Price Mar. 20, 1917.	Rise or fall this week.	Yield p.c.
Adelaide Sup. 6 per cent. Pref.	6	6	4 15/16	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	2⅞	—	9 11 4
do. 2nd Pref. ..	5½	5½	2⅜	—	—
do. 5 Deb. ..	5	5	64½	—	7 15 0
Brazil Tractions	4	4	45½	—1½	8 15 10
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	62	+2	8 1 4
do. do. Preferred	—	Nil	43	—	Nil
do. do. Deferred	—	Nil	39½	+2	Nil
do. do. Deb.	4½	4½	62½xd	—	6 16 0
Mexico Trams 5 per cent. Bonds	—	Nil	27½	+1½	Nil
do. 6 per cent. Bonds	—	Nil	25	+2½	Nil
Mexican Light Common ..	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	14½	—	Nil
do. 1st Bonds ..	Nil	Nil	27½	—	—

Manufacturing Companies.

	Dividend 1914.	Dividend 1915.	Price Mar. 20, 1917.	Rise or fall this week.	Yield p.c.
Babcock & Wilcox	14	15	2¾	—	5 9 1
British Aluminium Ord. ..	6	7	28/-	+6d.	5 7 2
British Insulated Ord.	15	17½	12¾	—	6 17 8
British Westinghouse Pref. ..	7½	7½	2½	+ 3/16	6 0 0
Callenders	15	20	12¼	—	8 4 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	3 5/16	— 1/16	6 13 0
Edison & Swan, £3 paid ..	Nil	—	5/16	—	Nil
do. do. fully paid ..	Nil	—	1⅝	—	Nil
do. do. 4 per cent. Deb.	4	4	66	—	6 1 3
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9½	—	6 6 4
do. Ord.	10	10	14½	—	6 18 0
Henley	20	25	15	—	8 6 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11¾	—	*8 10 2
Telegraph Con.	20	20	86	−1	*6 18 4

* Dividends paid free of income-tax.

SOME THOUGHTS ON THE CAPITAL AND LABOUR PROBLEM.

By W. T. Wardale, A.M.Inst.E.E.

In discussing the problem of obtaining greater mutual respect and helpfulness between Capital and Labour, most people are content to generalise by saying that Capital must cease to regard wages as something to be relentlessly cut down, and labour simply as a rather awkward money-making device; whilst, on the other hand, Labour must cease to regard the enhanced output as a sure ground for the "sack" the month after next.

Wonder is expressed that the two bodies cannot see the very simple sense of the two facts quoted above, and there the matter is left; if the matter was so simple, it would have been settled long ago.

As a rule, the workman will not look at the commercial side of the trade which employs him, and, generally, he so thoroughly despises the business of selling that he can hardly be brought to believe that many articles take more time and money to sell than to make. Now, if the workman would only attempt to understand the selling, or commercial, side of the trade, he would have taken a most important step towards understanding the peculiar handicaps often encountered by the employer in endeavouring to find profit for himself, and work and wages for his men.

This brings us to another point: the workman is often told that his employer does not find work for him, but that it is the customer who finds the work for him, the employer merely acting the part of a greedy middleman, who is quite unnecessary.

Like so many other freely-used phrases, this idea is theoretically correct only for a theoretically perfect state; it is not practically true under our present conditions, and even under idealistic and Utopian conditions the connection between maker and user could seldom be as direct as this idea suggests.

Take the case of a man opening a factory for electrical motors, and motor-starters, in a district possessing no such industry. This man struggles for custom in the open markets, and spends time, money, and energy in order to bring work to his factory; true, his aim in doing so is to fill his own pocket, but in pursuing this aim he is exercising a valuable function, and must, in order to carry it through, find work for his workmen.

Now, let this man invent a patent motor-starter which is more reliable, and costs, say, 30 per cent. less than any motor starter then on the market. As soon as this fact is known orders simply flow to his works, and, due to his brains, energy, and pluck, he finds work for a larger and larger number of workmen.

Thus, in the present conditions, the employer does find work for his workmen; and there are many cases of firms which, due to one cause or another, have found work for their men for many years, but never a dividend for the shareholders.

In the same way, all the great inventors, such as Marconi, find work for many thousands of people by creating new demands for new apparatus.

Thus, the successful solution of the commercial problem is of the utmost importance to the workman.

In this connection, the writer knows of a very interesting case of the refusal of the workmen to work to commercial conditions. The example has the additional merit of being in connection with a firm run by the workmen themselves.

Some years ago the men at a certain shear works quarrelled hopelessly with their employers, the upshot being that a works fitted with water power was taken, and a co-operative and co-partnership firm established.

Friendly buyers offered to find a market for the goods turned out, and there was the added advantage that the goods would not have to be designed, but simply made to designs supplied.

The outcome of the adventure, which still pursues a peripatetic way, was as follows:—The workers are in two bodies roughly speaking, forgers and grinders; obviously, if the forgers do not work the grinders have nothing to grind. The district in which the works are situated happens to be largely agricultural, whilst the workmen of the locality are enthusiastic gardeners. Living and rents in the country are cheap, whilst many of the men have one or two cottages, usually left to them by relatives. In consequence, these men find that an income of between 20s. and 30s. a week, in normal times, will allow them to live comfortably in the style in which they were brought up. Not being beholden to any capitalistic boss, they knock off when they have earned the amount which will last them for the next week, and devote the rest of the time to gardening and other pursuits of which they are fond. The writer knows for a fact that several times there has been risk of serious trouble, and of the works being shut up, because the grinders, who wish to make a full week, and to earn, say, 50s. or thereabouts each week, are hung up by the forgers refusing to work more than three or four days a week, the attitude being, "I've got enough for myself this week, and I'm not going to work any longer for anybody who wishes to make more." In peace times the concern finds that it only gets the dribblings which are left over from the market when other firms are full up. The factors and merchants cannot be humbugged by waiting on the pleasure of the gardening fraternity. Naturally, the more industrious men become irritated at this sort of thing, but, having a stake in the concern, cannot close the place down without some pecuniary loss to themselves.

If these same men, who will not work a full week, were to walk up to the local tobacco shop and be told by the proprietor, "Oh, I'm not selling any more this week; I've made my week's living, I'm going fishing to-day and to-morrow; you can have some more tobacco on Saturday, when I come back," they would be positively enraged at the tobacconist treating them to their own medicine. "How," they would ask, "does he expect to keep his trade if he won't consider his customers?" They, however, tell the prospective buyer of shears that he must wait their good pleasure. They neglect the commercial proposition, and the result is that, in normal times, what could be a really well-filled busy works simply drags on earning no more than a pittance for anybody.

Thus, the neglect of the commercial factor must cease; instead, the workman must be brought to realise that wrapped up with this same factor is that of increased output, which will mean a full order book for his employer, and a full and regular wage-packet for himself. How is he to be brought to realise the truth of this fact, and what is the obstacle now standing in the way? The answer is: Suspicion.

Why, and how, has this suspicion arisen, and why is it so stubbornly maintained? And to what lengths does it lead the workman? It will be best, perhaps, to answer the last query first, by giving an example of the dire effects of this feeling, the example being well known in the quarter in which it happened.

Many years ago, a well-known firm of engine-builders, whose care for their men was well recognised, decided to give the men employed at their works a chance to save money at a rather more rapid rate than usual. To this end, they arranged to take what savings the men cared to leave with them week by week, allow 2½ per cent. interest from the firm, bank the whole with a well-known banking company, who were prepared to give another 2½ per cent. on the amounts, making the rate of interest 5 per cent. in all. Note that this money was not used in the business of the company, but was withdrawable at very short notice, or in small sums on demand. The object was simply to show the men what could be done by regular small savings of their own money, and to encourage thrift by a good rate of interest; this interest of 5 per cent., by the way, was given at a time when debenture stocks were issued at 3½ per cent. to 4 per cent. at the outside.

For some time the deposits grew, and it almost seemed as if some real and lasting good was to be the outcome of the scheme. Then, without any warning, without any shadow of trouble looming on the horizon, the deposits were withdrawn first one by one, and then by larger and larger numbers of men, until in three months from the start of the unusual withdrawals there was not £10 standing to the credit of the scheme. It might be thought that rumour had set about the report that the firm were in low water; this was not so, and, incredible as it may seem, the sole reason for the emptying of the savings account was that some jaundiced and envious individual had gone round the works and told the men concerned the following tale: "Ah, it's all very well you thinking that it's being done for your benefit, but wait and see! All they want to find out is how much you are able to save, and to reckon up how much you have over what it costs to keep you. You see if, in a few months' time, they don't use the fact of so much having been saved to cut wages down. It's been done before, with similar tricks, at So-and-So's place (mentioning works where rate-cutting managers had been allowed full sway), and it will be done here as well." That tale, and that tale alone, told first to one, and then to another, with references to other works, settled the whole matter.

The heads of the firm satisfied themselves, after full inquiry, that the cause of the withdrawals was as stated above: small wonder that it effectually put an end to the philanthropic interest they felt in their men.

Most people would state that the above distrustful and suspicious attitude was simply and solely due to the unscrupulous rate-cutting indulged in in practically every engineering shop in the district at that period. The matter, however, goes further back than this, and is much more deeply rooted in the men's minds.

The writer has satisfied himself, as the result of long and careful inquiry extending over many years, that the root cause is the wrongs inflicted on the working population in the early days of the rise of the industrial system.

In particular, the manner in which children of extremely tender age were worked long hours under cruel supervision is largely to blame, not only for the bitterness felt by the workman toward his master, but also for the spirit of distrust shown even towards a well-meaning employer, and for the often short-sighted policy which the men adopt and are ready to follow.

The Lancashire or West Riding workmen of to-day have spoken with the men who, as children, went through the terrible times so well and strongly condemned by Prof. Sadler. It has not been a matter of reading or hearing of such things being done in far-off lands; the mischief was perpetrated on their own fathers and grandfathers, and perhaps, even worse still from a national point of view, on their mothers and grandmothers.

In consequence of this treatment, the workman of 70 years ago not only learnt to distrust the master, but, by the process he endured in the mills at a very early age, practically had his mental faculties blunted and stunted. The same thing happened to the women of that class and generation; in consequence, the children raised from such parents cannot be blamed if, in addition to a feeling of bitter opposition towards the employing class, they were born with a very stunted and short-sighted outlook on life.

The men had to have Trade Unions to get fair play; 40 years ago most unions had to fight for existence. Can it be wondered at that, now they have become strong, they should be used at times in a short-sighted and tyrannous manner? If one rears up three generations to learn as a basic fact that they can only secure a living wage and decent conditions by being ready to fight the employer, what else has one the right to expect than the present-day distrust and short-sighted policy of most of the union members?

Those members of the unions who have worked themselves into leading positions generally get the opportunity to study the economic side of the matter from a better and more all-round point of view than the ordinary union member can hope to have; and what is the consequence? Simply that as soon as these more enlightened views are put forward, the leader in question is dubbed a traitor, and his arrangements with the employers flouted and flung in his face. The evil has, of course, been aggravated and perpetuated by those managers who, often sprung from the men themselves, have taken a delight in cutting wages and prices, and, wherever possible, making of no avail the concessions obtained by the men from the employers. The workman of 50 years ago told his son to watch the employer, who would try to deceive him at all times and at every opportunity. He also solemnly warned him that if too much work was done in one month, or a machine capable of increasing the output was permitted to be used, then the next month or two would, as sure as the sun rose, see unemployment, and the permanent "sack" for many of the men. He also handed down the tradition that the commercial problem did not matter to the man.

The younger workman found out pretty quickly, owing to the machinations of the rate-cutting, nigger-driving manager, that the first portion of his father's advice had come literally true, and that he got nothing from the employer which he could not, through his union, force from him.

Can we wonder, then, that the other two traditional axioms of the workman, handed down by the same father who had warned him of the rate-cutting manager, have been accepted by him as essentially true? Thus, the matter of removing this unhappy feeling is no light one, as the cause is far deeper than is usually believed.

Only years of absolutely straight working will restore the faith in the employer, which is so necessary for securing the best results. The slightest sharp practice, or slim tactics on the part of any manager or foreman will at once arouse feelings which it has taken perhaps years to allay; and after the war these men must no longer be allowed the freedom they have enjoyed. They must be given to understand that any sharp tricks in connection with the men will be punished sharply and drastically.

The workman, on his side, must be ready to forget old-standing ideas and prejudices, and must, when he sees fair working, meet it with fair working in return. He may be assured that if he will not work with the employer, and will not consider and allow for commercial conditions, trade will decline, and employment at good wages become an impossibility. The evil done 80 years ago is not the fault of the employer of to-day; but he is often made to suffer for the things done in that far-off time. As a class, he has paid the full penalty for the mistakes of those early days, and this fact ought to be, and will have to be, recognised by the workman.

Let the employer who is irritated by the surly responses to his well-meant efforts bear in mind the cause of that surly attitude, and let him stretch his patience even a little more. Let the workman look to such places as Port Sunlight and Bournville, and remember that these happy industrial towns were founded, not by being forced out of the employers in question—that would never have been possible—but by the goodwill and good wishes of the employers towards the workpeople.

Let the workman take an interest in the commercial side of his trade; let him save up money collectively, not for the purposes of a strike fund, but for investment in the business at which he works. Such a policy pursued for 20 years would result in many more workmen being able to avoid seeking the shelter of the workhouse in their declining years.

The idea is not impossible; it only needs the difficulties on each side to be understood and appreciated in order to set on foot progress towards that desirable end.

The object of these notes has been to state those difficulties, in the hope that it may perhaps assist their solution.

HIGHER BOILER PRESSURES.

Our contemporary *Power*, in a recent issue, recorded the opinions of some well-known American engineers on the question of higher boiler pressures, amongst which were the following:—

Mr. F. Hodgkinson (Westinghouse Co.) considered that the only difficulty was the boiler (for pressures such as 600 lb. per sq. in.), and suggested some form of flash boiler. For the turbine it only meant the use of heavier parts for the extremely high pressure end at a small increase of cost, and in view of the theoretical gain of 10 or 12 per cent. it was important to secure it.

Mr. Samuel Insull (Chicago) thought there was quite a possibility of operating turbines and boilers at pressures as high as 1,000 lb., and regretted that the large-size turbine was being developed before the question of higher boiler pressures was settled.

Mr. R. J. S. Piggott (Remington Arms and Ammunition Co.), pointed out that the vacuum limit was practically reached, and as regarded higher pressure and superheat the characteristics of metals employed prohibited higher temperatures than about 700 deg. F. He did not much favour an exceedingly high pressure, say, 600 lb., with comparatively low superheat of 100 deg. F., for the reason that the most serious windage and friction loss occurred in the H.P. stages of the turbine; reducing the superheat would advance the dew point well into the H.P. stages. The first wheels of some of the 30,000 and 35,000-KW. turbine units had an efficiency of but 48 per cent., and although much of this apparent loss was recovered in later stages, the advancing of the dew point would increase losses due to wheel friction. Boiler plant might be designed for a normal temperature of 600 deg. F., but it was certain that this would increase at times to 700 deg. or 750 deg. F.

Mr. R. H. Rice (General Electric Co.) favoured all propositions tending to raise the limits of steam pressure and temperature, but pointed out that with high temperatures, considerable heat losses occurred at starting and stopping, and that such plant would be best used on 24-hour loads.

Mr. L. C. Loewenstein (General Electric Co.) said his company were prepared to handle temperatures up to 800 deg. F.

Mr. Frederick Sargent (Sargent & Lundy) said that both the General Electric Co. and Westinghouse Co. claimed that there would be no trouble about building a turbine for pressures of 500 or 600 lb., and temperatures of 700 to 750 deg. F. Several people, including Messrs. Babcock & Wilcox, were investigating types of boilers suitable for higher pressures, but preliminary designs along established lines were very costly In the meantime, his firm decided to use the highest pressure suited to the present type, and the boilers at the Joliet (Ill.) station were designed for 350 lb. pressure and 225 deg. F. superheat. He further referred to the experimental plant of the B.T.H. Co. at Rugby (which was briefly described in our report on the I.M.E.A. proceedings in June last). Welded steam joints in pipe flanges and valves were now being used: the 35,000-KW. set at the North-West (Chicago) station was treated in this way—a thin weld being made inside the bolt circle, to seal the joint only, which was held together by bolts, as usual. High temperature could be obtained by low pressure and high superheat, but the economy would be greater if both the superheat and pressure were high; the present limit was given by the manufacturers of machinery. The raising of the average temperature would be an advance, and could be obtained by superheating the exhaust from the high-pressure end of the turbine before it entered the low-pressure end, which in conjunction with high initial temperature would give a high average temperature. When this was done, and provided present boiler, superheater, and economiser efficiencies could be maintained, a KW.-hour should be available at the switchboard per lb. of high-grade coal.

Prof. E. F. Miller (Mass. Institute of Technology) said he believed that many new plants would in the not distant future be designed for pressures approaching 600 lb., and he knew one plant which had been considering such pressures.

Dr. Ferranti wrote emphasising his belief in the necessity of much higher pressures and temperatures in order to secure the greater economies which modern conditions of power generation demanded.

Prof. W. D. Ennis (Brooklyn Polytechnic Institute) pointed out that thermodynamic considerations favoured high initial pressure rather than high superheat, as essential to efficiency; unfortunately, pressures had to be exceedingly high in order to get a temperature range even reasonably good. In modern plants steam temperatures of 550 deg. F. were common, which with saturated steam would involve a pressure of 1,062 lb. per sq. in., so that a compromise was necessary, and the highest practicable pressures with proportionately high superheats were employed. The frictional losses of a turbine were proportionate to the density of the steam, and high pressures increased the density, while superheating at any pressure decreased it. With fixed exhaust pressure, the expansion of dry steam led to greater liquefaction, as the initial pressure was greater. Particles of moisture due to liquefaction caused friction and wear, and superheat was the preventative. In European practice in the last five years steam temperatures up to 1,000 deg. F. had been, if not common, at least commercially feasible, particularly in the locomobile. Boilers with small water tubes would probably be suitable with only minor modifications up to 350 or 400 lb., and on account of their reduced efficiency owing to the increased chimney temperatures, economisers might become standard equipment, as in Europe. As regarded engine pressures, he mentioned that Diesel engines regularly used 550 lb. compression, and many hot-bulb semi-Diesel engines with 300-lb. compression realised sudden maximum pressures of about 550 lb.

The Babcock & Wilcox Co., in the Prime Movers Committee report (N.E.L.A., 1916), mentioned that they had in course of construction a number of large boiler units for 350 lb. working pressure with 250 deg. F. superheat, following standard lines, but of heavier build. Inquiries regarding boilers of 500 to 600-lb. pressure with steam temperatures of 700 deg. F. had led to experiments which showed that such boilers could be manufactured as a standard commercial article if required. For 350-lb. pressure, the increased cost for large units over 200-225 lb. pressure would probably be about 20 per cent. The question appeared to be whether the advantages of the higher pressures with 700 deg. F. temperature limit would compensate for the difficulties, in comparison with 350 lb. working pressure and 700 deg. F. temperature. With such a temperature limit the problems to be solved were probably entirely outside the boiler and furnace.

An insurance view quoted was that any tendency greatly to increase the working pressure was likely to cause an increase in failures of such apparatus; the increased hazard resulting from explosions would also require to be met by a compensating increase in insurance rates.

THE VOLTAGE REGULATION OF ROTARY CONVERTERS.

By G. A. JUHLIN, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

(*Concluded from page* 306.)

Booster Control.—This method of voltage control is employed to a great extent for all classes of service. The voltage variation is obtained by the use of a synchronous booster mounted on the shaft of the converter. The type generally adopted is that with a revolving armature mounted between the converter slip-rings and armature. The field may of course be provided with shunt or series windings, or both, in accordance with the requirements of the service for which the converter is intended.

With the booster field unexcited and the converter operating on unity power factor, it is clear that the E.M.F. of the converter is not affected by the current passing through the booster, except to a very small extent, due to the impedance drop in the booster armature.

When the power factor varies from unity, the conditions are, however, quite different, as the booster armature reactance is then either magnetising or demagnetising, and the booster armature magnetomotive force must therefore be balanced by an equal number of ampere-turns on the booster field. The booster field may therefore require a certain amount of excitation, although no change in the converter E.M.F. is required. Conversely it is possible to obtain boost, positive or negative, without exciting the field of the booster, by producing wattless currents in the converter which will produce the excitation of the booster. This feature may be of service in cases of emergency, as when it is desired to put a converter into service and the bus-bar voltage has fallen below the lowest voltage obtainable from the converter under normal running.

From the above it is clear that the power factor is under complete control in a booster type of converter, as the influence of the wattless current on the E.M.F. can be counterbalanced by the excitation of the booster field. It should be noted, however, that it is essential not to operate a booster converter at a lagging power factor, as this will overload the booster field when raising the voltage, and may account for the booster not giving its full range in voltage.

The fact that the power factor can be kept at unity, or leading, if desired, is undoubtedly the chief reason why the booster type of converter has found such an extensive use. Some doubt may be expressed, however, as to whether this extensive use is altogether justified, as in many cases where comparatively small voltage variations are required, and the converter is not required to give wattless currents for power-factor improvement, the reactance control could be employed with equally good results.

In the simple converter all the electrical energy, except the small part absorbed in the losses, supplied on one side is transformed electrically and delivered in the form of electrical energy on the other side of the converter. The total armature reaction is in this case only produced by the losses in the converter, but the distribution over the pole-pitch is not uniform, with the result that a certain part is acting in the interpolar space. This must be compensated for by a certain number of ampere-turns on the interpole. The armature magnetomotive force is under these conditions a simple function of the load, and can therefore be taken care of by the ordinary commutating pole winding excited by the load current.

When the booster is used, the effect of the converter armature is more complicated, due to the fact that a part of the electrical energy supplied to the converter is transformed into mechanical power and transmitted through the shaft to or from the booster, the direction depending on whether the boost is positive or negative. In the case of positive boost, *i.e.*, when the E.M.F. of the converter is increased, it acts partly as a motor supplying mechanical power to the booster, which then acts as a generator in raising the E.M.F. On the other hand, when the converter E.M.F. is reduced by means of the booster the converter acts partly as a generator receiving energy from the booster, which is then operating as a motor delivering its energy through the shaft to the converter. Under these conditions the effect of the armature on the interpoles is no longer dependent only on the load of the converter, but also on the E.M.F. of the booster. This is due to the fact that the alternating and continuous currents are not balanced, as in the simple converter, and the converter armature, therefore, develops a motor reaction when the boost is positive, and a generator reaction when the boost is negative.

The value of this armature magnetomotive force is directly proportional to the output of the booster. For example, with the booster excited so as to raise the converter E.M.F. 10 per cent. the armature reaction would increase the interpole ampere-turns by an amount equal to 10 per cent. of the alternating-current armature reaction, or, if the E.M.F. were reduced by the same amount, the interpole ampere turns would be decreased by an amount equal to 10 per cent. of the alternating-current armature ampere-turns. This would, of course, mean an increase or a diminution of the flux required to obtain correct commutation; and when it is considered that as an average the interpole ampere-turns necessary to produce this flux, as well as compensate for the normal armature reaction at zero boost, only amount to about 35 per cent. of the armature ampere-turns, it will be readily appreciated that a reduction of 10 per cent. means a big change in the strength of the interpole flux. In order, therefore, to keep the interpoles at their correct strength at any load and voltage, it would be necessary to provide some means whereby the interpoles were automatically adjusted with the load. It is, of course, also necessary to vary the excitation on the interpoles with varying boost.

Unfortunately, it is not possible to compensate the armature reaction completely, as it is not constant for all positions of the armature, but fluctuates to a considerable extent. These fluctuations exist in the simple converter as well as in the booster type, but are accentuated in the latter under certain conditions of boost

Several different methods have been adopted in order to obtain the necessary compensation, all of which involve an auxiliary winding on the interpole, and in some cases special apparatus for varying the excitation of this winding. In most schemes, the variation in the excitation is obtained by variation of the resistance in the circuit of the auxiliary winding, and the accuracy of the compensation depends, therefore, on the number of steps in which the resistance is changed. The question of rapidity in adjusting the excitation is of importance in cases where sudden load fluctuations occur, and the time lag must, therefore, be reduced to the smallest possible amount.

The problem of accurate compensation of booster converters is, as will be appreciated from the above, not an easy one, especially in cases where large voltage variations are required.

A certain amount of boost can, of course, be obtained without any adjustment of the interpole excitation, but it is very limited, and as the conditions of commutation cannot be made uniform for all voltages, it is clear that full advantage cannot be taken of the material if good commutation is to be obtained at all loads and voltages. In other words, a given machine would reach its commutation limit at a lower load, if fitted with a booster for voltage regulation, than would be the case if arranged for reactance control.

When inverted running is required and voltage variation is necessary, a booster is essential, if the converter is not running in parallel with any other alternating-current plant, as reactance control cannot be used in such cases. This will be clear when it is considered that, with a given condition of load, to keep the speed, and therefore the frequency, constant it is essential to keep constant field current, assuming a fixed continuous voltage. In order to vary the E.M.F. delivered by the converter, it would be necessary, however, to vary the excitation, so that the two conditions are opposed. If the converter is running in parallel with an alternating-current system, it is possible to regulate the alternating voltage by means of reactance control, as in this case the speed of the converter cannot increase, due to the fact that it is held in synchronism with the system to which it is connected. Inverted running should, however, be considered as an emergency condition, as the rotary converter is primarily a machine for transforming alternating current into continuous current, and not *vice versa*.

The influence of the booster on the losses in the armature winding is of some importance and interest. The relations between the armature losses in a non-booster converter, and in a continuous current generator with the same winding, have been established for different power factors, both for the tap coils and for the whole winding. These ratios do not hold good, however, when a booster is introduced, as the resultant current in the armature winding varies for different values of boost. That this is the case will be clear when it is considered that the ratio of transformation of the converter is changed by the action of the booster. The values of the constants giving the ratios of the losses for different percentage of boost and power factor are shown in figs. 7 and 8, the former giving the ratios for the losses in the tap coil and the latter for the average losses of the whole winding.

The fact that the losses in the tap coils decrease with increasing negative boost is of practical importance in cases where full KW. output is required at the lower voltage, as the heating of the tap coils is the limiting feature as regards the copper loading of the armature, and higher current densities in the armature copper will be possible in cases where the voltage variation is obtained by means of a booster than would be the case if other means were used.

If the whole range were obtained by negative boost, a considerable reduction in the tap-coil losses would be obtained at the low voltage, but owing to the increase in the output of the booster, the cost of the converter would in most cases be increased.

The reduction in the losses obtained in ordinary cases is, however, of importance, especially in cases where the converter has to deal with wattless currents for power-factor correction.

Comparison.—No general statement as to which system of control is most advantageous can be made, as this must naturally depend on the conditions of the system on which the machines have to operate, but a study of a particular case may help to bring out the advantages and disadvantages of the respective types.

Assume that two ranges of voltage are required, *i.e.*, 400 to 440 volts for lighting and power, and 500 to 550 volts for traction, a fairly common case. For this voltage variation, the booster would required a range of ± 75 volts, which means that the output would be 15.8 per cent. of the converter output, on the assumption that the full range has to be obtained in a smooth curve, which is usually specified in such a case. Assuming a unit of 1,000-KW. output, the cost of the booster would be in the neighbourhood of 20 per cent. of the cost of the converter alone.

In the case of reactance control, the cost of the converter would be practically the same as for the booster control. Owing to the reactance and the tappings required in the transformer, the cost of this would be increased by approximately 5 per cent. of the converter cost. A three-pole double-throw switch would be required, the cost of which would be about 2 per cent. of the converter cost.

From the point of view of first cost, therefore, the advantage would be with the reactance control. The size of the booster would, of course, be materially reduced by arranging the transformers with tappings giving 420 and 525 volts respectively on the continuous-current side and providing a change-over switch as in the case of the reactance control. The advantage of this arrangement would be not only reduced cost, but also improved conditions from the point of view of commutation, on account of the reduced boost. This advantage is more marked in large units than in smaller ones, owing to the increased difficulties in commutation.

As regards the power factor, the booster type of converter has, as already stated, the advantage, as its power factor can be varied at will under all conditions of load and voltage, and, in cases where wattless currents are required for power-factor improvement independent of the voltage conditions, it is the only type suitable.

When no leading currents are desired, however, there appears little or no reason why the reactance type should not be used, as the power factor obtainable on the high-tension side is very close to unity over the whole range of voltage, and is slightly leading at the higher voltage, and it is doubtful whether better results would be obtained with the booster type, as very close adjustment is necessary to keep the power factor exactly at unity, and it should be remembered that it is necessary to adjust the field of the converter, as well as that of the booster, when changing the voltage of the converter, in order to keep the power factor at unity.

With the reactance type of control, it is only necessary to operate the field rheostat in changing the voltage, and the fact that the power factor is fixed definitely for each voltage is, therefore, not altogether a disadvantage, as less skill is required in operating this type of machine. Another point which should be considered is that if load having a power factor of approximately unity is added to a system having a low power factor, the conditions are of course improved in this respect, so that the converter acts as a power-factor improver without actually supplying leading current to the system.

In respect of commutation, the reactance control has the advantage, as good commutation is more easily obtained with this type. Satisfactory commutation can be obtained with the booster type of machine, but much finer adjustments as regards interpoles, brush-gear, &c., are necessary with this type of machine than with the former type if these results are to be obtained.

In many cases sacrifice is made in the most vital feature of the machine, *i.e.*, the commutation, in order to obtain the advantage of unity power factor, which may, or may not, be realised in actual operation.

The following summary of the two systems may be considered as generally applicable :—

	Reactance type.	Booster type.
Cost	Cheaper.	—
Power factor	Cannot be controlled at will for each voltage and load.	Can be controlled at will for any load and voltage.
Commutation	Good commutation more readily obtained.	—
Range of voltage	Limited (± 7½ per cent. may be considered as the limit).	Great range can be obtained (± 15 per cent. or more).
Efficiency	Slightly higher.	—
Starting	No difference.	No difference.
Space	Less space required.	—
Maintenance		More parts to keep in order.

The simplicity of the reactance control, coupled with its low cost and advantages in operation, are factors which recommend it very strongly wherever the range of voltages required permits its adoption, even at a sacrifice in the way of power factor.

We give below a corrected *résumé* of Mr. A. M. Taylor's remarks, which did not reach us in time for our report of the discussion last week :—

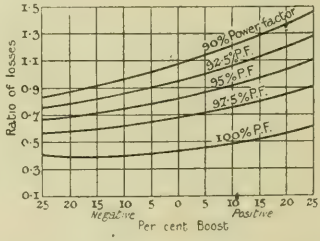


Fig. 7.—Curves showing Ratio of I^2 R Losses in the Tap Coils of a Rotary Converter to those of a Continuous-current Generator with a Similar Winding.

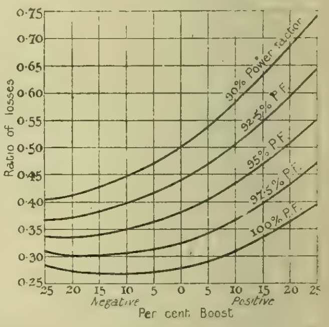


Fig. 8.—Curves showing Ratio of Average I^2 R Losses in Armature Winding of a Rotary Converter to those of a Continuous-current Generator with a Similar Winding.

This paper appears to have for its object the showing up of the advantages of the reactance-controlled rotary, when used in the ordinary way; but a question that is exercising the minds of many station engineers is whether the rotary cannot be satisfactorily used "inverted" to a much greater degree than has, up to now, been done.

The use of batteries in A.C. sub-stations has enormously increased during the past few years, and there are many sub-stations, especially towards the outskirts of large systems, where a large A.C. load is transmitted through the sub-station to regions beyond and where, if it were possible to feed into the A.C. network from the sub-station battery, and at the same time to boost up not only the A.C. voltage *but also its power factor*, engineers would not hesitate to pay, perhaps, 25-30 per cent. more than they at present pay for rotaries, in view of the considerable saving in copper which would be effected in the mains, and of the, in some cases, really serious difficulty of being tied up, on the one hand, to D.C. mains, fed from adjacent sub-stations of higher pressure, and, on the other hand, to its own A.C. mains which are considerably below the normal.

The speaker endeavoured to show, some years ago, that it was financially a safe proposition to put in batteries in the more distant sub-stations, even on the basis of unity power factor in the A.C. load; much more so would this be the case when the power factor was poor.

He believes that it is possible to obtain a large leading current from the rotary, both when it is delivering D.C. current to the sub-station bus-bars and also when it is running "inverted" off these bus-bars, *i.e.*, over the whole 24 hours, in fact, and this desirable result can, he believes, be obtained in either of two ways :—

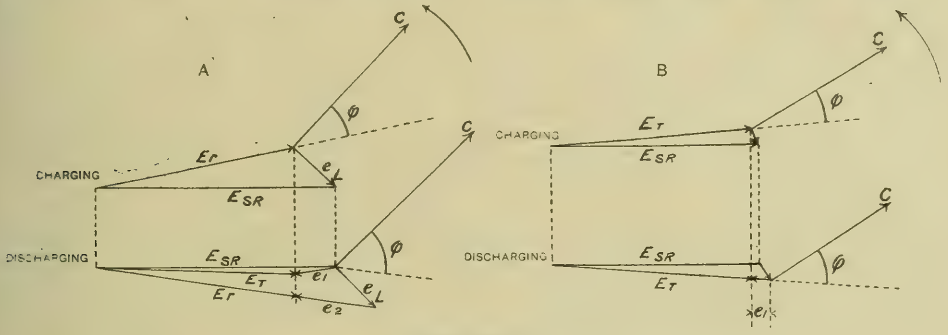
1. A rotary with a large external reactance can be used

on the "charge," and the rotary designed to give the correct D.C. and A.C. volts when heavily over-excited (*i.e.*, with a large leading current); the reactance, in this case, acting to give a heavy positive boost from the A.C. mains to the D.C. mains. The same rotary, with the reactance cut out by a switch, and with the addition of an A.C. booster (or induction regulator) giving a large counter-boost, can again be run at a high excitation, and with a large leading current, this time "inverted," and feeding into the A.C. mains.

The vectorial conditions are shown in fig. A.

2. The alternative would be to have only the A.C. booster (*i.e.*, without the reactance), and to have the rotary and transformer with as little reactance in them as possible.

In this case the rotary would be run over-excited on the "charge" as well as on the "discharge" (*i.e.*, when running "inverted"), and would take a big leading current in *each* case. The booster would be used to give a counter-boost on the discharge only: or, if found more desirable, it might give a forward-boost on the "charge" and a counter-boost on the "discharge."



Figs. A and B.

E_T = H.T. Mains: E_{SR} = Slip rings; e_1 = Counter boost, reactance out; e_2 = Counter boost, reactance in: e_L = Reactance.

The vectorial conditions for the former case are shown in fig. B.

He (Mr. Taylor) would be much interested to know whether the sparking conditions would prevent such machines being built at reasonable cost. No doubt the booster would have to be bigger than is usually supplied; but he believes engineers would willingly face the cost for the sake of the improved power factor.

It is, of course, not necessary that the required boost should be furnished by a rotating booster. It could equally be provided by, for instance, the new type of static regulator described at the meeting by Mr. Juhlin, which also has the advantage that it could be added to any existing rotary.

ELECTRICITY IN AGRICULTURE.

I.M.E.A. Agricultural Electrical Development Committee.

At a recent meeting of the Council of the Incorporated Municipal Electrical Association, the President, Mr. F. M. Long, referring to the paper read by Mr. Kerr at the last annual convention, suggested that the Council should take the initiative in developing this subject.

The Council, recognising the important part that electricity may be made to play in the better cultivation and greater production of the land, and in the extension of rural industries, have formed the nucleus of what is ultimately intended to be a committee representative of all interests with the object of a thorough investigation into the technical and commercial problems underlying the application of electrical energy for such purposes, by forming a small committee with powers to add to their numbers, both from the ranks of the Association and from other sources.

The Committee consists of Mr. S. E. Britton, city electrical engineer, Chester, chairman; Mr. F. M. Long, city electrical engineer, Norwich (President, I.M.E.A.); Mr. H. Faraday Proctor, city electrical engineer, Bristol; Mr. J. Christie, engineer and manager, electric supply department, Brighton; Mr. S. T. Allen, engineer and manager, electric supply department, Wolverhampton; and Mr. F. Ayton, engineer and manager, electric supply department, Ipswich.

Mr. W. T. Kerr, city electrical engineer, Hereford, has also been added to the Committee, and two sub-committees have been appointed to deal with publicity and technical matters, with Mr. Kerr and Mr. Long as chairmen, respectively.

The Committee will be known as "The Committee on the Development of Electricity in Agricultural Areas," formed by the Incorporated Municipal Electrical Association. The objects of the Committee will be:—

1. To investigate and advise upon the problems underlying the supply and use of electrical energy in agricultural areas for power, lighting, heating, culture, and other purposes for farms, villages, and rural industries.
2. To collect and collate information, and publish literature bearing upon the above.
3. To co-operate with agricultural and other associations.
4. To investigate in co-operation with manufacturers the development, manufacture, and adaptation of agricultural machinery, and appliances for utilising electrical energy.
5. To promote the exhibition of such machinery and appliances at agricultural shows and elsewhere.
6. To offer assistance in arranging demonstrations and lectures in conjunction with farmers' associations, clubs, &c.
7. To promote any legislation necessary to facilitate the application of electrical energy to agricultural areas.

When the Committee have formulated definite proposals for consideration and discussion, and compiled the necessary data and information, it is intended to invite kindred bodies to nominate representatives to serve on the Committee.

All communications should be addressed to the chairman, Mr. S. E. Britton, city electrical engineer, Chester.

Sir Oliver Lodge and Electroculture.—According to the *Birmingham Daily Gazette*, Sir Oliver Lodge, in a recent interview with reference to the forthcoming experiment in electroculture on some 50 acres of cereal and other field crops at Huntingdon Court Farm, near Hereford, said the scheme outlined was apparently what was desired rather than what had been settled; at any rate, the Agricultural Electric Discharge Co. had not, he thought, been consulted.

A large scale experiment on the electrification of crops, proceeded Sir Oliver, might with wisdom have been made by the Government many years ago, but they left it to private enterprise. The Agricultural Electric Discharge Co., of Gloucester, had gone into the matter in detail, and carried out the pioneering work without any State recognition and at a loss to themselves, but they had thereby gained some experience. They had supplied plants to the Board of Agriculture, and two had been working for Prof. Priestley, of Leeds, for a couple of years before the war. One had been supplied to the United States Agricultural Research Department. Another was working in Java, one in Norway, and six were supplied to Germany before the war. A few others had been erected in England and Scotland.

But all these must be regarded as experimental installations for the purpose of gaining experience as to which kind of discharge was most effective, and under what climatic conditions electricity was of most use, bearing in mind also that all agricultural experiments were necessarily slow because until the crops were reaped the results could not be scrutinised, and that conditions of failure, just as much as conditions of success, had to be examined, for both were instructive. Then, again, some seasons were very wet and some very dry. When there was plenty of sunshine it was possible that electrification was not much needed, and when there was a very wet season the crops might be inferior whether electrified or not.

Electroculture Experiment at Southport.—An interesting experiment in electroculture is to be made at Southport, where Mr. M. Ashley has been granted permission by the Food Supplies Committee to rent two 10-rod plots at Crowlands on which to carry out a scheme of electrical cultivation. The land adjoins the electricity works, and arrangements have been made for the supply of the necessary current. Messrs. M. Ashley, Ltd., electrical engineers, are manufacturing the plant, and undertaking the other expenses, and Mr. Black, the borough electrical engineer, is assisting the project as much as possible.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electric Radiators.

Referring to "Experiment's" article on radiators in the issue of March 2nd, I do not consider that he is wholly correct in his conclusions. Writing simply as an observer, like himself, I rather think he misses the chief point of the electrical radiator. This heater is used chiefly as a convenience heater. For regular heating (for obvious reasons) it has not a large field. In consequence, the public demand a radiator which will give a cheerful glowing effect immediately it is switched on.

An element of the type he suggests would take some time to build up. Further, there would appear to be no gain by placing a spiral in a horizontal position; a larger area is left for the cold air to play upon—hot air will rise, and there will be convected heat just the same. In the case of vertical spirals, the air passing the lower coils is heated, therefore hot air passes over the upper portion.

It is agreed that more radiant heat is required, but this probably means sacrificing the outstanding feature of the electrical radiator, *i.e.*, the production of a real red heat as soon as it is switched on.

There should be no considerations in the design of a radiator to prevent the bars from reaching a high temperature, as the radiant heat emitted increases proportionally with the increase in temperature.

It is doubtful whether primarily the failure of the lamp radiator can be attributed to too much convected heat. I should rather suggest it was lack of thermal storage. The filament of the lamp being *in vacuo*, practically 100 per cent. radiant heat is given off. Glass is not totally opaque to heat rays. It is granted it has a high capacity for sifting these rays, but it is to some extent diathermanous, and there is the probability that it is more so as the temperature is increased. Radiant heat also is emitted from the heated glass.

F. Cope.

Stanley, *March 19th*, 1917.

Curious Trouble with Lead-Sheathed Cables.

Being interested in the cause of the above trouble, and after observations extending over many years leading me to a somewhat different conclusion to the various causes set out by your other correspondents, I should be glad to hear if anybody has ever experienced a similar trouble to the one mentioned by Mr. G. W. Partridge, on either buried or manhole joint-boxes of the brass gland type, *i.e.*, one in which the lead sheath has been plumbed on to a brass gland which is then screwed up to the cast-iron or lead containing box surrounding the joints; for, although I do not consider this an ideal type of box, after many years' experience with boxes of this type, I cannot record one of this type having failed in the way in question.

The previous correspondents all appear to me to be of the opinion that the trouble is one peculiar to joints on cables "drawn-in," but this is not so, for I have had trouble on cables laid "direct" and laid "solid" in wooden troughs.

Whilst I do not suggest that it is from the same cause, it might interest some to know that I have had experience of two drums of cable (three-core L.R.I., paper insulated, L.S., S.W.A.) in which a very similar trouble extending completely around the cable, in both cases within a couple of yards of the running end, was apparent before the cable end was released for pulling in from the drum.

A. R. Chaytor.

Dewsbury, *March 13th*, 1917.

The "Bauer" Qualimeter.

Our attention has been drawn to a note, on March 2nd, to the effect that Messrs. F. R. Butt & Co. have applied for and obtained a licence to use the German patent No. 25,101 of 1912, the instrument being known as the "Bauer" Qualimeter.

In this notice it is stated that Messrs. Butt & Co. have had difficulty in getting these instruments from our firm, who had previously obtained a licence to manufacture them, and that they therefore concluded that we were not in a position to manufacture.

We beg to state that we are making these instruments in considerable numbers, and that Messrs. Butt & Co. have from first to last only placed one order with us, which order has long ago been fulfilled.

We do not know why the Controller of Patents did not ask for our evidence on this matter before taking further action, but as a statement such as that inserted in your paper is apt to do us harm as leading makers of X-ray apparatus, we should be very glad if you would insert this contradiction.

Newton & Wright, Ltd.

London, W., *March 16th*, 1917.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & C Electrical Patent Agents, 285, High Holborn, L W.C., and Liverpool and Bradford.

3,208. "Dynamo." T. Cooper. March 5th.

3,235, 3,236. "Electric controllers, &c." J. Anderson & G. Elliso March 5th.

3,250. "Use of relays for telegraphic, &c., purposes." H. W. Sullivan. March 5th.

3,253. "Electric heating elements." L. G. Caunter. March 5th.

3,258. "Miners', &c., electric safety lamps." O. Oldham. March 5th.

3,274. "Dynamo-electric machinery." Lancashire Dynamo & Motor C and G. E. Mason. March 6th.

3,285. "Electrochemical process for treatment of metallic ores." C. Griffith. March 6th.

3,290. "Electric controlling of locks of lockers, &c." A. A. Gran March 6th.

3,295. "Systems of control for electric motors." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 6th.

3,318. "Control and regulation of electric furnaces." Brown, Boveri a Co. & A. Gray. March 6th.

3,347. "Spark plug intensifiers." O. G. Singer. March 7th.

3,360. "Telegraphic relays." J. A. Fleming. March 7th.

3,368. "Electrical marine depth indicator." E. A. S. Swinson. March 7

3,394. "Regulating or controlling systems for electric motors." Electr and Ordnance Accessories Co. & J. Lichfield. March 7th.

3,400. "Electric lighting systems for motor road vehicles." F. D. Gordon. March 7th.

3,401. "Electric lamp for miners, &c." F. D. M. Gordon. March 7th.

3,422. "Welding or sintering tungsten ingots, &c." M. J. Insull. Mar 8th.

3,423. "Compressed tungsten powder and production of same." M. Insull. March 8th.

3,425. "Electrical contacts." M. J. Insull. March 8th.

3,426. "Electric furnaces." M. J. Insull. March 8th.

3,437. "Systems of electric motor control." British Thomson-Houst Co. (General Electric Co., U.S.A.). March 8th.

3,464. "Magneto-electric machines for ignition in internal-combustion gines." M. S. Conner. March 9th.

3,476. "Regulating voltage of alternating-current systems." A. M. Tay March 9th.

3,485. "Electric welding or soldering." L. Tweedale & Quasi-Arc C March 9th.

3,486. "Electric welding or soldering of metals." Quasi-Arc Co. & W. Coll. March 9th.

3,494. "Electric furnaces." British Thomson-Houston Co. (General El tric Co., U.S.A.). March 9th.

3,524. "Electric heating elements." L. G. Caunter. March 9th.

3,531. "Machine switching telephone system." F. R. McBerty, Pol kowsky & Western Electric Co. March 10th.

3,534. "Trolley pole head for tramcars, &c." J. Pratt. March 10th.

3,549. "Disconnecting boxes for electric cables." W. T. Henley's Te graph Works Co. & E. Moor. March 10th.

3,551. "Apparatus for direct conversion of energy of motion of water other dielectric into electric energy, and conversely for conversion of electr energy into the motion of mass." A. Young. March 10th.

3,558. "Apparatus for reception and utilisation of electric current i pulses." Selective Signal Co. & W. J. Lyons. March 10th.

PUBLISHED SPECIFICATIONS.

1915.

13,888. Dynamo-electric Machines. F. A. Hay & Nogaro Patents Ltd. September 30th.

14,500. Radio-telegraphy. J. Bethenod & E. Girardeau. (Octo 13 (October 15th, 1914.)

17,615. Loading Coils for Superimposed Telephone Working and th purposes. C. I. Hay & H. W. Sullivan. December 16th.

1916.

The numbers in parentheses are those under which the specifications wi be printed and abridged, and all subsequent proceedings will be taken.

2,346. Electric Air Purifying or Conditioning Apparatus. A. F. Berr February 16th, 1916. (104,019.)

2,347. Oil-cooled Electric Transformers. A. F. Berry. February 16t 1916. (104,020.)

2,547. Dynamo-electric Machinery. Lancashire Dynamo & Motor Co. an H. B. Whitmore. February 21st, 1916. (104,027.)

3,336. Incandescent Electric Lamps. J. I. Cornell & F. R. Grob March 6th, 1916. (104,039.)

3,797. Mount for Magneto Distributors. J. F. J. Schaser. Mar 14th, 1916. (104,046.)

4,186. Railway Signalling. J. P. O'Donnell & S. L. Gl March 21s 1916. (104,052.)

5,343. Electric Lampholders. A. P. Rutherford. April 12th, 191 (104,070.)

5,807. Distance-operated Mechanisms and Signals connected to Electr Supply Systems. H. F. Angood, W. Duddell, A. H. Dykes, H. W. Handcoc and C. Oliver. April 20th. (104,077.)

5,986. Apparatus for Producing Colour Effects in Theatres, Mus Halls, and the like. W. E. Grant. April 26th, 1916. (Addition to 2,254 16 (104,081.)

6,003. Lighting Fittings. British Thomson-Houston Co. & R. F. F an April 26th, 1916. (104,082.)

8,959. Electrical Bonding Junction Boxes for use with Metal sheathed Wires and the like. G. S. Boothroyd and Callender's Cable an Construction Co. June 26th, 1916. (104,106.)

9,079. Sparking Plugs for Internal-combustion Engines. D. McGrego June 28th, 1916. (Cognate application, 11,099/16.) (104,107.)

9,609. Electric Incandescent Lamps, and Method of and Means fo producing the same. Deutsche Gasglühlicht Akt. Ges. (Auergés.). Septembe 27th, 1915. (101,622.)

14,068. Method and Apparatus Applicable in Repairing Electric Powe Transmission Masts for Overhead Conductors. J. A. Hussbee. Octob 4th, 1916. (104,131.)

14,276. Contacts of Electric Circuit Interrupters. British Westinghous Electric & Manufacturing Co. October 9th, 1915. (101,796.)

THE
ELECTRICAL REVIEW.

Vol. LXXX. MARCH 30, 1917. No. 2,053.

ELECTRICAL REVIEW.

Vol. LXXX.] **CONTENTS**: March 30, 1917. [No. 2,053.

Page
Coal Winding Problems 337
Women in the Engineering Industries 338
Some Notes on the Electrical Driving of Workshops and Factories, by A. T. Bullen 339
Equipment of King George Dock, Hull (*illus.*) 341
The Voltage Regulation of Rotary Converters... 343
Correspondence—
  Electricity Supply Rates and Government Contracts ... 344
  The Controller Drum 344
  Oil-Immersed Circuit Breakers for use on Continuous Current Supplies 345
  Linking-up with Waste Heat Stations 345
  Women and "Shorts" 345
  Fault Localisation 345
War Items 345
Legal 347
Notes from Canada... 347
Trade Statistics of Canada 348
Business Notes 349
Notes... 352
City Notes 355
Stocks and Shares 357
Market Quotations 358
Exports and Imports of Electrical Goods during February, 1917 359
The International Aluminium Industry 360
The Faraday Society 360
Frequency Changers (*illus.*) 361
Diesel Engine Users' Association... 363
Foreign and Colonial Tariffs on Electrical Goods 363
New Patents Applied for, 1917 364
Abstracts of Published Specifications 364
Contractors' Column ... ... Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE :—4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.
Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.
AUCKLAND N.Z: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.
BRISBANE: Gordon & Gotch, Queen St.
CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.
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JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c.: Central News Agency, Ltd.
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MELBOURNE: The Mining & Engineering Review, 90, William Street; Gordon & Gotch, Queen Street.
MILAN: Fratelli Treves.
NEW YORK: D. Van Nostrand, 25, Park Place.
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto 1 307.
SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.
WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE "ELECTRICAL REVIEW'S"
ELECTRICAL & ALLIED TRADES DIRECTORY
(THE RED BOOK),

1917 EDITION

IN THE PRESS.

H. ALABASTER, GATEHOUSE & KEMPE,
4, Ludgate Hill, London, E.C. 4.

COAL WINDING PROBLEMS.

IN his presidential address to the South Wales Institute of Engineers, Mr. Hugh Bramwell took as his subject "The Raising of Coal from Vertical Shafts," tracing the various historical phases of the subject from as far back as 1750-65, when the hand-winch gave way to the horse-gin, and hourly outputs of 10 to 20 tons of coal were raised, up to the present time, when the electrical winder is rapidly establishing itself in favour. With the introduction of steam winding, speeds and outputs greatly increased, and in 1894 four and six-ton loads were lifted at average speeds of 35 ft. per second, giving outputs of 350 tons an hour; at the present time, however, a reversion has taken place in South Wales to slow-speed winding with a materially heavier load than has hitherto been adopted.

Up to 1870 the ropes were usually balanced in deep mines by means of balance-chains working on the drum-shaft and dropping into shallow staple pits. About 1874 the balance-chain method gave place to tail-rope balancing or to the conical drum. About 1905 the cylindro-conical drum was introduced, in which the acceleration of the masses is supposed to be completed and full speed attained with the two ropes on the maximum and minimum diameters respectively.

In 1914 the author introduced the subject of recoiling the rope on itself in layers, to the Institute, this being a means of keeping the diameter and width of drum within practical limits, where considerable rope-carrying capacity is required. The author gives an appendix containing a comparison between five more or less representative types of winding plants, which disclose the struggle between load and speed.

The Wearmouth "B" Pit engine of 1868 represented a reversion to slow speed with a heavier load (max. and av. speeds, 20 and 18 ft. per sec.; coal weight, 8,960 lb.); the Silkstone No. 2 (1872), Hickleton (1894), and Penrhiwceiber (1906) show that the load is maintained, but speed increased (the three examples give max. and av. speeds of 45 and 36, 50 and $36\frac{1}{2}$, 59 and $38\frac{1}{2}$ ft. per sec. respectively, with coal loads of 8,960, 9,856, and 10,080 lb. respectively). These are followed by the Cwm (Llantwit Fardre) electrical winder of 1914, again showing a reversion to slow speed and heavy load; in this case the max. and av. speeds are 28 and 21 ft. per sec., and the coal load is 26,880 lb. The Penrhiwceiber and Cwm winders each have a capacity of 360 tons per hour in full work.

The author says "the inference is that speed is controlled by wear and tear of the plant and, possibly, by safety; whilst the load is chiefly controlled by the improvements in rope construction. Incidentally, it may also be noted that with slow speed, cages may properly be very much lighter than with high speed, and therefore the proportion of effective load (coal) is materially improved. In this connection, it may also be pointed out that the life of a rope is related chiefly to the number of winds it makes, and, provided it is of reasonably adequate strength as compared with the load, its life is not so much influenced by the total weight raised; doubling the load halves the number of winds, and this, with reduced speed, must largely favour rope conditions."

The author concludes that a heavy load pays better than high speed, provided this is not attained at the cost of an unreasonably heavy initial outfit, and gives his opinion that for depths of 3,000 ft., which are being approached in practice, development may properly tend towards an equipment on the lines of a hotel or warehouse lift. The present single rope to each cage which both suspends and actuates the load may be replaced by a suspending rope common to both cages, and working over a pulley on the headgear, with subsidiary operating ropes to each cage from the winding drum. The former rope would thus suspend the load, and would be relieved of all acceleration and retardation strains. The actuating ropes, on the other hand, would be relieved of the suspended weights, and their work would consist of accelerating and retarding the masses only.

An arrangement of this kind would reduce rope sizes and weight of winding equipment, and render stage winding still less necessary. The Koepe system, employing a single frictional winding pulley, is somewhat similar, but the author's proposal differs in the separation of the suspending and actuating ropes; the Koepe arrangement has not been adopted to any extent here, its drawback being that there is no spare rope available for cutting and recapping—the cap end of the rope being the part where trouble is expected—and the author hints that his proposed arrangement shares this disability. Apparently the life of a winding rope averages about 3½ years, and recapping is necessary at intervals of not more than six months, to comply with Government regulations.

Mr. Bramwell's address contains matters of considerable interest to electrical men, first because his proposal would mean a radical departure from the strongly entrenched practice of the past, which has proved such an obstacle to the introduction of electrical winding, and, secondly, because it directly favours the adoption of the latter method. Obviously, the separation of the static and acceleration loads would, as the author states, lead to a reduction in weight of winding equipment, and, other things being equal, a reduction in winding speed also favours the same result, and this, in view of the heavier pit-head structure which would no doubt be called for with heavier loads, points strongly towards the adoption of the pit-head position for the winding or hoisting gear as the correct one. Electrically-operated winding gear, or that portion of it required for operating the winding drum or pulley, as the case may be, is eminently suited to such a position, whereas steam winding gear must of necessity occupy valuable space and buildings on the ground. Several well-known Continental electrical winding installations utilise the top of the pit head structure, generally, we believe, with the Koepe winding pulley, but in one instance with winding drums; in any case, with Mr. Bramwell's proposed arrangement, it would appear that the weight of winding equipment as a factor in the constructional arrangement would be so far reduced as to make the pit-head position, with electrical winding gear, a proposition worthy of close consideration.

The disadvantages incidental to the question of recapping should not be taken too seriously; there are possible ways and means of taking up the stretch in a rope and providing a sufficient margin for recapping—not, of course, without introducing some departure from simplicity. The simplest arrangement of all would appear to be an endless rope, passing through the cages, if that were feasible, with a guide pulley, adjustable for slack rope in a sump at the pit bottom; the cages could then be clamped to the ropes, and their position adjusted at intervals to distribute the wear evenly over the ropes. As an alternative, the excess rope due to stretching, or that required for recapping, might be stored on a small drum at the top of the cage, which would provide the necessary adjustment in length. We feel assured that the problem will provide no insuperable difficulty to the mining engineer—in any case, such difficulty will be trivial compared with those over which the electrical engineer has triumphed in bringing the electrical winder to its present position as a practical machine.

Women in the Engineering Industries.

The Ministry of Munitions (Labour Supply Department) is holding an exhibition this week at the Royal Colonial Institute, in Northumberland Avenue, W.C., which has doubtless been visited by many gentlemen responsible for the employment of labour in engineering industry. Those who have not had an opportunity of attending in response to specially issued invitations, since the opening of the Exhibition by Mr. F. Kellaway, M.P., on Monday afternoon last, would do well to make a point of doing so before the closing hour to-morrow (Saturday) afternoon, for the photographs and materials brought together form a unique, instructive, and most timely collection, demonstrating the thousand and one various types of work upon which women are being employed in engineering and other industries on munitions of war. The manner in which women have come to the assistance of the Empire in taking the places of men of fighting age and fitness, and in facilitating the most necessary work of dilution, must fill us all with admiration, but it is of the greatest possible importance that the movement, with its magnificent record, should not stop where it is. There is need for the employment of female labour to be carried much farther than it has yet gone, for the number of fighting men must be increased continuously until the enemy has been utterly defeated, yet the output of munitions for their use must be maintained at all costs. Of course, it is no new thing for women to be engaged in lamp-making, armature winding, accessories manufacture, and so on, but at this exhibition there is brought together a collection of articles of many other kinds upon which they have brought their now proved adaptability and deft fingers to bear. Sparking plug parts, complete magnetos, lamp-holders, armature parts, lighting switchboards for mechanical transport work and scientific instruments, are among the purely electrical examples upon which women have worked either at drilling or milling, winding, engraving, assembling, and so forth. But the collection of photographs carries us into classes of labour where before the war female labour, if not unknown in this country, was almost a curiosity. They depict women engaged in a host of operations involved in general engineering, shipbuilding, and marine engineering, tool-room and precision work, small arms work, the manufacture of parts of internal-combustion engines; they show them engaged on wiring and rolling mills, operating all kinds of lathes and similar machinery, building small commutators, operating presses for armature work, assembling ironclad switchgear, erecting switchboards, driving 40-ton cranes, in charge of motors on industrial installations, driving electric trucks, electrically welding electric contact mines, operating a 500-KW. switchboard, and attending a 300-KW. direct-coupled engine set and a 1,000-H.P. steam engine. These are a few of the pictures now on exhibition; our reference is not by any means exhaustive, but we think it may be taken as indicating the very wide field of service in which female labour, after suitable training, has proved to be not only applicable, but very successful. The progress which these examples and photographs represent has been remarkable considering all the prejudices which have naturally been encountered by those who have striven to bring about, if not a revolution in industrial life, a remarkable extension of the use of a class of labour which was not rightly valued, probably because there was not the same need, in normal times. Prejudices from Labour; prejudices from Employers and their management and staff; prejudices from women themselves; all called for tact, enthusiasm, and determination if this, the only means of enabling us to carry the war through to an unquestioned victory, was to be availed of. Of course, those prejudices have not yet been entirely removed from any of the three classes, although they are disappearing more and more as our leaders, political, labour, industrial, and social make absolutely definite the necessities of the situation and the inevitability of women taking a new place in the world until the present emergency has passed right away. Fear and suspicion on the part of male workers as to the position of certain classes of trades after the war, consequent upon the change, still lurk beneath an apparently calm surface; unwillingness and want of conviction as to the suitability of women for certain classes of work still mark the attitude of some employers; and many women continue to show a predilection for classes of service which normal times have proved to be their natural avocations. But we are governed to-day by the dictates of absolute necessity, and for the time being all will do well to pack up their prejudices, as the soldiers do their troubles, and find a way for doing their bit to further, in the interests of the great cause of Civilisation, the employment of women in the engineering factories of the United Kingdom. If the call of the War Office is for men of fighting age and fitness, that of the Ministry of Munitions is for women, more women, and still more women for our factories in order that those fighting men may do their part with a minimum loss of life, and by hastening the end save millions of treasure also. Our after-the-war problems may seem to be increased with each successive step forward in disorganisation, but who can show suitable alternatives to present methods? Further, may it not well happen that instead of being detrimental to the national industrial situation that follows the war, the availability of a vastly larger volume of skilled and semi-skilled female labour will be an asset of immense value when we resume the manufacturing operations of pre-war times on what we hope will be an exceptional scale, calling for the co-operation of all the demobilised fighting men, and all the new industrial women, in the building up of greater industries than have ever been ours in the past?

SOME NOTES ON THE ELECTRICAL DRIVING OF WORKSHOPS AND FACTORIES.

By A. T. BULLEN.

Electricity as a source of power is now well known in most of the larger factories in this country, and, generally speaking, the operatives in those factories have every reason to be satisfied with it. A man brought up in the traditions of steam or gas power is not always willing to change over to electricity: but having put it to the test, and overcome his natural mistrust of a new thing, he will usually speak highly of the steadiness, constant speed, and reliability of the new driving power, and, more than that, he would not revert to the older forms even if he had the opportunity.

In the larger factories, the owners, too, have every reason to be satisfied, for on account of the large quantities of electricity consumed, they are usually able to arrange terms which make it not only a reliable, but a very economical form of power.

In the smaller factories and workshops, however, we do not always find the same satisfactory conditions, and the price per unit will not work out to anything like the economical figure reached in the case of the larger factory.

There may be two reasons for this; the first due to the method of payment, and the second the result of the method of installation.

If the supply is charged for on the flat-rate principle we usually find a considerable rebate allowed on very large consumptions. If, on the other hand, the charge is based on the maximum demand the large factory scores again by reason of its diversity factor. A small workshop of about half-a-dozen machines will often get them all on together, which will make the demand high compared with the number of units consumed, whereas in a factory with, say, 100 machines it is probable that not more than 80 will represent the maximum load, so that the relative number of high-priced units is less, which means a corresponding drop in the average price per unit for the whole consumption.

But the number of consumers dissatisfied on account of the prices charged is few compared with the number whose dissatisfaction is proved to be due to errors of installation and power wasted in driving shafting and the like.

In a large factory electric driving would rarely be installed except as advised by some prominent and capable engineer. This authority would prepare a plan of the shop, and would arrange the whole thing on economical and efficient lines, whereas, in the case of a small workshop, an expert authority would rarely be consulted, the work, more often than not, being entrusted to inexperienced local contractors who have been used to wiring anything up to 20 points for lighting, but, beyond occasionally cleaning a motor or fixing new brushes, have had little to do with them or their uses. The result is inefficiency and expense.

Here is a case in point. It is a small printing works boasting, in all, 17 machines. The majority of these machines are small, the largest of them taking less than 1 H.P. to drive it. The average load, measured by the electrical input into the motors, of which there are two, is 10·7 H.P. (independent of the motor losses), and of this quantity only 3·7 H.P. is useful work, the remaining 7 H.P. being absorbed in driving the shafting.

Either or both motors may be used, but, whichever method is chosen, the whole of the shafting is running continuously, and 5·2 units per hour are registered on the meter. When both motors are used, the first one drives seven machines, and, in addition to its main shaft, requires two countershafts. The second motor uses six countershafts in addition to its main shaft to drive the remaining 10 machines.

Can it be wondered at, that the proprietor of this establishment is not satisfied with the cost of his electric power? Yet he will not seek expert advice in order to improve the conditions, and so he rubs along, grumbling all the while, but paying all the same.

The case of this printer is by no means an isolated one, and few realise the enormous amount wasted in the transmission of power by mechanical methods—such as shafting, belts, or ropes. When installing electrical driving many simply replace their steam or gas engine by a large motor, still retaining all the power-wasting belts and shafting. This is obviously wrong, and the power is likely to cost as much, or more, than previously. The correct method is to subdivide the works as much as possible into sections (it is rarely possible or advisable to fix a separate motor on each machine, although this is the theoretical limit), and to provide a separate motor for each batch of machines. This will save much countershafting, and will, moreover, allow of certain machines being used without the necessity of running the whole of the shafting.

Where a considerable amount of shafting is really necessary, care should be taken to reduce the friction to a minimum. For this reason, ball bearings should invariably be used. Their first cost is comparatively high, but that this expense will soon be repaid by the saving effected on the electricity consumed is clearly shown by the following figures :—

A certain consumer had a motor driving two machines, and he wished to add a third ; but as he was not sure if the motor would take the extra load, he wrote to the Corporation for advice. A test was made, when it was discovered that his shafting, which was 20 ft. long, supported by three bearings, took 2 KW. to drive it. He was advised to substitute ball bearings, which he did, at a cost of about £10. A second test was then made, and it was found that his shafting losses had been reduced to ½ KW. His running hours were about 30 per week, so that, in the first instance, 3,120 units per year were consumed in driving the shafting, which at 1d. per unit cost £13. Now these losses have been reduced to ½ KW. the cost per annum is £3 5s., so that in one year a clear saving of £9 15s. has been effected, which is practically the first cost of the ball bearings.

As much power as is lost in friction in the shafting is often lost in the belting used. A man who substitutes a motor running at 1,500 R.P.M. for a gas or steam engine running at about 200 R.P.M. will frequently use the same heavy belt to save the cost of a new one. This is a great mistake, for at the higher speed a much lighter belt will suffice, and its cost will soon be saved in electric power.

As an example of power lost in a rope drive, the following would be hard to beat. In the engineer's office of one of our municipal generating stations, in a district where pottery is among the staple industries, there hangs a photograph of a 1-H.P. motor. This photograph is a source of just pride, and the engineer is ever ready to tell the story of its distinction.

The machinery in the pottery where this motor is now installed was originally steam-driven, but it was one day decided to consider electric driving, whereupon the electrical engineer was approached, and asked to give advice on the subject. Having examined the machines to be driven, he decided that a 2-H.P. motor would provide ample power, and was subsequently asked to install it. This he did, only to find that it would not move under load. A 5-H.P. motor was substituted, but was little better ; even a 7½-H.P. gave results far from satisfactory, and eventually a 12-H.P. motor was installed. The engineer, however, was not satisfied ; he considered his reputation at stake when it was found necessary to install 12 H.P. to do work which, he said, could be done with 2 H.P. He knew there was a great loss and wastage of power somewhere, and asked to be given a free hand, in order to reduce this loss. This he succeeded in doing, and to-day the whole of that machinery is driven by this 1-H.P. motor.

The steam engine was reckoned as 6 H.P., and the driving of the various shafting and machines had been carried out by means of a very long rope, which ran practically all round the pottery. It is probable that only about 10 per cent. of the power used was usefully employed, the rest being absorbed in the absurd rope drive.

Much of the loss and wastage of electric power indicated above, arises out of the short-sighted policy of many factory owners and their contractors, and it is particularly to contractors that these words are addressed.

In a very large number of cases, the change to electric driving is a gradual process. Comparatively few will suddenly change their whole factory to electric driving, since few are ready to be guided by the experience of others. It sometimes happens, however, that perhaps the insurance company have condemned a boiler, when the complete conversion usually takes place. More frequently, though, it is decided to install, say, a 5-H.P. motor, so that a personal trial and investigation can be made. In such a case, this motor will probably drive an individual machine, when all the advantages of electric driving will be derived. Extensions will follow, and it is then that the contractor must be very careful, for he will not be able to give an individual drive to each machine, and unless he adopts practical measures to keep down the driving losses, the final results will be much less satisfactory than those given by the trial motor.

If he is wise, the contractor uses whatever influence he has, professional or personal, to persuade the proprietor to convert the whole factory at once. It is a good plan to keep in close touch with other power users in the district, who are usually willing to allow new electrical clients to inspect their workshops and arrangements ; but if, after such inspections, the doubting one still desires to make a personal trial, then the certainty of future extensions, and the absolute necessity of allowing liberally for them, should be impressed on him. It will cost more in the first place, but it will mean a considerable saving later.

Before installing any one motor, a complete plan of the works, embracing all the possibilities of electric driving, should be made, and a central position chosen from which the supply of power will radiate. Here install a substantial distribution board with plenty of room for new circuits, and then run some heavy leads to the supply service. When the extension comes along, you are ready for it, and instead of having to run all round the shop to the point of supply, you simply run a pair of leads from the specially situated distribution board to wherever they are wanted. The scheme never becomes patched, and the hopeless tangle of wires we so often see round the meter and cut-outs, is avoided.

Further, the foundation is laid for the individual driving of the various sections of the works, which is so essential if the final results are to be up to the standard fixed by the original trial motor. There is no risk of changing over to one large motor and then finding that the power wasted in the shafting and belting brings the cost up to, and perhaps even more than, that of the older method of driving.

A word now as to the wiring. Do not spoil an otherwise good job by cheap, and therefore poor, wiring. If the price is not reasonable, it is better for neither the factory owner nor the wiring contractor to accept the work. Good work can always demand a fair price, and those who undertake cheap work, immediately brand themselves as second-rate contractors.

Electric motors, as a rule, require but little attention, and for this reason they very often get none whatever until something goes wrong ; but although many motors have been known to work for 10, or even 15, years without attention, it is advisable to examine them occasionally.

It is a good practice to put in circuit an ammeter, which will give an excellent indication of the load or the condition of the motor and equipment. The mechanic or electrician responsible for the motor gets to know about how many amperes should be registered, and if he finds the current going up he knows that something needs attention, and thus faults are checked and quickly rectified.

Consumers will find the officials of the supply authorities always willing, out of their varied experiences, to advise on particular matters connected with individual workshops : for although, as in this article, general broad principles can be laid down, yet each separate case calls for special arrangement and consideration, which can only be determined by a thorough investigation of the nature of the shop and machines to be driven. This the officials, as a rule, are able and willing to do, and they will make many useful suggestions which will materially assist in making electrical power both a practical and a financial success.

It is quite certain that in most districts electricity for power purposes can easily compete on the question of cost with either steam or gas, while for practical utility its position is unassailable, provided always that it is properly installed.

EQUIPMENT OF KING GEORGE DOCK, HULL.

A paper read before a joint meeting of the Liverpool Engineering Society and the Manchester Section of the Institution of Electrical Engineers recently, by Mr. L. Leighton, contained some interesting particulars of the electrical equipment of the King George Dock, Hull, which is the most recently opened large dock in the kingdom; the following is an abstract of his remarks:—

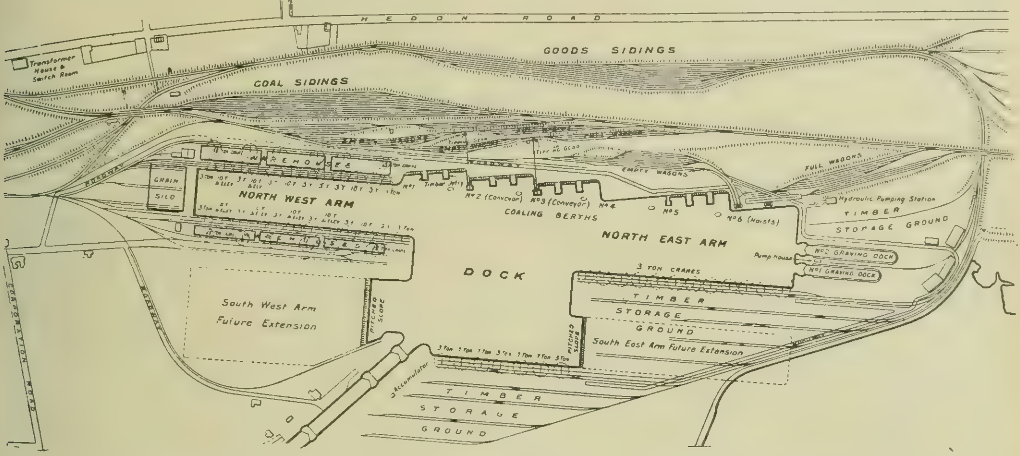


Fig. 1.—Plan of King George Dock, Hull, showing Position of Cranes, Conveyors, &c.

This dock was opened in June, 1914—an article, which remained unfinished, owing to the outbreak of war, appeared in our pages at the time—and was constructed entirely to the designs of the joint engineers, Messrs. T. M. Newell and R. Pawley, of the North-Eastern and Hull and Barnsley Railways respectively. The water area of the dock, which is shown diagrammatically in fig. 1, is 53 acres, and it is provided with a complete system of railway sidings for handling coal, timber, and general merchandise; with transit sheds on the quays, and a grain silo.

Electricity is adopted as the prime mover for the various appliances on the estate, the only machines not directly driven by this power being the coal hoists, coal conveyor, tipping gears, gate machines, sluices and warping capstans at the entrance lock. These machines are operated by hydraulic power, the pressure water being supplied from electrically-driven pumps.

The author believes that this is the first large dock in the country to depend entirely upon electricity as a prime mover.

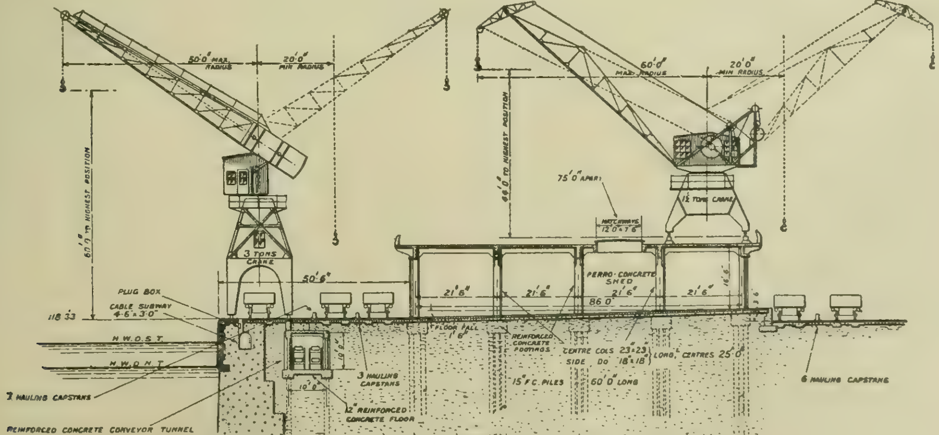


Fig. 2.—Electric Quay and Roof Cranes, King George Dock.

Three-phase current is supplied by the Hull electricity department at 6,600 volts to a special sub-station on the dock estate, built by the Joint Committee.

The equipment consists of 500-kw. motor converters, which transform to 440-460 volts, at which pressure direct current is supplied, through the Corporation's low-tension switchboard, to the bus-bars of the Joint Committee's switchboard, situated in the main switch-house adjacent to the sub-station, this board being operated by the Joint Committee. The lighting service is on the three-wire system, with a pressure of 440-460 volts across the outers, a balancing set being provided in the main sub-station for dealing with any out-of-balance load.

The quays and warehouse roofs are equipped with quick-working electric cranes, the principal dimensions being shown in figs. 2 and 3.

The speeds of working and horse-powers of the various motors are as follows:—

	10-ton.	3-ton.	1½-ton.
Speed of lift ...	50 ft. per min. (10-ton)	150 ft. per min. (3-ton)	250 ft. per min.
Do.	150 ft. per min. (3-ton)	250 ft. per min. (1½-ton)	
Luffing speed at hook	100 ft. per min.	150 ft. per min.	200 ft. per min.
Revolving speed of hook (max.)	300 ft. ..	400 ft. ..	450 ft. ..
Travelling speed on crane rails	30 ft. ..	30 ft. ..	50 ft. ..
H.P. of motors—			
Hoisting ...	55	45	35
Luffing ...	15	8	6
Slewing ...	12½	5	6
Travelling ...	15	8	6
Elevator ...	15	-	–

The cranes are all of the portal type with plated gantries, the quay cranes having clearance through the portals for the maximum railway load gauge.

Patent gears are fitted to all the cranes, so that the load moves in a horizontal path during luffing motions, in consequence of which there is a considerable saving in power and quicker luffing is permissible.

All the gearing is of machine-cut cast steel, with the exception of the motor pinions, which are of raw hide or compressed paper. Each motion is fitted with an electric brake, and in the case of the hoisting motion a foot brake is also provided on the barrel shaft for quick lowering without current, in which circumstance the electric brake is held off by a hand release arrangement.

The motors are of the totally enclosed type, six-hour rated, and work off the 440-volt D.C. circuit, current being conveyed to the cranes through armoured cable, from plug boxes connected to the mains, and fixed at intervals along the quays or shed roofs.

The switchboards are totally enclosed and fitted with voltmeter and ammeter, double-pole switches and single-pole overload and no-volt release circuit breaker, and fuses for the main incoming supply; the circuits to the various motions each have fuses and double-pole switches. Automatic cut-outs are provided as safeguards against over-running in either direction on the hoisting and luffing motions.

An interesting point in connection with six of the 10-ton cranes is that they are fitted with telescopic grain elevators, which, as will be seen from fig. 3, are carried by a supplementary jib at the opposite side of the centre post to the main jib. When not in use the elevators are derricked in to the centre and stowed in a vertical position. The elevators have a capacity of 120 tons of bulk wheat per hour, and are of the bucket type. They are driven by a separate motor, which, with the reducing gear and adjusting gear for the telescopic leg, is mounted on a platform at the head of the leg.

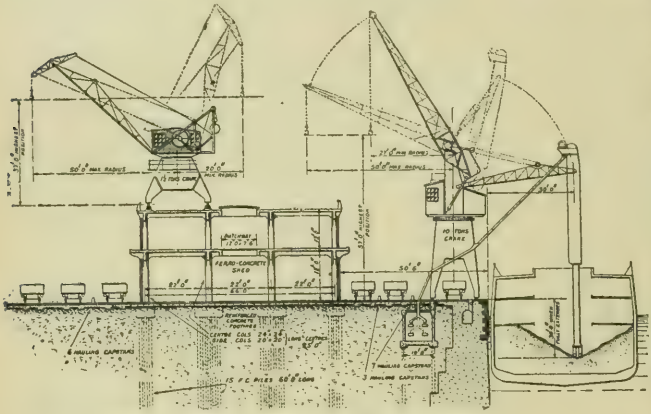


Fig. 3.—Electric Cranes, King George Dock.

To facilitate the handling of wagons 52 electric capstans and 88 rope fairleads are installed in convenient places between the railway sidings serving the various quays.

These capstans are of the self-contained turn-over box type, and are capable of hauling a load of one ton at a speed of 200 ft. per minute.

The motors are 18-B.H.P. totally enclosed, and one hour rated. The switchgear and starters are contained in an auxiliary cast-iron box fixed to the main frame, the starters being operated by a foot pedal.

A double-pole switch is fitted in an independent box in the line of the service to the machines. 26 of the capstans are fitted with automatic starters, while the other 26 have a centrifugal clutch, which does not take up the load until the motor has attained its full revolutions, the motor being started up under no load by a switch in the main circuit, operated by a solenoid in a shunt circuit, which is energised when the foot pedal is depressed.

In addition to the quay cranes a floating crane for maximum loads of 80 tons is provided. This is propelled by vertical compound condensing engines, the steam being obtained from a marine type boiler, but the lifting, slewing, and luffing motions of the crane, also the travelling counterweight, are driven by electric motors, supplied with current from dynamos which are clutch driven by one of the engines.

The output of the plant is 60 KW. at 220 volts, direct current; the Ward-Leonard control is adopted, all movements being operated by one man from a cabin placed on the revolving structure about 50 ft. above the deck.

The rails for the shed roof cranes are 20 ft. 7½ in. centres and extend for a length of 325 ft. at each block; they are bolted to timber way beams, which are supported by cast-iron chairs bolted to the roof. To enable the roof cranes to handle goods in the sheds five hatchways as shown are provided at each block, in the roof and first floor.

The sheds are effectively illuminated by clusters of metallic filament electric lamps fixed to the underside of the floor and roof slabs.

Special facilities are provided for dealing with grain traffic, consisting of a granary on the west quay of the north-west arm of the dock, having a storage capacity of 40,000 tons, built on the silo principle and equipped with all the most modern machinery for handling grain.

The granary is built in two blocks, each containing 144 storage bins.

Receiving houses are provided at the front of each block for housing the elevators, weighers, separators and other machinery. The fronts of the receiving houses, below cope level, are connected with a distributing chamber built below the quay and connected to the conveyor subways shown in figs. 2 and 3.

The conveyor subways extend for a length of 900 ft. at the North and South quays of the North-West arm. Two elevator legs mounted on the 10-ton cranes are provided at each berth, and deliver through pipes in the quay on to four conveyors in each quay subway, which deliver on to eight cross conveyors in the distributing chamber, fitted with movable throw-off carriages, which deliver on to any one of eight conveyors leading to the silo elevators, so that any one of the subway conveyors may deliver into any one of the silo elevators, for distributing to the various bins by means of eight conveyors placed above the bins and running the full length of the building. For the purpose of redistribution in the bins and for cooling off, the grain may be gravitated from the bins on to four conveyors fixed in subways under the silo, which deliver on to four cross conveyors in the distributing chamber, which in turn deliver to the elevators for returning the grain to the bins.

Four sack conveyors are provided under the sacking-off floor, capable of delivering at rulley slides for local distribution or of discharging on to four of eight conveyors running from the silo to the quay and supported on overhead gantries, for delivery to barges.

Travelling elevators, either of the pneumatic or bucket type, will be provided on the quay in front of the silo, for delivering grain from barge to the belts in the distributing chamber.

Twelve Avery automatic weighers of the latest type are provided in the receiving houses, together with 12 elevators for lifting the grain into the same, in addition to which there are eight elevators for lifting the grain to the top of the silo for distribution to the bins.

In addition to the main ship discharging elevators, six portable telescopic elevators, capable of discharging at the rate of 60 tons per hour, are provided. They are supported by beams spanning the hatchways and driven by electric motors and chain gearing. Portable conveyors working in conjunction with these elevators deliver, through spouts, to the quay conveyors or to the hoppers of Avery automatic triple weighers placed on the deck of the vessel and delivering overside to barge.

The conveyors, elevators and weighers have a capacity of 120 tons of bulk wheat per hour.

Each conveyor is fitted with screw tightening gear, and driven by a separate electric motor and a single train of machine-cut double helical gear.

The elevators are of the bucket type, and driven by electric motors through belting and a single train of double helical gear.

The electrical installation consists of completely equipped switch boards, mounted in a special switch-room. For controlling the main incoming supply there are two panels, and for the various power circuits ten panels, each panel being equipped with a circuit breaker and ammeter. The total aggregate brake-horse-power of the motors is 1,546.

The cables from the switchboard to the distribution boards and sub-boards are V.I.R. lead covered and armoured; between the distribution boards and starters and motors they are taped and braided and run in conduit.

The motors are totally enclosed and dust-proof and rated for continuous running. Each motor has a dust-proof ironclad type starter equipped with starter, circuit breaker, and ammeter.

The buildings are lighted by metallic filament lamps in well glass or bulkhead fittings.

A complete system of automatic lever type inter-communication telephones is provided in the buildings and along the quay subways, also special alarm hooters for use in case of any stoppage or breakdown of the machinery. A one-ton electric lift is provided in each receiving house.

(To be continued.)

Belfast Electricians' Wages.—The Committee of Production, having considered an application for an advance of wages made to the Electrical Contractors' Association of Belfast by the Electrical Trades Union, have decided that the men shall receive 5s. per week and boys and youths 2s. 6d. per week, these to be regarded as war advances. Pieceworkers, premium bonus workers, and others paid by results are to be paid 5s. per week over and above the week's earnings, calculated on the present basis.

THE VOLTAGE REGULATION OF ROTARY CONVERTERS.

At a meeting of the Yorkshire Local Section of the Institution of Electrical Engineers on March 21st, at Leeds, Mr. G. A. Juhlin read his paper on the above-named subject.

Mr. J. H. Shaw said that many rotary converters had been installed with a large voltage range, which was quite unnecessary. On the other hand, the author's point with regard to large power factors on light loads did not count much with a large system. Take a railway company with a few trains per hour. The load on one sub-station might be very high when that on another sub-station might be low. In various circumstances rotary converters were not very suitable for a large range of voltage. He thought that a point which Mr. Juhlin had not brought out was that the rotary converter with a fairly large voltage range and purely shunt control could be satisfactorily designed, because the increase in voltage and operation was under hand control, and the commutating pole strength could be brought up, whereas the machine that was working on traction, perhaps over-compounded, was automatic. Another point was that power-factor correction on traction was utterly impossible. The load varied so quickly that it was impossible to follow it.

Mr. Christianson said it seemed to him that the booster method was inapplicable to traction for railways or tramways where the load was rapidly varying, because the operators could not follow the variations necessary in their rheostats. The reactance control was beautifully simple, and undoubtedly, from the operator's point of view, the ideal one. The machine simply acted like a pure shunt generator, and the operation was so like that of the ordinary generator that he thought many assistants in sub-stations thought that it just acted the same as the generator did. Referring to the trouble of flashing over on traction systems in the event of a short circuit, he would like to know whether there was any great difference between the flashing-over propensities of the booster-control machine and the reactance-control machine.

Mr. W. L. Browne said he thought that where the voltage variation was only small, reactance control was the best. His rotaries were inverted, and he did not quite see how to control the power factor in the case of the inverted rotary by the method which Mr. Juhlin had described; nor had he yet got very good control over the voltage when running inverted. He would like the author to say to what extent the voltage ratio might be altered by varying the design of the poles. He noticed that the minimum wattless current was got with a reactance of about 20 per cent. Ought the customer to ask the maker for a reactance value of about 20 to 25 per cent. in each case, or was it a point which the maker would put in for his own ends, and not look at it from the customer's point of view? He wished to know also whether the change of tapping could be done whilst the machine was on load.

Mr. Selvey said that such difficulty as he had with rotary converters had not been due to voltage regulation, but to the flux of the interpoles and their spacing, and that was a very important matter, especially on quickly varying loads

Mr. Juhlin, in reply, said with regard to power factors on light loads, it was quite true that on a large system the total load did not change to the same extent as the load on the converter; but, even then, if the system had a big number of converters on it—as was the case with a number of the larger towns which ran their own tramway systems as well as lighting and power—there was certainly a considerable peak on the system due to the traction load, and, correspondingly, a reduction in the load when the traction peak was small. Mr. Shaw had wished the point to be emphasised that booster-control could be used with large shunt machines and over a considerable range, owing to the fact that it was possible to change the excitation on the winding of the interpole. If the load variations were slow that was perfectly true, but if the loads were rapid the matter became rather difficult. As to the question of power-factor control on a system operating on traction load, there was no difficulty in changing the power factor provided the booster was used, even on the traction system, as they could arrange the booster with a series field, which would take care of the changes required in voltage. At the same time a shunt field could be used on the booster, which would be required to compensate for any change in power factor on the rotary. So it was possible to vary the power factor on the traction system by means of the rotary, provided the booster was used. On main traction systems it was quite unnecessary to do so, because the power factor, as a rule, was sufficiently high without any correction. Mr. Christianson had raised the question of booster-control on traction systems; it was perfectly applicable, as they could use the series field on the booster. It was true that some sub station attendants regarded the rotary more in the light of a D.C. machine than anything else. That point of view was fatal to the good operation of the converters, and ought to be combated by every possible means, because it was only by clear appreciation of the rotary as a machine that they could get really good operation. The question of flashing over was, naturally, bound up very closely with that of commutation; a machine which was operating under adverse conditions in regard to commutation would flash over more readily than a machine which commutated really well. It was generally more difficult to get good commutation on the booster type of machine. In considering the inverted rotary, it must be remembered that they could only get a certain range of voltage regulation on that type, and that could only be obtained by changing the wattless current from the rotary on the synchronised sets running parallel with it. Very low reactance in the transformers was required when the machine was running inverted, in order to get wattless regulation With regard to the extent of regulation by changing the shape of the poles, it was possible to get a considerable range by the "split-pole" method. As for simply changing the shape of the main poles, it depended largely upon the individual design of the converter, but the range was very small only, possibly, a few per cent.; very limited indeed. The customer should specify clearly the range of voltage required and the conditions as to power factor required on the high-tension side of the transformer. With these conditions given, the manufacturer should have free choice as to the reactance which he considered most suitable. If the customer specified for the reactance as well as the power factor of the system, it left the manufacturer very little choice in designing. Changing the taps on the transformer so as to give different ranges could not be done except where they could shut the machine down, unless a booster-transformer was used. The conditions which he had based his points on in that connection were that they had two ranges, one for general lighting and power work, and the other for traction, in which case the machine need not necessarily be shut down. Mr. Selvey had raised a question as to the spacing of the poles, which, of course, was a point of considerable importance, especially in low-voltage machines, and it had received very careful consideration by manufacturers as a whole. A point of very great importance in Mr. Selvey's remarks was that they should arrange machines for a given service, and he believed that in a number of cases where lighting and power work was done, as well as traction, a certain number of rotaries were used purely for general power work and lighting, whilst others were used exclusively for traction. In such cases the machines were not only cheaper, but better running conditions were obtained with them. If a large range was required, it was quite clear that the rotary was operating under adverse conditions, as it was normally a machine for fixed voltage. That point, to his mind, was one which should receive the most careful consideration by operating engineers and others who had to specify for rotary converters.

Mr. Juhlin's paper was read and discussed at a meeting of the Scottish Local Section at Edinburgh on March 20th.

Mr. W. B. Hird, in a communication, pointed out that in cases such as that mentioned in the paper where two different ranges of voltage were required, it seemed self-evident that the use of two tappings on the transformer had such great and immediate advantages that one would expect it to be universally employed. By reducing the range of regulation required from the reactance, the booster, or whatever other method was employed, it evidently simplified and very much cheapened the first cost of the apparatus required. It would seem, however, that for the fine regulation required in addition to the tappings, there were other methods worthy of consideration. One of these was the use of a D.C. instead of an A.C. booster, and although the difficulties of designing a suitable commutator for such a machine might in some cases be prohibitive, there must be many cases in which the D.C. booster would give an ideal method of regulation. It would be free from the objections to the reactance method in that it would give a greater range of regulation, and would allow of control of the power factor. It was true that if connected with the rotary shaft it would still introduce increased difficulties in the commutation of the rotary in the same way as described for the A.C. booster, but it was quite conceivable that cases would occur where it would be possible and convenient to employ a motor-driven D.C. booster Another method of theoretical interest would be the use of a reactance in the line, so that the amount of reactance could be varied at will. Such an arrangement, if found possible in practice, would do away with some of the difficulties now experienced in the use of voltage control by reactance

Mr. Belsey emphasised the necessity for the purchaser or the operating engineer to look very closely into the limits of voltage that might be required. If there was a little more sympathy between the designer and the purchaser it would be greatly to the benefit of both sides. While the induction regulator had not been much used in this country, it had, he thought, been a success in the United States.

Mr. Rorr pointed out that in many cases they had found that machines with a large range were never run to their highest limits, with the result that the customer had to pay for a larger machine—one that was more expensive and not so efficient as if the range had been confined to smaller limits. Referring to the motor converter, he remarked that due to the higher reactances which these machines had on low loads, the wattless current taken on the low loads was considerably smaller than with the corresponding type of rotary converter.

Mr. ARCH. PAGE said that he was associated with the Glasgow T.C. electricity undertaking, in which there were at present 97 rotaries carrying 53,000 KW., and they had only half a dozen booster controlled rotaries out of that 97. They had, however, a number of motor generators—34 with 24,000 KW., and one motor converter of 1,000 KW., a total altogether of converting plant of approximately 79,000 KW. For the last two years their specifications for rotaries had hardly varied at all. They got sufficient regulation from their resistance controlled machines, but they did not go the length of asking 7½ per cent.—they were content with 4 per cent. either way. That, he believed, was probably more than sufficient; in fact, when there was a fair number of substations dotted all over the system, he thought that 2½ per cent. would be sufficient to meet the average case. He would put the cost as probably the most important item, with commutation second, power factor third, and range of voltage in the fourth place. Efficiency required consideration, but as all these properly designed and constructed machines were more or less of equal efficiency it did not amount to very much. Maintenance was, however, distinctly against the booster type. There seemed to be quite a lot of trouble over interpoles, and he described an experiment on an automatic method of changing which was proceeding in Glasgow. This consisted of a double set of brushes, and rather a complicated set of brush gear. The one set led through the synchroniser to the lines, and the other set led through the commutating pole windings, with the result that if the adjustment was correct they got the effect desired. They had also persevered with high output machines, and they were now able to buy these high-speed machines, and get very successful results from them. He asked Mr. Juhlin if he could explain the excessively high open-circuit L.T. voltage one sometimes got with a transformer built specially for rotary-converter work. He found an open-circuit voltage of about 600 volts instead of what one would expect—370 to 400.

Mr. SEDDON said the object of the paper appeared to be to point out the value and simplicity of reactance control when a voltage regulation of not more than 15 per cent. was required on the D.C. side. Up to this point a rotary converter was a comparatively simple machine, but, if an increased regulation was desired, then the rotary did not appear to be quite so simple as was claimed. There were many ways of effecting this increased regulation, and he believed that most engineers were agreed that, from an operating point of view, the synchronous motor-generator was the ideal machine; it gave them all the regulation that was required in practice, and the power factor was under complete control, though, unfortunately, its efficiency was low. On the other hand, the simple rotary converter had poor regulation, but its efficiency was high. He thought the case could be met by the motor converter.

Mr. WHYSALL said that in Greenock they had carried out their extension on the lines advocated by the author. All their rotaries were of the reactance-control type, six-phase converters (with the exception of one 75-KW. inverted rotary, with which was a D.C. booster). In the case of two rotaries they had a middle-wire booster introduced for balancing purposes on a three-wire lighting system. In his opinion, the reactance-control type of rotary was the most suitable provided the conditions were such that the voltage regulation would come within the range of the 15 per cent. mentioned in Mr. Juhlin's paper. Their voltage regulation was carried out satisfactorily, and a variation of about 10 per cent. was all that was necessary under normal working conditions. Two-thirds of the machines were installed on consumers' premises for two-wire working with a D.C. voltage range of 200-240 with level compound characteristics, the compounding effect being necessary on account of the very heavy intermittent loads with the service required. He referred to shipyards and engineering works using 200 to 250-H.P. air compressors accelerated from standing to full load within 20 seconds and automatically controlled. The voltages on the lighting and traction systems where the rotary converters were used for either service were 500-560 volts on the outers for lighting, and 540 volts for traction, so that no A.C. boosters were required; 2½ per cent. tappings were left on the H.T. side of the transformers to enable the same range to be got at lower or higher voltages, say, 480-520. The higher range was only required during the winter months, and little trouble was involved in changing from one set of tappings to another at the beginning or end of the season. There was a tendency to over-excite the fields of the rotaries under the reactance control with the intention of improving the power factor to compensate for the wattless currents which might come from other parts of the system, and experiments had demonstrated that the heating of the near tap coils on the armatures of six-phase rotaries had been so great, more especially on overloads at leading power factors, as to make it rather a risky proceeding. The inherent good voltage characteristics of converters were at times rather embarrassing, especially when feeding into a heavy fault, or endeavouring to parallel with the D.C. network at nearly full voltage after a shut-down. In this connection, it had occurred to him that with lower voltage and frequency concurring simultaneously trouble might be caused due to resonance being set up on the circuit.

Mr. HININGS gave the opinion that one disadvantage of the reactance-control rotaries not mentioned by the author was the question where the shunt field rheostat should be fixed. If it was fixed adjacent to the A.C. control panel of the machine for ease in synchronising, it was in the wrong place for D.C. regulation, as usually the A.C. and the D.C. controls were some distance apart. When two rheostats were fitted, one in the A.C. and one for the D.C. panel, the length of the field connections of the two rheostats formed a possible source of trouble. With booster control the main field rheostat was fixed adjacent to the A.C. panel for ease in synchronising, whilst the booster field rheostat was fitted near the D.C. voltage control.

Mr. JUHLIN, in reply, agreed with the necessity for closer co-operation between the manufacturers and the purchaser. There was no question that the induction regulator was very useful for voltage regulation of rotaries. The usefulness of the reactance in the case of heavy overloads was a point which required consideration from the operating engineer. They had no other means of varying the voltage of the motor-converter than reactance control, while, further, they had in the motor-converter the question of the magnetising current. They had in the motor-converter, as in the rotary-converter, a fixed ratio between the voltages, whereas in the motor-generator set they had absolutely independent control. There was no difficulty in getting transformers with 25 per cent. reactance; in fact, larger ranges could be obtained. There could be no rise in voltage except where a fairly heavy wattless current was being carried. The rotary getting out of step and surging was due in many cases to high drop in the feeders, which might be accentuated in the case of surging. In Mr. Whysall's description of the system he was operating it was interesting to find operating engineers who considered it little trouble to change over the transformer; if used, it would mean a considerable lessening of the difficulties in connection with voltage variation. As a general rule they had to go to very much larger systems than were prevalent in this country to find resonance conditions.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electricity Supply Rates and Government Contracts.

Now that the War Office and other Government Departments are taking electric supply in every part of the country for offices, works, hospitals, camps, &c., electricity undertakings are faced with the usual formal requests for special terms, and are sometimes rather in a dilemma on what principle to act, in view of the argument that the supply is wanted for national purposes, and, as such, entitled to special consideration. But, looked at correctly, the decision is really taken out of their hands by Act of Parliament. In the Electric Lighting Act, 1882, it is enacted that the undertakers shall not "show any undue preference to any local authority, company, or person." Corporate bodies or Government Departments are, therefore, as clearly debarred from preferential treatment as any private consumer.

The course laid down is obviously quite clear, namely, that there must not be made to any Government Department any reduction from the standard rates beyond that which is warranted by the conditions under which supply is taken (maximum demand, hours of use, &c.), or, in other words, Government Departments must be treated on all fours with all other consumers.

Of course, where there is a case where a patriotic feeling might naturally come to the fore, say, in the case of hospitals, &c., it is clearly the more advisable course to keep strictly within the Electric Lighting Act, and to give, say, a donation to the hospital, or help in any other way, quite independently. It amounts to the same thing in the end, and no principle is violated, and no improper precedent formed. Further, if undertakings took this course, it would mean consistency of action throughout the industry.

Electric Supply.

The Controller Drum.

Referring to the article under the above heading appearing in your issue of 16th inst., it appears to the writer that there is an even more important point in the arrangement of controller drums, which does not appear to be generally recognised by the designers.

This is that the field windings of the motor, whether shunt or series-wound, and especially, of course, when not provided with any "kicking" coil or "discharge" resistance, should be so connected to the controller that interruption of the current when "switching" off will leave the field windings isolated from the controller, motor armature, &c.

Unless this is done, such apparatus is needlessly exposed to the inductive rise of voltage which occurs when the current in the field windings is interrupted.

In the diagram shown in the article in question it is evident that both the magnetic blow-out coil and also the controller resistances are thus needlessly exposed to this strain, and, in consequence, more liable to breakdown of insulation.

It is not possible by examining the diagram to say whether or not other parts of the apparatus (the armature of the motor, for example) are thus affected. It depends upon the point in the controller at which interruption first occurs.

The field connections, whether shunt or series, should be brought through corresponding contact fingers to two separate bars, which, to ensure the circuit being opened at the right points, should be made slightly shorter than the other bars.

The writer has come across several instances of breakdown of insulation of series-wound crane motor armatures from this cause.

In such cases, of course, interruption of current is frequent and very rapid, thus causing considerable inductive rise of voltage even in the case of series-wound field coils.

Norman J. Hockley.

Manchester, *March 22nd*, 1917.

Oil-Immersed Circuit Breakers for Use on Continuous Current Supplies.

As there appears to be some considerable diversity of opinion as to the suitability of oil-immersed circuit breakers on continuous-current supplies, I take the liberty of writing you to inquire if you would care to take this question up with your readers. Doubtless some of them have had experience with gear of this nature on D.C. systems, the results of which experience they may be pleased to make known.

G. G.

March 22nd, 1917.

Linking-up with Waste Heat Stations.

I understand that several of the large electric power companies have linked-up their generating stations with smaller power stations using waste heat from coke ovens and blast furnaces. I should be much obliged to know if any of your readers have heard of municipal or company undertakings linking-up with factory generating plant where the exhaust steam from the engines or turbines is utilised for a heating or evaporation process in the factory.

Central Station.

Greenock, *March 22nd*, 1917.

Women and "Shorts."

With regard to the controversy *re* above at Marylebone started by "Exciter" some weeks ago, we understand that the Chairman (Mr. Duncan Watson) has been making investigations among the employés of this Corporation electrical department with a view to ascertaining the originator of this article, in order, we believe, to mete out justice accordingly.

We think it only fair to state (for the benefit of the staff concerned) that we were not, and are not, employés of this Borough Council.

Exciter.
Booster.

Fault Localisation.

I should be very glad if any of your readers could suggest an accurate method of locating a fault under the following conditions:—

Tramway feeders, V.I.R. double taped and braided, 1 sq. in. section, in duplicate, laid solid in wood troughing, with bitumen. Both cables shorted and earthed.

Any of the ordinary tests were of no use, varying nearly every time.

On finding the fault, both the feeders were found to be burnt out completely for a distance of about 6 in.; carbonised bitumen between them, and between them and earth, had been the means of carrying the test currents.

A. Sommerville.

Ayr, *March 26th*, 1917.

WAR ITEMS.

Marylebone Electricity Staff and National Service.—The Marylebone B.C. Electricity Supply Committee reports that it has considered the question of employés enrolling under the National Service scheme. Owing to the fact that the staff of the department has now been reduced to the absolute minimum, and to the importance of the work being done by the department, and the urgent necessity, being the public lighting authority, for maintaining an efficient lighting service, the Committee has directed the general manager to inform the employés that as they are already engaged on work of national importance they should not, for the present, enrol under the scheme.

Westinghouse War Relief Funds.—We have received a copy of the British Westinghouse Employés' War Relief Fund which was submitted at the meeting of delegates held at the British Westinghouse Club, Moss Road, on Friday last. The contributions by employés down to December, 1916, amounted to £24,529, and those by the company to £11,391; other income brings up the total to £36,394. There has been paid to dependents £20,584, Christmas gifts amounted to £1,204, donations to local and national funds £831, and after meeting sundry expenses there is transferred to Disablement and Dependents' Fund £11,235, the balance being £2,294. The fatalities to date number 168, but it is impossible to estimate what the increase therein will be in future. It is estimated that £14,000 invested at 4 per cent. would be sufficient to pay 5s. per week to 200 families for five and a half years. Therefore, it is necessary not only to conserve the present balance, but to augment it in readiness for probable further losses.

The Unruly Member.—A night scene at the Central Electric Co.'s works in Lodge Road, St. John's Wood, was described at the Marylebone Police Court recently, when George Dellar, a pensioned quarter-master in the Navy, living at 61, Wharncliffe Gardens, was summoned before Mr. Paul Taylor for assaulting Charles David Brodie, a skilled electrician at the power station, living at 63, Wharncliffe Gardens. Mr. F. Freke Palmer, solicitor, supported the summons, and explained that Mr. Brodie was a man of 25 years of age, who was badged by the Minister of Munitions in consequence of the responsible position which he occupied at the electric power station—a certified undertaking under the Munitions of War Act. He had twice offered himself for service, but had been refused on the ground that he was engaged in his present employment on work of national importance. For some months, however, he had been greatly annoyed by the defendant's wife, who taunted him with living in a funk-hole, and after he had remonstrated with her about it, her husband visited him at his work and committed the assault complained of.

Mr. Brodie, giving evidence, said he was in charge of a switchboard at the power station. He attested under Lord Derby's scheme, and had twice offered himself for service, but was refused on the ground that he was doing better work where he was. Mrs. Dellar had been offensive to him, and on March 6th he spoke to her about it. Next night, while he was at work at the power station, she called there, and when he went out to speak to her her husband stepped from behind, made some remark about insulting his wife, and struck him on the side of the mouth. He also swore, and his wife shouted as loudly as she could: "Two and a half years in a funk-hole; two and a half years a slacker, slacker, slacker."

Mr. H. P. Gaze, executive engineer at the station, stated that Mr. Brodie had been there 12 years, and was a highly skilled man occupying a very responsible position.

Mr. Paul Taylor said he regarded it as a very serious matter. Mr. Brodie was serving his country, and no doubt he was doing good service as a skilled electrician at the power station. The defendant, however, had done a positive disservice to his country, and, but for the fact that he had not abused Mr. Brodie, he should not have hesitated to send him to prison without the option of a fine. Anything more outrageous he could not understand. It made one despair of the stupidity of some people. Husbands were supposed to be able to keep their wives in order, though it was difficult, no doubt, to keep a woman's tongue in order. He fined the defendant 10s., with 21s. costs.

Ministry of Munitions and Electric Lamp Glass.—The Ministry of Munitions has issued the following regulations:—

(1) No person shall manufacture any electric lamp glass unless the purpose for which such glass is required has been approved. Such approval must be evidenced by one or other of the following, which must be quoted by the ordering firm to the manufacturer, together with the purpose for which the glass is required:—

(*a*) Reference to and number of an Admiralty, War Office or Ministry of Munitions contract for which the glass is necessary; or

(*b*) A certificate authorising the supply issued on behalf of the Minister of Munitions by the Director of Optical Munitions and Glassware Supply.

(2) Manufacturers of Electric Lamp Glass are required to render to the Director of Optical Munitions and Glassware Supply at regular intervals full and accurate returns of their manufacture and output of electric lamp glass in accordance with the directions from time to time given by the said Director.

(3) No person shall buy, sell, or deal in any electric lamp glass situated or to be manufactured outside the United Kingdom unless a certificate authorising such purchase, sale or dealing has been issued on behalf of the Minister of Munitions by the Director of Optical Munitions and Glassware Supply.

(4) For the purpose of this Order Electric Lamp Glass shall include all glass intended for use in the manufacture of electric lamps except glass used or intended for use in lamp caps for insulating purposes, but shall not include glass shades and similar accessories.

(5) All applications in reference to the above Order should be made to the Director of Optical Munitions and Glassware Supply, Ministry of Munitions of War, 117, Piccadilly, W. 1.

Exports to China.—Further additions to the list of persons in China and Siam to whom exports may be consigned appear in the *London Gazette* for March 27th.

Exemption Applications.—Conditional exemption has been continued in the case of Mr. W. J. Oxenham, 29, married, "A," engineer and manager for the Launceston and District Electric Supply Co., Ltd. It was stated that Mr. Oxenham and the engine driver were practically the only ones left. Six months ago a disabled soldier was engaged, but he left, and since then Mr. Oxenham had had to attend to the switchboard in addition to his other work. They were unable to get a switchboard attendant to relieve him. If Mr. Oxenham went the town would be in darkness.

At Rotherham, a switchboard operator, aged 18 and passed for general service, engaged at the Corporation electricity works, was appealed for by Mr. Lilliker, who said that it was impossible to get a substitute. Two months were allowed, and conditional exemption was conceded to an employé, aged 39, engaged on repair work at the electric light station, who averages 84 hours' work per week.

At Wrexham, the Military appealed against conditional exemption held by G. Steen (35), chief inspector to the Wrexham Tramway Co., in Class A. The manager, Mr. Hawkins, said that the cars carried 7,000 miners weekly, and the pre-war staff of 82 had been reduced to 35, only three of whom were of military age. Exemption until May 13th, subject to substitution, was the decision.

At Cowes (I.O.W.), the Isle of Wight Electric Light Co. appealed for A. C. Long (22), shift engineer, passed for general service after being placed in Class B 4, equivalent to C 1. The Chairman said they were prepared to admit that the man was of the greatest importance to the company, but, having regard to his age and Class, they could grant only two months' final exemption. Leave to appeal was granted.

On the appeal of the Military, the Lewes Tribunal has cancelled conditional exemption held by J. Morris (30), clerk, &c., with the Lewes Electric Supply Co., who asked for the exemption to be continued. The certificate was withdrawn, a month being allowed.

At Falmouth, an appeal was made by Mr. F. E. Deeble (26, in Class A), electrical engineer, who has sole management of his father's business in Arwenack Street. He stated that he was contractor to the naval authorities, and had been badged. In reply to the Military Representative, he said that he served for six years in the Electrical Engineers Volunteers, and applied for his discharge 10 months before the war broke out. The application was refused, with a month's grace.

Mr. Fergusson, tramway manager at Dartford, appealed for three drivers and repairers, and a fourth repairer, and produced a telegram from the Ministry of Munitions calling attention to the importance of maintaining the system. One was refused exemption, and the others were conditionally exempted.

At Doncaster, an appeal was made by the Corporation tramway department for the car-shed foreman, who, Mr. E. S. Rayner, manager, said was the only skilled man left at the sheds. They had lost 80 per cent. of the staff, and had the greatest difficulty in keeping the cars running. The Chairman: Do you put it as strong as to say that you could not carry on if this man went? Mr. Rayner: The service would have to be cut down until we could get another man of equal merit; we could not keep the shed running. Exemption until May 31st was given.

Clacton-on-Sea Tribunal has cancelled conditional exemption held by an employé at the U.D.C. electricity works, aged 28, and four weeks' grace was given. The manager stated that he could not get a substitute.

At Hythe (Kent), Mr. T Hesketh, manager of the Electricity Supply Co., Ltd., appealed for Mr. A. C. Wampach (38), the company's electrical engineer. He said that he appealed as a matter of necessity and in the national interest. They required for the work in hand many more men, but it was utterly impossible to get them. If Mr. Wampach had to go, the Hythe works would have to be shut down. The company was under contract to supply current to the military. The Tribunal allowed three months.

Conditional exemption has been given to Mr. J. T. Jones (25, in Class C 1), manager for the Oswestry Electric Light Co., Ltd.

At Aldershot, the Traction Co. made appeals for a driver and fitter (37, general service), a fitter (34, C 1), and a foreman fitter (39, general service). Asked which was the most important, the night or day staff, Mr. Eggar said that both were of equal importance. If the night staff could not get their work done the day services could not run. The Tribunal decided that the company ought to be protected, and each man was given three months.

At Southend-on-Sea, the borough electrical engineer appealed for 12 tram drivers, aged from 30 to 40, seven passed for general service, four in B 1, and one in C 1. Mr. Birkett asked for as long delay as possible so that women could be trained. Seven of the men were given until May 1st, two until June 1st; and the others had conditional exemption.

At Bridlington, Mr. Ffrench, borough electrical engineer, appealed for a mechanic and stoker at the electricity works, and said that he must have a qualified man. The Military Representative said that he would see that a substitute was provided, and this was assented to, a month's respite being given.

An appeal was made at Peterborough for C. W. Armitage (29, passed for general service), foreman with the Tramway Co. The Chairman said that there could be no exemption as their instructions were to send all men under 31 and in Class A.

Kidderminster Tribunal has refused exemption to a tram driver, appealed for by the Electric Traction Co. In reply to a question, the manager said that they had not yet tried the experiment of women drivers.

An appeal was made to the Esher and Ditton Tribunal for exemption for the head electrician engaged at the Royal Mills, Esher, and he was given until June 1st.

At Windermere, the Military appealed against exemption until June 1st granted to Mr. L. Birkett, of the staff of the Electrical Supply Co. The exemption was continued, but the Military Representative warned the company that Mr. Birkett would not be further exempted, and that they should provide a substitute. The Military also had reviewed the case of J. Reed, of the company's staff, called up under the new order as to men under 31. He was 31 before March, 1917, and, on the Military assenting that he was in a reserved occupation, conditional exemption was agreed to.

At Barnsley, Mrs. Burns appealed for B. Gregory (23), electrician, the only man left to assist her in the business. She said that she had failed to get anyone to replace him, and, on the suggestion of the Mayor, it was decided to refer the case to the substitution officer to find a substitute.

On the appeal of the Urban Electric Supply Co., Walton-on-Thames Tribunal has granted two months' exemption to J. Wheatley (24), electric wireman, in Class C 2

At Doncaster, the tramways department, through Mr. E. S. Rayner, the tramways manager, appealed for a car-shed foreman and a driver. Mr. Rayner said it was impossible to replace the foreman. They were having difficulty in keeping the cars on the road, and great trouble in getting materials. It was impossible to get skilled labour. The department had lost 80 per cent. of its men. The bulk of the passengers were munition workers. Postponement to May 31st was allowed. The driver was granted a similar, but final, period.

At Ilkley, an application for conditional exemption was made by a consulting electrical engineer, aged 33, married, who had been exempted for four months to allow him to devote time to experimental work on a patent electrical motor. He said the work had been completed, and the motor placed on the market, and was now being used for Government and munition purposes. He was devoting part time to munitions, and the remainder to the commercial side of his patent. He desired exemption to enable him to apply for a badge. The case was adjourned for a fortnight in order that he might apply to the Ministry of Munitions for a badge.

The Heckmondwike District Council's electricity department applied on behalf of an engineer's clerk and shift engineer, aged 21, and unmarried, and two junior shift engineers, aged 18 years, all being Class A men. The Military Representative admitted having to recognise the importance of the maintenance of public services, but he said one of the men concerned was engaged chiefly on clerical work, and, he thought, might be replaced by a girl. The three claims were disallowed, provisionally on substitutes being found.

The Batley Corporation electricity department applied for reconsideration of cases heard in the previous week. The Electricity Committee doubted whether the whole of the facts had been placed before the Tribunal, and the Chairman (Coun. F. W. H. Auty) attended to ask for a review. He said the three men particularly concerned were A. Russling, aged 23, single, station superintendent, who had been given till May 1st; J. Ainscough, 36, married, shift engineer, disallowed without grace; and R. J. Greenwood, 19, single, junior engineer, grace till May 1st. If these decisions were allowed to stand, said the Councillor, the electricity works would, at May 1st, be left with one driver and no shift engineer. The Chairman of the Tribunal said Ainscough's case had been refused because he was leaving the works. Coun. Auty said it had been thought they had power to keep him, but they found on inquiry that they had not, and that was the reason why they had lost their chief assistant. Ainscough, however, was now willing to stay at the works. Even with Ainscough remaining they would only have three shift engineers, whereas they ought to have four. If Ainscough had to go and another man could not be got, it would be a big step nearer shutting up the works. The engines could not be kept going without shift engineers. Eventually it was decided that Ainscough should have conditional exemption, but, in view of the urgent demand for men under 31, the Tribunal could not alter the decision as to the other men. The Electricity Committee must do its best, in six weeks, to replace Greenwood and Russling.

All Hands to the Plough.—According to the *Sheffield Daily Telegraph*, Mr. S. E. Fedden recently communicated with the Board of Agriculture, offering the services of the staff of the Sheffield Corporation electricity power stations as volunteer ploughmen in their spare time. It appears that the men will be motored to farms in the evening, and will do night ploughing with motor-ploughs to be provided by the Board of Agriculture, and at week ends they will engage in general work on the land.

LEGAL.

British Thomson-Houston Co., Ltd., *v.* Duram, Ltd.

The Court of Appeal, composed of the Master of the Rolls and Lords Justices Warrington and Scrutton, delivered judgment, last week, in this case upon the plaintiffs' appeal from a judgment in favour of the defendants.

The Master of the Rolls said that he had had an opportunity of reading the judgment about to be delivered, and agreed with the conclusions arrived at by the learned Judge. He was of opinion that the judgment of Mr. Justice Astbury should be affirmed, and the appeal dismissed, with costs.

Lord Justice Warrington said the first question was to determine what was the true construction of the specification, in order to ascertain what was the invention described and claimed. Tungsten was one of the refractory metals, was ordinarily in the form of a finely-divided powder, and had a very high melting point—viz., somewhere about 3,000° C. It could only be melted by the employment of the electric current, and the product so obtained was apt to be a carbide of the metal, and so hard as to be of no use for purposes such as those for which a metal was commonly used. Prior to the date of the patent, however, means had been suggested -notably by Moissan, in 1896, and in a specification of Just and Hanaman, in 1904—for obtaining pure tungsten in a solid form. In Just and Hanaman's specification, the object aimed at was to obtain a filament of pure tungsten for electric lamps In 1906 there had been no commercial application of any of these suggestions, but the plaintiffs' specification assumed that tungsten might be obtained in a solid form suitable for the application of the invention claimed in various ways, and the patentees described one of such ways, treating it as one already kown, and making no claim to it as an invention of theirs. Working a metal in the technical sense meant altering its shape in such a manner as to produce a spreading or extension of the actual metallic body. The expression covered and included the well-known processes of hammering, rolling, and drawing. Turning to the specification, his Lordship said the first claim with which it was necessary to deal was in these terms:—"The method of working tungsten which consists in subjecting the metal in a coherent form to the action of heat while it is being operated on or manipulated." Taken by itself that created no difficulty. The only special feature claimed was subjecting the metal referred to to the action of heat during the operation of working. This special feature was claimed as applicable to every mode of working, including hammering, rolling, and drawing; as to that, there was no dispute. The fight had ranged round the words "the metal in a coherent form." Did they mean, as the defendants said, any form of solid metal however obtained, or were they limited, as the plaintiffs contended, to a metal which had assumed a solid form only by reason of the coherence of the particles of which the original powder consisted? Reading the words by themselves, he should feel no difficulty in saying that they included any form of solid tungsten, the only form of the metal to which the process of working could be applied. But it was said that the specification afforded a context with reference to which the words must be read, and that if that was done it would be found that they bore the narrower construction for which the plaintiffs contended.

His **Lordship**, having read the material portion of the plaintiffs' specification, said that the patentee plainly applied his invention not only to a rod obtained as described, but to one "obtained by any other method which yielded a pure coherent product." He could not see that that meant anything less than pure metal in a solid form as distinct from powder. In his opinion, the context, so far from assisting the plaintiffs, tended to show that the patentee was dealing with the metal in a condition suitable for working, that was to say, not as a powder, and that he regarded it as perfectly immaterial how that condition was obtained.

Continuing, his Lordship said: The view which I have expressed as to the construction of the specification is, I think, supported by the extreme difficulty the plaintiffs' counsel found in stating in a consistent or intelligible way the limitation they seek to impose, and it was only in Mr. Walter's argument in reply that we got it in a definite shape, in substance corresponding with what he stated to be their contention. The claim therefore is, in my opinion, simply for the employment of heat during the working operation, whatever it may be, as a means of effectuating or facilitating that operation when the subject of it is tungsten. The patentees condescend to no definite particulars as to the degree of heat, nor do they lay claim to any special form of apparatus for its application, or any special mode of applying it.

The so-called discovery seems to me to be no discovery at all, for it is proved that it is part of the ordinary routine of a metallurgist, if he has to deal with a metal which cannot be worked cold, to use heat to facilitate the operation, it being well known that the action of heat on a metal is to encourage the change of shape which it is the object of the working to produce. If the present patent were to be held valid, no person could during its subsistence follow this routine in the case of tungsten without infringing the patent. I am clearly of opinion that, construed as I think it ought to be construed, the specification neither describes nor claims an invention which can be the subject matter of a patent, and the patent is, therefore, invalid. It is unnecessary to deal with the question of anticipation or insufficiency of the specification. The appeal, in my opinion, fails, and must be dismissed.

Lord Justice Scrutton read a judgment also dismissing the appeal. He said he agreed with Mr. Justice Astbury's view that there was not sufficient subject matter in Claim 1; the subject matter, if any—the knowledge of the malleable and ductile quality of a metal under a well-known process—was, he thought, anticipated by Moissan. He could not think there was any patentable invention in applying to a new metal a method which any competent metallurgist would use if invited to report on the qualities of a metal of whose nature he was ignorant. That short point disposed of the case, and it was unnecessary to deal with the numerous other points that were raised in the defendants' arguments.

Pritchard *v.* Peto and the Electrical Contract and Maintenance Co., Ltd.

In the King's Bench Division, on March 27th, Mr. Justice Bailhache and a common jury heard an action in which a newsagent, of Packington Street, Islington, claimed compensation for personal injuries against Mrs. Peto, the occupier of a house in Packington Street, and the Electrical Contract and Maintenance Co., Ltd., when the question arose as to whether Mrs. Peto or the Electrical Contract and Maintenance Co., whose telephone line was fixed to the coping, the falling of which caused the accident, was liable. On April 16th, 1916, the plaintiff was calling at Mrs. Peto's house in the ordinary course of his business, when a piece of the cornice from the top of the house, without warning, fell upon his head, causing injuries by which he was confined to his bed for some weeks. The plaintiff's case was that the cornice was rendered unsafe by reason of the manner in which the telephone wire was fixed to it, and in this contention he was supported by the first defendant.

Mr. Langdon, K.C., appearing for the defendant company, contended that the telephone fittings had nothing whatever to do with the crack which had caused the accident, and, after a discussion, it was agreed that a surveyor should visit the premises and report, and upon that report the parties would take their stand, and accept any assessment of damages at which the jury might arrive in the meantime.

The jury accordingly assessed the damages at £100.

Mr. Elkington, who was the surveyor chosen, subsequently reported that after viewing the premises he came to the conclusion that the driving of the nail to hold the telephone triangle had nothing to do with the cracking or the accident.

Mr. Langdon, K.C., said that that exonerated the Electrical Contract and Maintenance Co., and he asked for judgment as far as they were concerned.

Judgment was accordingly given in favour of the defendant company, and, after hearing arguments, his **Lordship** reserved his decision in regard to Mrs. Peto, the other defendant.

NOTES FROM CANADA.

[FROM OUR SPECIAL CORRESPONDENT.]

There has just been published by the Commission of Conservation of Canada, a report on the water powers of Manitoba, Saskatchewan, and Alberta, which forms a sequal to a similar work, issued in 1911, called "The Water Powers of Canada." In the latter, the Eastern Provinces of the Dominion were pretty thoroughly covered, but as the information then available regarding the West was insufficient, it was not possible to treat the subject other than quite cursorily.

It is evident from the report under review that the Government is doing a work which will some day prove extremely useful. Probably many of the water powers now being surveyed will not be made use of for a considerable time, but everyone acquainted with the development of hydraulic power knows how unreliable records of stream flow may be if taken over short periods, so that the longer the period of observation is, the more accurate will be the calculations based on the records obtained.

On the recommendation of the Commission referred to above, an area of 17,900 sq. miles has been assured protection against denudation by the setting aside of the eastern slope of the Rocky Mountains as a forest reserve. This is a very wise measure, as it will tend to regulate the flow of the rivers and prevent floods and droughts. Similar steps are recommended regarding the drainage area of the Winnipeg River. In this vast country, although in the past much harm has been done by cutting down forests, so far as stream regulation is concerned, a great deal of good can be accomplished by the prevention of further damage in the future.

The Dominion Government has recently decided to reserve all vacant Dominion lands which may be valuable for the development of water power, in order to keep them from the hands of speculators, so that only promoters of *bona fide* power development may secure them.

A few months ago a Research Committee, consisting of prominent scientists and engineers, was organised by the Dominion Government, and these men are taking up many questions of national importance in connection with the development of Canada's resources in water powers, minerals, timber, &c.

One subject which is receiving particular attention is the utilisation of lignite in the Prairie Provinces. In Saskatchewan there are immense deposits of this material, and the Department of Mines is carrying out experiments on briquetting and burning it, with a view to its being made use of commercially on a big scale.

The development of water powers for the fixation of atmospheric nitrogen, and generally for great electrochemical industries, is also receiving attention.

The chairman of the Timiskaming and Northern Ontario Railway has recently been advocating the electrification of the whole line of some 328 miles. As this line runs through a good deal of thickly wooded country, and as steam railways in Canada annually cause a vast amount of damage to forests by fire, some people take the view that it would pay the country to have such a line electrified, merely for the saving in forest fire destruction, which might thereby be prevented.

The coal situation has been very acute this winter, and prices for bituminous coal, which is mostly used for power purposes, have been about three times as much as in pre-war days, while anthracite, which is extensively used for heating houses, &c., has been 30 per cent. or 40 per cent. higher than before the war; besides this, the railway freight facilitiies have been so completely tied up, due to one cause or another, that it has been sometimes impossible to obtain coal at any price. Toronto University had to close all its buildings for several days quite recently, as no coal was to be had, and the temperatures were zero F., or below, about that time. Preference has in all cases been given to the munitions plants, and even some of these have had a hard time to keep going, for want of coal.

TRADE STATISTICS OF CANADA.

The following figures, showing the imports into and exports from Canada of electrical and similar materials during the year ended March 31st, 1916, are taken from the recently-issued trade statistics. Figures for the year 1914-15 are given fot purposes of comparison, and notes of any increases or decreases have been added:—

IMPORTS.

	1914-15. Dols.	1915-16. Dols.		Inc. or dec. Dols.
Copper wire, plain, tinned, or plated.—				
From United Kingdom ...	2,000	—	–	2,000
,, United States ...	23,000	18,000	–	5,000
Total	25,000	18,000	–	7,000
Electric light carbons and carbon points.—				
From United Kingdom ...	1,000	—	–	1,000
,, United States ...	36,000	50,000	+	14,000
,, Germany	6,000	—	–	6,000
,, Other countries ..	1,000	2,000*	+	1,000
Total	44,000	52,000	+	8,000
*Switzerland $2,000.				
Incandescent lamp bulbs, &c.—				
From United Kingdom ...	1,000	—	–	1,000
,, Austria	8,000	—	–	8,000
,, Germany	4,000	—	–	4,000
,, United States ...	54,000	62,000	+	8,000
,, Other countries ...	3,000	1,000		2,000
Total	70,000	63,000	–	7,000
Electric apparatus not mentioned (insulators, batteries, telegraph and telephone instruments).—				
From United Kingdom ...	538,000	207,000	–	331,000
,, Austria ...	2,000	—	–	2,000
,, France	9,000	2,000	–	7,000
,, Germany	68,000	—	–	68,000
,, Sweden	41,000	3,000	–	38,000
,, Switzerland ...	2,000	—	–	2,000
,, Italy	8,000	3,000	–	5,000
,, United States ...	3,675,000	3,367,000	–	308,000
,, Other countries ...	1,000	—	–	1,000
Total	4,344,000	3,582,000	–	762,000
Manufactures of india-rubber and gutta-percha (except tires, clothing, and similar goods).—				
From United Kingdom ...	224,000	193,000	–	31,000
,, Austria	3,000	—	–	3,000
,, France .. .	3,000	2,000	–	1,000
,, Germany	24,000	—	–	24,000
,, United States ...	621,000	625,000	+	4,000
,, Other countries ...	2,000	2,000		—
Total	877,000	822,000	–	55,000
Gasoline engines.—				
From United Kingdom ...	85,000	32,000	–	53,000
,, United States ...	1,905,000	3,376,000	+	1,471,000
,, Other countries ..	44,000	1,000	–	43,000
Total	2,034,000	3,409,000	+	1,375,000
Steam engines.—				
From United Kingdom ..	67,000	12,000	–	55,000
,, United States ...	170,000	95,000	–	75,000
Total	237,000	107,000	–	130,000
Steam boilers.—				
From United Kingdom ...	35,000	33,000	–	2,000
,, United States ...	163,000	81,000	–	82,000
Total	198,000	114,000	–	84,000
Concrete mixing, cement-making, and coal-handling machines.—				
From United Kingdom ...	7,000	1,000	–	6,000
,, United States ...	241,000	91,000	–	150,000
,, Other countries ...	1,000	—	–	1,000
Total	249,000	92,000	–	157,000
Electric motors, generators, and dynamos.—				
From United Kingdom ...	175,000	35,000	–	140,000
,, France	2,000	—	–	2,000
,, Sweden	25,000	2,000	–	23,000
,, United States ...	1,146,000	863,000	–	283,000
,, Other countries ...	1,000	1,000		—
Total	1,349,000	901,000	–	448,000
All machinery not mentioned, except sewing machines, textile machinery, printing machinery, &c.—				
From United Kingdom ...	992,000	302,000	–	690,000
,, France	5,000	2,000	–	3,000
,, Germany	110,000	—	–	110,000
,, United States ...	8,091,000	12,140,000	+	4,049,000
,, Other countries ...	66,000	53,000	–	13,000
Total	9,264,000	12,497,000	+	3,233,000
Iron and steel wire, single or several, covered with cotton, linen, silk, rubber, or other material, including cables so covered.—				
From United Kingdom ...	159,000	5,000	–	154,000
,, United States ...	175,000	160,000	–	15,000
,, Other countries ..	4,000	1,000*	–	3,000
Total	338,000	166,000	–	172,000
* France.				
Lighting fixtures of metal (including electric).—				
From United Kingdom ...	11,000	10,000	–	1,000
,, Austria	1,000	—	–	1,000
,, United States ...	401,000	310,000	–	91,000
,, Other countries ...	5,000*	10,000†	+	5,000
Total	418,000	330,000	–	88,000
*Germany $6,000. †Japan $5,000.				

EXPORTS.

Mica.—				
To United Kingdom	32,000	34,000	+	2,000
,, United States	184,000	195,000	+	11,000
,, Other countries ...	2,000	—	–	2,000
Total	218,000	229,000	+	11,000
Electrical apparatus.—				
To United Kingdom ...	17,000	142,000	+	125,000
,, Newfoundland ...	16,000	17,000	+	1,000
,, United States	49,000	52,000	+	3,000
,, Other countries ...	16,000	362,000*	+	346,000
Total	98,000	573,000	+	475,000
*Spain $340,000.				
Machinery (other than linotype, washing, and sewing machines).—				
To United Kingdom ...	40,000	252,000	+	212,000
,, Newfoundland ...	20,000	23,000	+	3,000
,, New Zealand	5,000	2,000	–	3,000
,, Argentina	21,000	2,000	–	19,000
,, France	9,000	12,000	+	3,000
,, United States	188,000	371,000	+	183,000
,, Russia	11,000	34,000	+	23,000
,, Other countries	20,000*	44,000	+	24,000
Total	314,000	740,000	+	426,000
*Australia $9,000.				
Gasoline engines.—				
To United Kingdom .	7,000	10,000	+	3,000
,, Newfoundland ...	94,000	63,000	–	31,000
,, United States	13,000	11,000	–	2,000
,, Other countries ...	3,000	2,000	–	1,000
Total	117,000	86,000	–	31,000

BUSINESS NOTES.

Bankruptcy Proceedings.—Fred. W. Chamier, electrical, &c., engineer, 59 Fleet Street, E.C.—An application for an order of discharge was made to Mr. Registrar Hope at the London Bankruptcy Court on March 21st, on behalf of bankrupt, who failed in October, 1913, with ranking liabilities £511, and assets valued at £18,517, made up of book debts stated to be due from companies and persons in Russia and Germany. The Senior Official Receiver (Mr. E. Leadam Hough) reported that for six years prior to 1911, the bankrupt acted as manager at Frankfort-on-Main for an electrical apparatus manufacturing company, in which he had acquired a controlling interest, but which had, prior to the receiving order, gone into liquidation. In 1912 he came to England and began his career as a consulting engineer. With regard to the assets disclosed by the bankrupt, the chief item was a claim for £76,700 (estimated to produce £15,000) against the Deutsche Beck Bogenlampen Gesellschaft M.b.H., of Frankfort-on-Main. As offences, the Senior Official Receiver reported: (1) insufficiency of assets to equal 10s. in the £ on the amount of the liabilities, nothing having been realised from the before-mentioned claim and book debts; and (2) omission to keep proper books of account. After hearing Mr. J. D. Kingham, in support of the application, his Honour granted a discharge subject to judgment for £300, to be satisfied by a cash payment of £50 within one month, and the balance within a further twelve months. Order entered accordingly.

S. S. Coster & Co., electrical and mechanical engineers, 14, Gladstone Road, West Ham Park, Essex.—Receiving order made March 20th on a creditor's petition. First meeting, April 3rd; public examination, May 9th, both at Carey Street, W.C.

E. W. Barton Wright, electrical therapeutic expert, Acton (formerly 133, Oxford Street, W.).—Order made March 23rd, at Brentford, discharging receiving order. Composition, 5s. in the £. April 11th is the last date for sending proofs for dividend to E. W. J. Savill, Official Receiver, 14, Bedford Row, W.C.

Book Notices.—*Our Weights and Measures.* By Allan Granger. London: Eyre & Spottiswoode, Ltd. Price 6d.—In this booklet the author takes the view that to change our system of weights and measures would involve a serious disturbance of trade customs and social habits, and a large expenditure, and that the consequences of a partial change would not be so grievous. He sees no probability of the adoption of the metric system, and lays emphasis on the enduring value of measures of length, in contrast to the mutability of measures of weight and volume; and therefore, whilst he proceeds to put forward simplified and improved measures of weight and capacity, he refrains from suggesting any change in measures of extension. Proposing a new pound equal to the half-kilogram, Mr. Granger bases upon it a new cwt. (50 kg.) and a new ton (1,000 kg.), and subdivides it into 16 new ounces and 7,680 new grains. He also increases the gallon by 10 per cent., making it practically equal to 5 litres, with a new pint, &c. We will not follow the author through his arguments in favour of these changes; his proposals appear to be directed towards retaining the old names whilst practically adopting the values of the metric units of weight and capacity, and obviously the disturbance to trade which he foresees in the event of the metric units being adopted would not be avoided—except in respect of length measurements—were his suggestions carried out. To our mind, half-measures are not only useless, but mischievous; if we are to change at all, let us place ourselves *completely* in harmony with other nations by adopting the metric system outright.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXVI, No. 3. March, 1917. New York: The Institute. Price $1.

"The Calculation and Measurement of Inductance and Capacity." By W. H. Nottage. London: The Wireless Press, Ltd. Price 2s. 6d. net.

"Electrical Laboratory Course for Junior Students." By M. Maclean. London: Blackie & Son, Ltd. Price 2s. net.

"The Engineer's Year-Book for 1917." By H. R. Kempe. London: Crosby Lockwood & Co. Price 20s. net.

Patent Application.—Notice of application by the British and Overseas Engineering Syndicate, Ltd., for leave to amend Patent No. 15,599 of 1913, granted to V. Poulsen for "Improvements relating to the production of alternating electric currents," appears in our advertisement pages to-day.

Dissolutions and Liquidations.—Ashworth & Parker, Riverside Works, Bury, Lancs.—Mr. W. A. Ashworth has retired from the firm. The business will be continued under the same name by the remaining partners, Messrs. W. S. Parker & F. O. L. Chorlton.

London Electron Works, Ltd.—The controller, Mr. A. Taylor, has applied for his release.

Simplex Insulators (Bourke's Patent), Ltd.—Meeting of creditors, April 5th, at 56, Moorgate Street, E.C.

Meirowsky & Co., Old Trafford, Manchester, enemy subjects.—Creditors in this case must send particulars to the Controller, Mr. G. H. Warmington, 33, St. Swithin's Lane, E.C., by April 23rd.

Aluminium Stamping Co., Ltd., Garnham Street, Stoke Newington, N.—First meetings of creditors and contributories, April 4th, at Carey Street.

Colston Electrical Works, Ltd., Bristol.—April 11th is the last date for the receipt of proofs for dividend, by Mr. C. H. King, the liquidator, at 26, Baldwin Street, Bristol.

Catalogues and Lists.—British Thomson-Houston Co., Ltd., 77, Upper Thames Street, London, E.C.—Twenty-eight-page illustrated price list, No. 10,600 A, giving full particulars of an extensive range of "Calorite" electric heating appliances.

British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park.—Special publication, No. 7,855/1, of 36-pp., contains a reprinted illustrated article from the *Beama Journal* on "The Control of Motors for Industrial Purposes," by Frank Walker.

Messrs. Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Mailing card No. 653 describes, illustrates, and gives prices of their combination pin-plug and lampholder adaptor.

The "Z" Electric Lamp Manufacturing Co., Ltd., of Southfields, S.W., have prepared some large adhesive labels for the use of the trade generally. They are supplied free of charge, overprinted with the trader's name and address.

For Sale.—The controller, Mr. H. J. Morland (Price, Waterhouse & Co.) is inviting tenders, by April 18th, for the purchase, as a going concern, of the business of The Brimsdown Lamp Works, Brimsdown. Full particulars are given in our advertising pages to-day.

American Westinghouse Extensions.—Announcement has just been made by the Westinghouse Electric and Manufacturing Co. that the plot of ground recently purchased at Essington, near Philadelphia, will form a new industrial centre for the Westinghouse Electric interests. The site embraces about 500 acres, with a frontage of approximately one mile on the Delaware River. Additional transportation facilities will be afforded by tracks from the Pennsylvania and Philadelphia and Reading Railroads. This new centre will be devoted to the production of large apparatus, the first group of buildings being for power machinery, principally steam turbines, condensers and reduction gears. The initial development will cost in the neighbourhood of $5,000,000 or $6,000,000, occupying about one-fifth of the area of the entire plot. The group will consist of the following buildings:—Two large machine shops, an erecting shop for heavy machinery, forge shop, pattern and pattern-storage shop, and power house. Work will begin on these as soon as satisfactory building contracts can be let. The number of employés to be engaged at the new plant will number several thousand people, and, undoubtedly, will in the future equal the number employed at East Pittsburgh, representing over 20,000 people.—*Journal of Electricity, Power and Gas.*

Trade Announcements.—Mr. L. Vandervelde has purchased the business of D. Jaroslaw, together with the assets, and he will conduct the business under his own name at 19, Tower Hill, London, E.C., and will discharge liabilities. Mr. Vandervelde has been manager of the firm for more than 20 years.

Mr. T. J. Farrell, electrician, of 5, Moss Lane, Altrincham, is giving up the business.

The address of Mr. Syd. H. Symmons has been altered to 9, Mincing Lane, London, E.C., 3. Telephone No.: "Avenue 6893."

The "Z" Electric Lamp Manufacturing Co., Ltd., have opened a branch at 59, Victoria Street, Bristol (manager, Mr. W. Weeks, late of Messrs. Veritys, Bristol). Stocks of all classes of their lamps, as well as accessories and cables, will be carried.

LIGHTING AND POWER NOTES.

Aylesbury.—Plant Extension.—Mr. Turnbull, electrical engineer to the U.D.C., has interviewed the authorities with respect to the likelihood of increasing the plant at the works in order to supply current to a local controlled establishment in the town. As a result, the Council has asked the L.G.B. if it will be prepared to grant sanction to a loan for the purpose.

Begelly (Pembrokeshire).—Electrical pumping and winding plant is being installed at the New Reynalton Colliery; electrically-driven screens and washers are also to be erected.—*Western Mail.*

Bootle.—The Corporation electricity works have made a surplus of over £3,000 for the past year, and the reserve and renewal fund accounts show a credit balance of £19,765. The reserve fund has nearly reached its maximum limit.

Clayton.—A public meeting, last week, held to consider the question whether the township should seek electric supply from the Yorkshire Electric Power Co. or from the Bradford Corporation, passed a resolution instructing the Council to rescind its recent decision to support the company's Bill at present before Parliament, including Clayton in its area of supply, and to send a copy of the resolution by telegram to the B. of T. The comparative charges are as follows:—The company: Lighting, for any quantity, 5d. per unit; heating and cooking, any quantity, 1d. per unit; power, from ·9d. to 1d. per unit, all subject to a discount of 2½ per cent. Bradford: Flat rate of 4d. per unit; maximum demand rate from 1¼d. to 7d. per unit; heating, cooking, and small power installations, 1d. to 2d. per unit net; large power installations, ¾d. to 2d. per unit; discount, 2½ to 3 per cent.

Dundee.—On Tuesday morning, last week, a fault occurred in an E.H.T. trunk feeder supplying a sub-station, with the result that a portion of the tramway supply and that of some works was temporarily stopped. On the following morning the second feeder to the same sub-station failed, causing an interruption in E.H.T. supply. On localising the fault, the ground, which is chiefly composed of gas works refuse, was found to be on fire under the cables, which accounted for their giving way. The cables were laid some five or six years ago in fibre conduit surrounded by concrete, and at that time the ground gave no indication of such an occurrence being possible.

Dublin.—Docks Supply.—As a result of an inquiry into the cost of working of the Dublin Port and Docks Board electricity station, it has been found that the units generated during 1916 were 437,840; the generating cost was 2·5d. per unit; interest, sinking fund, 1·119d. per unit; salaries, ·110d. per unit, making a total of 3·76d. per unit. The average cost per unit sold by the Dublin Corporation for 1916 was 2·62d., which included all charges. It is suggested that it might be possible to enter into an arrangement by which the Corporation would take over the Port and Docks Board station and supply the Board with electricity at a lower price than it is costing at present.

Grimsby.—The T.C. has entered into an agreement with the Great Central Railway Co. for a supply of electricity for emergency purposes.

Hornsey.—According to the estimate of the Electricity Supply Committee, there will be a deficit of about £700 on the year's working. Councillor Moritz said that in increasing the charges by 25 per cent. in two steps the anticipations of increased revenue had been fulfilled, and he thought that they would be in a position to carry on until the end of the war without putting any further burden upon the consumers. The undertaking had only had the benefit of the 25 per cent. increase for one quarter, and when they had had longer experience of it he hoped the finances would show the advantage.

London.—Hackney.—The Electricity Committee reported that the official tests of the 5,000-KW. turbo-alternator and auxiliary plant installed by Messrs. Willans & Robinson, Ltd., had been carried out to the satisfaction of the borough electrical engineer.

The Committee recommends that, subject to the approval of the L.G.B., an annual subscription of £5 5s. be paid to the Engineering Standards Committee.

Lambeth.—The Council has agreed with the Deptford B.C. that representations be made to the Commissioner of Police urging that street lighting, except at dangerous corners, be dispensed with during the months of May, June, and July.

Mexboro'.—Proposed Loan.—The U.D.C. has decided to ask the Treasury for permission to raise £9,500 for an additional electricity works extension, subject to the sanction of the L.G.B.

Morecambe.—Proposed Extension.—The T.C., last week, considered a proposition by the Electricity Committee that application be made for sanction to borrow £6,000 for electricity works extensions, at the expiration of the war. The Committee reported that a generating set was required to meet the demands of the department. Councillor West questioned whether £6,000 would be enough. Alderman Birkett asked whether the whole existing plant might not be better scrapped. He pointed out that the works had never been a paying concern, and said that was largely due to the unfavourable situation. Despite the fact of Parliament having asked the Council to state what money was likely to be required after the war, the Council ultimately referred the matter to Committee.

Northwich.—Price Increase.—The Northwich Electric Supply Co. has given notice that certain of the charges at present made for current for lighting purposes will, on and after July 1st, 1917, be revised as follows:—Sliding scale: Now 6½d. and 4½d., in future 7d. and 4½d. Flat rate:—Now 5¼d., in future 6d. per unit.

Perth.—An estimate of the cost of the electrical stoking plant erected four years ago was submitted, at a meeting of the Gas Committee, by Mr. David Vass, gas manager. A total of £6,200 was spent on the installation, and since the introduction of that plant £3,347 has been paid in respect of retort-house extensions.

Rochdale.—New Plant.—Mr. W. J. H. Wood, borough electrical engineer, Bolton, the consulting engineer to the Corporation, has reported on the condition of the electricity works, and the Electricity Committee recommends the T.C. to spend a sum of about £20,000 to put the undertaking in the necessary condition of efficiency to meet the growing demands. In May last year an expenditure of £60,000 was proposed, but it was vetoed, and an outlay of only £10,000 was sanctioned. It is stated that the application will have official support. Mr. Wood reports a marked improvement in the general running of the plant, and says there is no doubt the staff have been fighting against adverse circumstances and abnormal conditions in the past. His proposals accepted by the Committee provide for one 750-KW. rotary converter, £3,000; additional water intake and screens, £1,000; and two boilers, with stokers, and coaling plant, flues and buildings, £15,000. An item of £4,500, put down as the estimated cost of linking up with a neighbouring authority for a stand-by supply, has been postponed for further inquiries.

The bursting of a tube in a boiler, last week, put one of the boilers out of action, and considerably reduced the supply of current.

Shildon (Durham).—The Council considered, last week, a letter from the Electric Supply Co., agreeing to accept £150 in full settlement of its lighting account, and stating that it might be necessary to again raise the rate for current. It was decided to settle the claim, and to ascertain the right of the company to increase its charges.

South Africa.—The Cape Town Corporation Electric Light Department has given notice that, consequent upon the delay in securing the additional generating and boiler plant due to the war conditions, no extensions to existing installations can be permitted, or new connections for purposes other than domestic lighting be made, until the installation of the additional plant.

Stockton-on-Tees.—It is expected that there will be a fairly considerable loss on the working of the Corporation's electricity undertaking during the present financial year, although not as much as the £2,000 allowed for in the estimates.

Wakefield.—Year's Working.—There has been a loss of £1,300 on the working of the electricity undertaking for the past year, due to increased cost of labour, coal, and oil.

West Ham.—The borough engineer estimates a deficiency on the electricity undertaking of £35,500 for the year ending March 31st, 1917, together with a further sum of £4,500 for allowances to men on Active Service—total, £40,000. On the tramways for the same period the deficiency is estimated at £15,500, and a further sum of £16,100, allowances to men on Active Service—total, £31,600. The Finance Committee is to be asked to provide for the foregoing deficiencies in the estimates. Upon the recommendation of the electrical engineer the revised standard charges for lighting, power and heating, operating from the March, 1917, meter reading period, are to be advanced by 10 per cent., such advance to come into force in connection with all existing standard supplies, as and from the date of the meter reading immediately following the expiration of six months' notice.

Willesden.—The Electricity Committee has decided to terminate the agreement with the North Metropolitan E.P.S. Co. on March 31st, 1918, and that negotiations be entered into with the company with a view to a new agreement. The L.G.B. has refused to sanction the raising of a loan of £10,110 for new cables.

TRAMWAY and RAILWAY NOTES.

Bingley.—Linking-up.—Deputations from the Bingley U.D.C. and the Keighley R.D.C. met the Keighley Corporation Tramways Committee last week, to exchange views on the linking-up of the Bradford tramway service which runs through Bingley to Cross Flatts, and the Keighley tramways which run to the bottom of Stockbridge, a matter of 2¼ miles. All three parties are favourable to the proposal, and the next step is to ascertain the views of the Bradford Corporation, who lease the line through Bingley. The scheme is held to be highly desirable as a means of through traffic between Bradford and Keighley, and particularly so in view of the high railway fares.

Birmingham.—The use of the Boy Scouts in assisting the women conductors on the Corporation tramcars has proved very successful, and the Tramways Committee proposes to avail itself of the services of the boys on all routes. The boys give the signal to stop and restart the cars, and generally attend to the platform duties, while the conductress collects the fares.—*Birmingham Daily Despatch.*

Blackpool.—Revenue Returns.—At March 16th, with only 16 days more to run of the present financial year, the total Corporation tramway receipts were £90,603, compared with £77,429 last year, an increase of £13,173. In 1913, the record for the department, the full year's receipts were £84,000, and this year's full takings will be over £92,000, thus beating the record by over £8,000.

The Watch Committee has decided to licence women drivers on the Corporation cars, thus reversing the decision of last year. A number of women drivers are now in training in preparation for the coming season.

Bootle.—There is a deficit of £2,822 on the Corporation tramways account for the past year, an increase of £1,811 above the estimated deficit. A sum of £4,689 in respect of rental payable by the Liverpool Corporation has not yet been paid. An increased expenditure of £4,000 is estimated this year, with an estimated loss of £6,080, of which £2,262 is for reserve. Extensive track repairs and renewals largely account for the increased expenditure.

Burnley.—Accident.—About 10.30 p.m. on March 23rd, two tramcars came into collision near Duke Bar; none of the passengers were hurt, and the damage was very slight.

Huddersfield.—The Tramways Committee has transferred £8,800, equal to a 4d. rate, to the borough fund in relief of next year's borough rate. In regard to the service of cars to Marsden, a suggestion by the tramway manager is to be carried out as an experiment. This is for the use of special cars, with an arrangement of fare-paying before entering the cars which will ensure preferential entry for long-distance passengers, for whom the cars are chiefly provided. Ordinary fares are to operate when the car moves into service.

Newcastle-on-Tyne.—Rate Relief.—At a meeting of the City Council, last week, for fixing the rates, Councillor Mayne, chairman of the Tramways Committee, offered £7,000 from his Committee's funds. The profits at the end of the year are estimated at £36,000. To bring the reserve fund up to the requisite figure of £100,000, would require £29,000. That left £7,000 at the disposal of the Council. Several members spoke against acceptance of the money, claiming instead a cheaper and more efficient service; other members were not satisfied that the money might not be required for renewals, repairs, and the like. Acceptance was agreed to by 36 votes to 8.

Preston.—An application of the permanent-way men to to be granted a war bonus has been referred to the Workmen's Wages Sub-Committee: it is recommended that the Council join with other Lancashire and Cheshire tramway authorities to consider combined action to secure greater uniformity in fixing areas and conditions of labour.

Salford.—The increased fares on the Corporation tramways come into operation on Monday. War bonuses and allowances paid to dependents of employés serving with the Forces have caused an additional annual expense of not less than £30,000, and it is hoped by the Committee that the fare and stage revision will be sufficient to meet the increased financial obligations, and also make a substantial contribution towards the relief of the rates. One of the changes is the abolition of the halfpenny fare for children, and all children occupying seats must be paid for.

Stalybridge.—The Joint Tramways Board has received complaints of the crowded state of the cars on certain routes in the early morning, and the manager has been instructed to write to the owners and managers of mills suggesting a variation in the times of commencing and ceasing work, so as to minimise the pressure at certain hours.

York.—When the City Council met last week to consider the estimates, Ald. Rhodes Brown said that instead of the estimated profits there was a loss of £700 on the tramways and £1,470 on the electricity undertaking. Ald. Meyer, chairman of the Tramways Committee, said the higher prices, including labour, represented 50 per cent. of the expenditure, while the 6s. war bonus represented 25 per cent. of the increase; also there was a decrease in efficiency. Unless transport undertakings could charge more for their services, they could not be run at a profit. The Electricity Committee had given notice of an increase of 10 per cent. in its charges, but they could not increase the tramway fares, as these were fixed by Act of Parliament.

TELEGRAPH and TELEPHONE NOTES.

Bagdad Wireless Station.—A powerful wireless installation at Bagdad, constructed by the Germans, and in direct communication with Berlin, was blown up by the enemy before the arrival of the British Forces on March 11th.

Electrophones in Hospitals.—The free electrophone service given by the Electrophone Co. to many London hospitals and homes for wounded soldiers and sailors includes an installation at the London Hospital, by which 100 patients can listen whilst lying in bed to the performances at the leading musical comedy theatres and music halls.—*Daily Telegraph.*

Imperial Communications.—The Royal Commission on the Natural Resources, Trade, and Legislation of the Empire, in its report, issued this week, includes a statement that cheaper cable rates are an urgent necessity, and that public opinion in all the Dominions is in favour of State control of the Imperial lines. The acquisition of an Atlantic cable by the State is recommended, and a considerable reduction in Press rates is proposed for the cheap and wide dissemination of Imperial news.

Post Office Telegraphs and Telephones.—The annual report of the Postmaster-General for 1915-16 was issued last week. It states that 68,000 Post Office servants are with the Colours, and 7,000 more will be set free when required. Nearly 2,000 have lost their lives, and many honours have been won by Post Office employés. The depletion of the trained staff has thrown a heavy strain on the Department, which has had to carry out new work on an extensive scale, and to deal with phenomenal development in certain branches, while it has constructed and maintains a network of telegraph and telephone lines for the use of the Home Defence Forces, and its factories are engaged on munition work and in making telegraph and telephone apparatus for use in the field.

Increased charges were brought into force in October and November, 1915, and brought in (up to March 31st, 1916) about one million sterling additional revenue: the extra charges included:—On telegrams, 3d. per message, realising £200,000; on telephones, flat-rate (unlimited) lines, £3 per line in London, £1 10s. and £2 in the Provinces; trunk calls, an increase of one-third (but a large reduction in trunk traffic occurred, and the yield was only £80,000, whereas £120,000 was expected); and call office charges were increased by 1d., realising £10,000, as against £60,000 estimated.

On March 31st, 1916, the total mileage of wires was 3,264,822 miles, an increase of 6·3 per cent.; telegraph wires amounted to 264,480 miles, telephone wires to 2,843,254 miles, and spares to 157,088 miles; aerial wires, 1,022,036 miles; underground wires, 2,229,055 miles; and submarine wires, 13,731 miles.

The storm in March, 1916, was the worst in the history of the telegraph and telephone services, especially in the Midlands, where every line crossing a belt of country in a northern and southern direction was brought down: 2,150 poles were broken, 6,050 uprooted, and 33,300 blown over. This involved the re-erection of 41,500 poles, equivalent to 14,000 miles of main pole line, and about 1,500 tons, or 17,000 miles, of copper wire had to be replaced. Owing to shortness of staff, the work of repair occupied many months.

A large number of special telegraph circuits was provided for Government departments, and Government traffic nearly doubled. The number of telegraph offices open on March 31st, 1916, was 14,156, a decrease of 66. The number of telegrams handled was 84,157,000, of which 64,685,000 were ordinary (a reduction of 7½ millions), 3,695,000 Press (a reduction of ¾ million), 7,503,000 foreign (a reduction of nearly 2 millions), and 7,128,000 Government (an increase of 3,410,000). The revenue from paid traffic was £3,111,235, an increase of £97,326; unpaid traffic was estimated at £538,461, an increase of £270,182.

The decrease in ordinary inland traffic was 10·4 per cent., and in Press telegrams 17 per cent. To compensate for the withdrawal of telegraphists for military service, additional operators have been trained, telephone transmission has been employed, and the use of high-speed apparatus has been extended. The Committee appointed in 1914 to consider the various systems of high-speed telegraphy reported in January, 1916. The use of the telephone for the dispatch and delivery of subscribers' telegrams has been fostered, and the telephone has been substituted for the sounder at a large number of small offices.

Foreign telegrams showed a substantial decrease in number, but an increase in length, with the result that the revenue was slightly higher. The use of nine codes has been authorised. An "urgent" telegraph service with Russia and Roumania was introduced in January, 1916, at triple rates.

The development of the telephone system has been seriously retarded by want of funds and labour. New orders for 43,286 telephones were accepted during the year, and over 5,000 circuits were provided for Government departments. It was impossible to keep pace with the applications for new telephones, and a war surcharge (minimum £4) was imposed to limit the demand, with the result that the applications were reduced by 50 per cent., and a sum of £45,000 was brought in during the seven months ending March 31st, 1916. Notices to remove 54,680 telephones were received, an increase of 4 per cent. Apart from 15,000 telephones provided for the temporary use of Government departments, the Post Office owned on March 31st, 1916, 786,991 telephones, of which 263,135 were in London, 406,347 in England and Wales, 91,221 in Scotland, and 26,282 in Ireland: 776 million effective calls were originated, a decrease of 4·8 per cent. The total number of inland trunk calls was 40,357,284, a decrease of 0·56 per cent. New exchanges opened numbered 71, making the total number 3,109; 751 public call offices were opened, and 991 closed. Seventy-four exchanges were connected with the trunk system, and 126 additional trunk circuits were completed; the amalgamation of trunk and local exchanges was also carried further. The London-Birmingham cable was extended to Liverpool, and a new cable between London and Brighton was brought into use. Short-distance trunk services have been accelerated. Automatic exchanges are in satisfactory operation at the General Post Office (London), Accrington, Chepstow, Darlington, Epsom, Hereford, Newport (Mon.), and Portsmouth. The war has delayed the construction of similar exchanges at Leeds, Grimsby, and Stockport. Continuous telephone service is now provided at all except 334 exchanges. Rural party lines increased by 133 to 2,398. It is estimated that 7,721,000 telegrams, 115,900 express letters, and 5,650 ordinary letters were sent by telephone. The receipts from private telephone lines were £248,078, as compared with £263,108. In London, the new Charterhouse exchange is approaching completion, but work on the Bishopsgate, Tower, and Holborn exchanges has been suspended. During the year the telegraph factory at Birmingham was completed. The total expenditure out of telephone capital on sites and buildings was £94,894.

The expenditure on the telegraph service amounted to £5,155,850, and the revenue to £4,786,391, leaving a net deficiency (adjusted) of £502,670, of which £278,616 was allotted to depreciation, and £271,691 to interest on the purchase of the telegraph system. The plant was valued at £7,692,420, less depreciation £2,429,373. The expenditure on the telephone service was £7,463,809, and the revenue £7,362,315, leaving a net deficit (adjusted) of £128,043; the plant was valued at £27,768,535.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—U.D.C. Electricity Department. Battery of accumulators, complete. See "Official Notices" March 16th.

Aylesbury.—Electricity Department. 200-KW. direct-coupled internal-combustion engine and generator, fuel plant, and accessories. See "Official Notices" to-day.

Bray.—April 3rd. U.D.C. Stores for electric light works. See "Official Notices" March 23rd.

Bury.—Overhauling and maintenance of private telephone system for Bury District Co-operative Society, Ltd. Particulars at Office, Knowsley Street.

Glasgow.—April 5th. Corporation. Turbo-alternators (15,000 KW.), transformers, and condensing plant for the new generating station at Dalmarnock. Particulars from Mr. W. W. Lackie, Chief Engineer and Manager, 75, Waterloo Street, Glasgow.

Hull.—April 12th. Electricity Committee. Cooling towers. See "Official Notices" March 23rd.

London.—St. Pancras.—April 12th. B.C. Arc lamp carbons. See "Official Notices" March 9th.

Manchester.—April 3rd. Corporation Electricity Department. Stuart Street generating station. Low-pressure water pipes, &c. Mr. F. E. Hughes, Secretary.

Warrington.—April 11th. Electricity and Tramways Committee. One 3,000-KW. turbo-alternator and surface condensing plant. See "Official Notices" March 16th.

April 11th. Electricity and Tramways Committee. Motors and transformers. See "Official Notices" March 23rd.

CLOSED.

Glasgow.—The T.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for three 1,000-KW. rotary converters, at £3,160.

Leyton.—Trolley wire: British Insulated and Helsby Cables, Ltd.

FORTHCOMING EVENTS.

Association of Mining Electrical Engineers (Lancashire, Cheshire and North Staffs. Branch). Joint meeting with the Colliery Managers' Association. Saturday, March 31st. At 3 p.m. At the Technical College, Stoke. Paper on "The Electrification of a Group of Collieries," by Mr. H. Green.

(West of Scotland Branch).—Saturday, April 7th. At 4.30 p.m. At the Royal Technical College, Glasgow. Annual meeting.

Institution of Civil Engineers of Ireland.—Monday, April 2nd. At 8 p.m. At 35, Dawson Street, Dublin. Ordinary meeting.

Society of Engineers. Monday, April 2nd. At 5.30 p.m. At Burlington House, Piccadilly, W. Paper on "Ball Bearings," by Mr. A. M. Arter.

Institution of Electrical Engineers (Western Local Section).—Monday, April 2nd. At 5 p.m. At the Merchant Venturers' Technical College, Bristol. Annual meeting.

(Scottish Local Section).—Tuesday, April 3rd. At 7.30 p.m. At 207, Bath Street, Glasgow. Paper on "Some Points in connection with Engineering Specifications," by Mr. J. Shepherd. Annual meeting.

(Manchester Local Section).—Tuesday, April 3rd. At 7 p.m. At the Engineers' Club. Lecture by Prof. E. Wilson. Annual meeting.

Institution of Civil Engineers.—Tuesday, April 3rd. At 5.30 p.m. At Great George Street, S.W. Discussion on the paper on "The New Electric Power House at Birchills, Walsall."

Roentgen Society. Tuesday, April 3rd. At 8.15 p.m. At the Cancer Hospital, Fulham Road. Discussion on "The Future of the British X Ray Industry," to be opened by Mr. G. Pearce. Sir Jas. Mackenzie Davidson, Prof. Porter, F.R.S., Major Wilson, and others have consented to take part in the discussion.

Liverpool Engineering Society.—Wednesday, April 4th. At 7.30 p.m. At the Royal Institution, Colquitt Street. Paper on "The Michell Thrust Block and Journal Bearing" by Mr. J. H. Gibson.

NOTES.

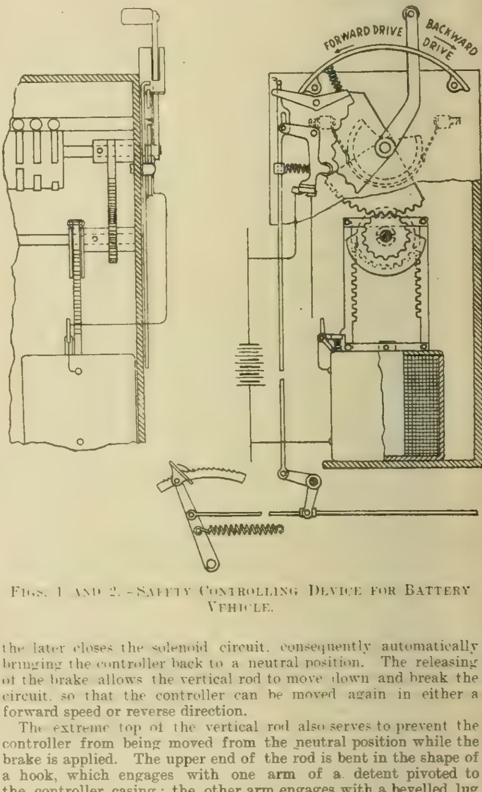
Easter Holidays.—The next issue of the Electrical Review will be published on Wednesday morning, April 4th, instead of April 6th (Good Friday). All matter should be in our hands at the earliest possible moment, as announced last week.

A Safety Controlling Device for Electric Motor Vehicles.—With the object of eliminating the waste of current of the battery of an electric motor vehicle, and the danger of injury to the electric motor, if the controller is not returned to the neutral position when the brakes are applied, an ingenious device has recently been patented by an American electrical engineer, Mr. S. S. Amdursky, of Rochester, N.Y., by means of which such neutralising of the controller is automatically effected whenever the brakes are applied. This is accomplished by the electromagnetic mechanism depicted in the accompanying diagrams, fig. 1 being a front elevation of the controller and the added mechanism, and fig. 2 a side elevation.

The electro-magnetic mechanism consists of a solenoid magnet mounted in the base of the controller case. Two vertical racks, connected at top and bottom by horizontal cross-pieces, are attached to the top of the movable core of the magnet. A mutilated gear, carried on a small horizontal countershaft below the top of the rack framework, when it is in its highest position, meshes with the teeth of the racks. Another pinion mounted on the same shaft as the mutilated gear meshes with a segmental gear pivoted to the controller shaft, as indicated in fig. 2.

In the drawings, the controller handle is shown in its neutral position. When it is moved either backwards or forwards to give a forward or reverse speed, the segmental gear on its shaft revolves the pinion on the countershaft, causing the teeth of the mutilated gear to engage one of the racks, and raise the rack framework and the core out of the solenoid. If the latter is energised after the parts have been moved in this manner, it tends to pull the core and the rack framework down again, thus racking the several gears back to their normal position, and causing the controller to return to neutral.

In order that the energising current for the solenoid shall only be employed when the brake is applied, it is controlled through an electrical circuit, which is opened and closed by the brake manipulation. In fig. 2 the solenoid is shown connected with the leads of an electric battery—which may be the battery that supplies the current for driving the vehicle; the free ends of the wires of the circuit are attached to two contact pieces which can make contact with the lower end of a bell-crank lever shown near the top left corner of fig. 2. The other end of the bell-crank has a pin which works in a slot in the top of a vertical rod, the latter in turn being connected with the brake rod by another bell-crank. As the brake rod moves by pressure on the brake pedal, the vertical rod is pushed up, turning the bell-crank and its contact point so that the later closes the solenoid circuit, consequently automatically bringing the controller back to a neutral position. The releasing of the brake allows the vertical rod to move down and break the circuit, so that the controller can be moved again in either a forward speed or reverse direction.



Figs. 1 and 2.—Safety Controlling Device for Battery Vehicle.

The extreme top of the vertical rod also serves to prevent the controller from being moved from the neutral position while the brake is applied. The upper end of the rod is bent in the shape of a hook, which engages with one arm of a detent pivoted to the controller casing; the other arm engages with a bevelled lug mounted on the controller shaft. So long as the brake is not in use, the detent is held on the bevelled lug by a small coil spring. When the brake is applied, the upward movement of the hook at the end of the vertical rod permits the detent to be released, and when the controller returns to its neutral position, the detent rides over the bevelled lug and snaps in position behind it, as shown in fig. 2. The detent is so arranged, however, that it does not prevent movement of the controller to the reverse position, since there may be occasions when it would be desirable to move the controller to such a position while the brake is applied, in order that the electric motor may be used to supplement the action of the brakes in reducing the speed of the vehicle or in bringing it to a standstill.

Provincial Electric Supply Committee.—We are pleased to learn that the Committee formed to represent the provincial electric supply authorities of England holding Provisional Orders has already met with a full measure of success. The appeal met with the complete concurrence of the companies interested, and in a short space of time, some 60 provincial companies, representing between 200 and 300 Provisional Orders, have become members. The bulk of the capital invested in provincial companies is therefore represented, amounting to some seven or eight million pounds, and all the important companies in the United Kingdom are included. In view of the many serious problems with which the electric supply industry may have to deal in the immediate future, the Committee should form an excellent means of focusing the active lines of policy of the various companies on any such questions.

Volunteer Notes.—FIRST LONDON ENGINEER VOLUNTEERS.—Headquarters: Balderton Street, Oxford Street, W.

Special Notice.—The Commandant congratulates the Corps on having received official recognition. He trusts that *every member* will make it convenient to attend at headquarters on Monday, April 2nd, between 6 and 7, for medical examination and attestation.

Monday, April 2nd.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30—8. Medical examination, 6.

Wednesday, April 4th.—Instructional Class, 6 15. Platoon Drill, Platoon No. 1.

Thursday, April 5th, to Monday, April 9th.—Headquarters closed during Easter. Training at Esher. Special orders will be sent to each Volunteer who has sent in his name.—(By order), MACLEOD YEARSLEY, *Captain and Adjutant.*

Board of Trade Departmental Committee on Electricity Supply.—As foreshadowed in our last issue, the President of the Board of Trade has appointed a Committee to consider and report what steps should be taken, whether by legislation or otherwise, to ensure that there shall be an adequate and economical supply of electric power for all classes of consumers in the United Kingdom, particularly industries which depend upon a cheap supply of power for their development. The Committee is constituted as follows:—The Right Hon. F. Huth-Jackson (chairman), Mr. H. Booth, Mr. James Devonshire, Mr. J. Falconer, M.P., Mr. G. H. Hume, Mr. John Kemp, Mr. H. H. Law, Mr. C. H. Merz, Sir Charles Parsons, K.C.B., Sir John Snell, Alderman C. F. Spencer, and Mr. A. J. Walter, K.C. The secretary of the Committee is Mr. M. J. Collins, to whom all communications on the work of the Committee should be addressed at the Board of Trade, 7, Whitehall Gardens, London, S.W.1.

Dublin Electricity Undertaking.—The death of Mr. Elward, Chief Inspector of Consumers' Supplies under the Dublin Corporation's electricity department, has led to a proposal that his successor might discharge dual duties, and so effect a considerable saving without interfering with the efficiency of the undertaking. Other re-arrangements are stated to be in contemplation.

Strike of Electricians at Athens.—Dispatches from Reuter's agent at Athens state that, as the result of a strike of electricians belonging to the Pan-Hellenic Union, the supply of electric current was stopped in Athens and the Piræus, "and presumably in other towns," with a consequent cessation of communications, lighting, and industry. An agreement with the Government was subsequently arrived at, an assurance being given that the men's claims would be considered.

Inquiries.—Makers of a battery automatic cut-in and cut-out switch, *without mercury contacts*, are asked for; also makers of electrical apparatus for relieving deafness. A correspondent seeks information on the manufacture of permanent magnets and the composition of the steels employed.

The Metric System.—On Tuesday evening, at a meeting of the INSTITUTION OF CIVIL ENGINEERS, MR. HARRY ALLCOCK delivered a lecture on the Metric System, before a large audience. Mr. Allcock dealt first with decimal coinage, advocating the adoption of the florin as the base, divided into 100 parts; he showed that for many years the business community had pressed for this reform, and that the change would not involve any serious disturbance to trade. He then stated the case for the adoption of metric weights and measures, pointing out that the system was already largely used in Russia, and that if we led the way, the United States would be sure to follow our example. Manufacturers need not fear any interference with their internal organisation, as the Bill to be introduced into Parliament would make the use of the system obligatory only in commercial transactions, and any alterations in designs, tools, &c., would be entirely optional.

A lengthy discussion followed, in which Sir Guilford Molesworth, Mr. Oliver Berry, Sir Archibald Denny, Mr. J. A. F. Aspinall, Mr. E. C. Barton, Prof. Lupton, Dr. Hunter, and others took part. A report will appear in our next issue.

The sense of the meeting was unmistakably favourable to the reforms advocated by Mr. Allcock, the opposition being of a trivial description.

No B.A. Meeting.—It is announced that the meeting of the British Association arranged for Bournemouth this year will not be held, owing to the restriction of railway travelling and other circumstances.

Re Meirowsky & Co.—Messrs. George Schultz & Co., Ltd., of 10, Arthur Street, London, E.C., wish it to be understood that the winding-up of the affairs of Meirowsky & Co., A.-G., in this country, by the Board of Trade, as publicly announced, does not in any way affect the position or business of their company, in which only British subjects have been and are interested.

Electrochemistry in France.—The *Journal du Four Electrique et de Electrolyse* remarks on the part played by French electrochemical works during the war. Acetylene is employed as an illuminant in sapping and mining operations, for motor-car lights, and more especially in autogenous soldering. Calcium cyanamide helps in the production of nitrate of ammonia, the base of several explosives. Ferro-chrome, ferro-silicon, ferro-tungsten, and ferro-molybdenum are utilised in the making of steels, Aluminium is employed in steel works, the making of fuses, aeroplanes, automobiles, and in certain explosives such as ammonal, which is a mixture of nitrate of ammonia and powdered aluminium. The manufacture of chlorine gas has had a sudden development: the same is true of the manufacture of various other products such as sodium, magnesium, the ferro-cyanides, electric steels, ferromanganese, and nitric acid. These manufactures have borrowed next to nothing from abroad: the electrical energy was supplied by French hydro-electric works, and the greater part of the raw materials was procured from the soil of France or from that of her colonies.

Institution and Lecture Notes.—Royal Institution.—The list of lecture arrangements after Easter has been issued. It includes the following:—

May 11th, 5.30 o'clock. Prof. J. Joly, F.R.S., "Radioactive Haloes."
,, 18th, ,, Prof. F. Soddy, F.R.S., "The Complexity of the Chemical Elements."
June 8th, ,, Prof. Sir J. J. Thomson, P.R.S., "Industrial Applications of Electrons."
April 19th and 26th, at 3 o'clock. Prof. H. S. Foxwell on "Industrial Finance After the War." (1) The Industrial Struggle of To-day; (2) Its Financial Needs: How They Can Best be Met.
May 5th, 12th, 19th, 26th, June 2nd and 9th } at 3 o'clock. Prof. Sir J. J. Thomson, P.R.S., on "The Electrical Properties of Gases."

Electrical Association of Australia.—At the third annual meeting of the Victorian Section, the report of the Council stated that a Sub-Committee dealing with the licensing of wiremen had drafted suggestions, and was arranging for a conference with the Contractors' Association and the Wiremen's Union. The Council expressed the hope that a final scheme would be agreed to, enabling the proposals to be placed before Parliament. The proposed incorporation of the Association and the question of the use of letters after members' names had been referred to the Federal Council for its consideration. The total number of members of all classes was 227. The balance-sheet showed receipts £324, and the credit balance was £176.

The following officers were elected for the year:—President, Wilfred N. Kernot; past presidents, W. H. Alabaster, F. A. McCarty; vice-presidents, A. McKinstry, A. N. Macnicol; hon. sec., A. Maling; hon. treasurer, G. B. Lincolne; members of Council, F. W. Clements, H. R. Harper, A. L. Hargrave, A. W. Kendall, J. C. Lane, W. J. Newbigin, H. Clement Newton; hon. auditors, A. C. E. Pulling, C. C. Gray.—*Commonwealth Engineer.*

Appointments Vacant.—Electrical staff, for the aerodromes and hutted camps in the Southern Command. For particulars see our advertisement pages to-day.

Restrictions on the Importation of Certain Goods.—A Supplement to the *Board of Trade Journal* of March 29th contains a complete list of articles the importation of which into the United Kingdom has been prohibited, except under licence, by Royal Proclamations of February 15th, 1916, and subsequent dates, and in respect of which applications for licences should be addressed to the Controller, Department of Import Restrictions, 22, Carlisle Place, Westminster, London, S.W. 1.

I.E.E. Wiring Rules.—In view of the great demand by the Government for small stranded wires, the Council has decided to permit for the period of the war the use of single-strand conductors up to No. 14 S.W.G. (see Rule 42).

NEW COMPANIES REGISTERED.

Isenthal & Co., Ltd. (146,791).—Private company. Registered March 22nd. Capital, £5,000 in £1 shares. To take over the business of an electrical engineer and manufacturer of and dealer in electrical and mechanical apparatus carried on by A. W. Isenthal, at Denzil Works, Willesden, N.W., as Isenthal & Co. The subscribers (each with one share) are: A. W. Isenthal, 95, The Avenue, Ealing, W., electrical engineer; Mrs. C. R. Isenthal, 95, The Avenue, Ealing, W.; J. F. Fogarty, Dene Cottage, Ruislip, Middlesex, electrical engineer. The first directors are A. W. Isenthal (permanent), C. R. Isenthal, and J. F. Fogarty.

The Double Arc Electric Welders, Ltd. (9,782).—Private company. Registered in Edinburgh on March 16th, with a capital of £1,000 in 980 ord. shares of £1 each and 800 def. shares of 6d. each. Objects: As indicated by the title. The first directors are M. M. Irvine and R. Irvine. Solicitor: J. L. Mackie, Glasgow.

Nottingham Electro-Plating Co., Ltd. (146,641).—Private company. Registered March 19th, with a capital of £7,000 in £1 shares (3,000 pref.), to take over the business carried on by E. Wilford at 98, Sherwood Street North, 85a, Mansfield Road, and 32, Upper Parliament Street, Nottingham, as the Nottingham Electro-Plating Co. The subscribers (each with one share) are: E. Wilford, 98, Sherwood Street North, Nottingham, electroplater; Miss N. Wilford, 10, Mapperley Road, Nottingham. First sole director: E. Wilford. Solicitors: Warren & Allen, Nottingham.

Hackbridge Cable Co., Ltd. (146,684).—Private company. Registered March 20th, with a capital of £25,000 in £1 shares, to take over the business of cable makers, electrical engineers, &c., carried on at Hackbridge, Surrey, as the Hackbridge Manufacturing Co. The subscribers (each with one share) are: H. Allwood, Dignall, Stanley Park Road, Wallington, Surrey, engineering works manager; A. Kent, Clovelly, Marshalls Road, Sutton, Surrey, cable engineer and manager. Permanent governing director: C. W. Bloomfield. Registered office: London Road, Hackbridge, Surrey.

Burdette & Co., Ltd. (146,713).—Private company. Registered March 21st, with a capital of £6,000 in £1 shares (1,000 pref.), to take over the business of electrical and general engineers carried on by P. Speedy, G. L. Eynon, and J. Meech, at 7, Pocock Street, S.E., as Burdette & Co. The subscribers (each with one ord. share) are: Mrs. G. L. Meech, 29, Pearfield Road, Forest Hill, S.E.; J. Meech, 29, Pearfield Road, Forest Hill, S.E., electrical engineer; P. Speedy, 6, Duke Street, Adelphi, W.C., electrical engineer; G. L. Eynon, 6, Duke Street, Adelphi, W.C., engineer. The first directors are J. Meech, P. Speedy, and G. L. Eynon.

Mavall & Co., Ltd. (146,594).—Private company. Registered March 17th, with a capital of £1,500 in £1 shares, to take over as from February 28th the business of factors of and dealers in electrical and mechanical equipment, &c., carried on by J. W. Mavall at 147, Corporation Street, Birmingham, as Mavall & Co. The subscribers (each with one share) are: J. W. Mayall, 147, Corporation Street, Birmingham, electrical engineer; F. A. Couzens, The Uplands, West Heath, Northfield, [illegible] engineer. The first directors are J. W. Mavall (permanent director and chairman) and F. A. Couzens. Registered office: 147, Corporation Street, Birmingham.

Hudson's Electrical Engineering Co., Ltd. (146,731).—Private company. Registered March 21st, with a capital of £1,000 in £1 shares, to take over the business of an electrical engineer carried on at 3, Prudential Buildings, Park Row, Leeds, and elsewhere, as Hudson & Co. The subscribers (each with one share) are: J. A. Atkinson, 17, Clarendon Place, College Road, Leeds, solicitor; G. Harper, [illegible], Thorne, near Wakefield, contracto. The first directors are to be appointed by the subscribers. Solicitor: A. Willey, Calverley Chambers, Victoria Square, Leeds.

Nicholson & Crockett, Ltd. (146,743).—Private company. Registered March 21st, with a capital of £500 in £1 shares, to take over the business of manufacturers of and dealers in electrical and scientific instruments carried on by J. N. Clark and L. C. A. Aylett, as Nicholson & Crockett, at 116, Dallow Road, Luton. The subscribers (each with one share) are, J. N. Clark, 6, Vernon Road, Luton, scientific instrument maker; L. C. A. Aylett, 116, Dallow Road, Luton, scientific instrument maker; J. P. G. Aylett, 10, Rosebery Road, Chelmsford, works accountant. The first directors are: J. N. Clark (chairman), L. C. A. Aylett, and J. P. G. Aylett. Registered office: 116, Dallow Road, Luton.

Power Engineering Co., Ltd. (146,808).—Private company. Registered March 22nd, with a capital of £1,000 in £1 shares, to take over the business of engineers, welding experts, manufacturers of wood and rubber blocks, cranes, hoists, tubes, &c., carried on at Manchester by E. R. Voigt & Partners as the Power Engineering Co. The subscribers (each with one share) are: Emil R. Voigt, 69, Hodge Lane, Prestwich, Manchester, engineer; Ernest M. Ginders, 75, Albert Avenue, Prestwich, Manchester, engineer. The first directors are: Emil R. Voigt (permanent director and secretary), Ernest M. Ginders, and Mrs. M. Voigt. Registered office: Thomas Street, Cheetham Hill, Manchester.

J. & W. B. Smith, Ltd. (146,734).—Private company. This company was registered on March 21st, with a capital of £70,000 in £1 shares, to acquire from the executors of the late J. G. Watkinson the business of manufacturers of and dealers in gas, electrical, glass, sanitary, and ironmongery goods, &c., formerly carried on by the said J. G. Watkinson, as successor to J. & W. B. Smith. The subscribers (each with one share) are: F. Watkinson, 196, Camden Road, N.W., works manager; A. H. Mebes, 29, Ailsa Road, Westcliff-on-Sea, accountant; J. Macnum, 1a, Dowgate Hill, E.C., solicitor. The executors of the late J. G. Watkinson may, while holding £500 shares, appoint a governing or ordinary director. Helene Watkinson (one of such executors) may, while they and she hold £1,000 shares, appoint a governing director by will or codicil. Secretary: E. A. Lewin. Registered office: 19, Farringdon Road, E.C.

Eclipse Carborundum & Electrite Co., Ltd. (146,853).—Private company. Registered March 24th, with a capital of £10,000 in £1 shares, to take over the business carried on at Apollo Works, South Road, New Southgate, N., as the United Carborundum & Electrite Works, Ltd., and the Vinot Co., Ltd. Agreements (a) with T. E. Fowler, and (b) between the above companies, C. Eves, and T. E. Fowler, for the purchase of assets by the said T. E. Fowler. The subscribers (each with one share) are: T. E. Fowler, 10, Beaconsfield Road, New Southgate, N., manufacturer; P. H. Goodwin, 85, St. Kilda Road, West Ealing, W., clerk. The first directors are: J. E. Beale, S. R. Beale, and T. E. Fowler. Directors must be British, and the usual provisions for ensuring the general British nature of the company are inserted in the Memorandum of Association. Solicitors: Kenneth Brown & Co., Lennox House, Norfolk Street, W.C.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The Shipley District Council has advanced the salary of Mr. W. REDMAN, its electrical engineer, from £250 to £300 per annum.

The Aylesbury U.D.C. has increased the salary of Mr. TURNBULL, its electrical engineer, to £225 per annum, rising to a maximum of £250 by £12 10s. a year.

The Hackney B.C. Establishment and General Purposes Committee recommends the following special grants to the undermentioned officers of the electricity department for additional work performed by them in consequence of the war:—Mr. J. R. J. Bowden, deputy electrical engineer, £50; Mr. T. Dalby, works and sub-station superintendent, £30; Mr. P. M. Shears, canvasser, £20; Mr. E. Wilkinson, generating engineer, £10; Mr. A. G. Helling, assistant distributing engineer, £10; Mr. J. F. Heathman, chief clerk, £10. The Committee recommends that the designation of Mr. P. M. Shears be sales engineer.

The Bexhill-on-Sea T.C. has appointed Mr. R. C. CARTER, who has been on the staff for two years, as assistant electrical engineer.

General.—Coun. RICHARD HOLT, J.P., the Deputy-Mayor, is the new chairman of the Blackpool Tramways and Electricity Committee. He was vice-chairman to the late Ald. James Brodie.

Mr. B. J. GRIGSBY, A.M.I.E.E., who has been identified with the Benjamin Electric, Ltd., London, since 1908, and was managing director until December last, when he resigned in order to return to the States and take up interests acquired there, has been elected a director, and is now vice-president and general manager, of the Anderson Electric Speciality Co., 562-564, West Van Buren Street, Chicago, U.S.A.

Acting-Corporal N. K. THOMSON, from the R.H. and R.F.A., has been granted a commission in the Tyne Electrical Engineers, R.E. Second-Lieutenant Thomson was gazetted on March 7th.

Roll of Honour.—A member of the staff of the Hendon Electric Supply Co., Ltd., P.O. J. F. SLADE (R.N.A.S. Armoured Cars, Russian Squadron), has been awarded the St. George's Medal. Writing to Mr. Drummond, the company's manager, he says: "We have had some exciting times in Roumania, and as a result of the work of the car crews several of our fellows have received decorations."

P.O. ALLAN WATSON, of the same company, is now attached to the same branch of the service, which is doing excellent work in Russia.

Private HARRY HEPWORTH, A.S.C., one of the oldest employés in the Blackpool Corporation tramways department, has succumbed to pneumonia in a military hospital at Liverpool. He was about 41 years of age.

Lance-Corporal E. NETTLETON, West Yorkshire Regiment, killed in action, was employed as electrician by Mr. Harry Moss, electrical engineer and contractor, Bradford.

Obituary.—MR. J. S. RAWORTH.—We record with deep feelings of regret the death of Mr. John Smith Raworth, M.Inst.C.E., M.I.E.E., which occurred on March 24th at Streatham Hill, London, at the age of 71 years. Mr. Raworth was so well known and so popular a member of the electrical fraternity that his death will evoke from many quarters expressions of sorrow at the loss which the profession and industry have sustained. We were privileged to count him as one of our oldest electrical friends, and desire to express on our own behalf, as well as on behalf of our readers who knew him and appreciated his many excellent qualities, our deep sympathy with his widow and children. The late Mr. Raworth had been associated with the electric lighting and traction industries from their inception, indeed, it is close upon 40 years since he put up the first installation of electric lighting in Manchester. He served his time in the shops and drawing offices of Messrs. R. & W. Hawthorn, of Newcastle-upon-Tyne, and of Messrs. Wren & Hopkinson, of Manchester, and he approached the designing of electrical machinery from the point of view of the mechanical engineer rather than from that of the electrician. He represented Messrs. Siemens Bros. in Lancashire in the late seventies and early eighties of last century, devoting his attention largely to ship lighting, first with arc and then with incandescent lamps. It was practically a case in which bricks had to be made without straw, for though there were dynamos, lamps, and wires available, such things as high-speed engines, fittings, switches, and switchboards, castings, &c., were non-existent, and types and patterns of his own had to be evolved which have persisted, forming the basis for several distinct trades. His early work in connection with ship installations on such ships as the *City of Berlin*, *City of Rome*, *Arizona*, *Alaska*, *Orient*, &c., left its influence on ship lighting plant for many years. While at Manchester, however, he was engaged with many other matters as well. For instance, he ran, for a time, a small central station distributing current in its immediate neighbourhood, and most of the important Manchester installations erected in those days were done under his superintendence. He put up the first electrically-worked hoist. In 1886 he came to London, and settled here, taking a leading position with the Brush Electrical Engineering Co., then operating under another title. The company was in a state of transition, and difficulties were numerous, but the world was beginning to awaken to electrical possibilities, and a good deal of useful work was done by him as responsible head of the engineering department. When the Electric Lighting Act of 1888 was passed he was entrusted with many enterprises, including the supply stations of the City of London Electric Lighting Co., the Leicester Corporation, and others at Huddersfield, Hanley, Bournemouth, and elsewhere. Many of these were wholly, or in great part, designed by him. When he joined the Brush Co. a 50-H.P. dynamo was about the limit of their capacity, but when he left ten years later—in 1896—a 1,000-H.P. combined plant, including both engine and generator, was an ordinary order for them. The works at Loughborough were designed, erected, and equipped under his superintendence, and that being completed, he exchanged the position of chief engineer for a seat on the board, and commenced practice in Westminster as a consultant. He was already technical adviser to several important electrical undertakings, among which was the British Electric Traction Co. Although lighting and power schemes claimed much of his attention, his interest became more and more diverted towards tramways, until he eventually undertook the technical directorship of the B.E.T. Co. He was actively associated with this company for many years. Mr. Raworth has been a prolific inventor, yet one seldom hears his name associated with any particular machine; even the high-speed engine that he invented was always known as the "Universal." His regenerative patents, however, were put forward under his name. Mr. Raworth was a man of strong personality. Subtlety of mind, ready wit, and oratorical powers of a high order, were among his characteristics, and he could always be reckoned upon to add life and interest to an Institution discussion in the years when he could be more frequent at meetings at Westminster than had latterly been the case. He had been in failing health for two or three years, and his presence had been sadly missed.

MR. W. H. HALLIWELL.—The *African World* records the death of Mr. W. H. Halliwell, acting general manager to the Lobito, Benguella, and Catumbella Electric Light & Power Co., Ltd., who died of fever in hospital at Lobito on 17th inst. Mr. Halliwell only returned from England to Lobito a few months ago to take over the general managership, pending the absence of the general manager, Mr. E. H. Rhodes, on leave. He formerly acted as Mr. Rhodes's chief assistant at Benguella.

MR. ARTHUR BROOKER.—We regret to learn that Mr. Arthur Brooker, general manager of the Automatic Telephone Manufacturing Co., Ltd., of Liverpool, and known to electrical students everywhere as joint author of the widely-used "Slingo and Brooker" electrical compendium, passed away on March 23rd at his residence, Ashfield, Huyton. We hope to refer to the deceased gentleman's career in our next issue.

We extend our sincere sympathy to Mr. C. P. ELIESON on the death of his wife, which occurred on March 27th at 24, St. Mary Abbotts Terrace, Kensington, S.W.

CITY NOTES.

Newcastle - upon - Tyne Electric Supply Co., Ltd.

The annual meeting was held on March 23rd. Mr. J. H. Armstrong, who presided, referred to the satisfactory results of the year's work (see Elec. Rev., March 16th). The engine-house at Carville, when completed, would accommodate five large turbines. 270 of their employés had gone to the Front, and six had lost their lives. The vacancies on the staff had been partly filled by female labour and partly by discharged service men. As it was necessary that some of these men should have certain technical knowledge, they had established regular classes for them, at which lectures were delivered and demonstrations given by their own officials, and this systematic training had proved most beneficial, and the men and women were giving every satisfaction. The directors had been in negotiation with the Cleveland & Durham Electric Power, Ltd., with the object of this company acquiring an interest in the latter concern, and the directors had decided to remommend that this company should make an offer to acquire, by exchange of shares, the shares and funded preference income stock of the Cleveland Co., and he now submitted the scheme for their approval. The Cleveland Co. had 300 miles of cables laid in its area; it had 81,469 H.P. connected; and its gross profit for 1916 was £37,129. The Teesside area had excellent facilities both by rail and by sea, and had during recent years shown the promise of becoming a very large industrial centre. Quite recently it had given indications of more active development; in fact, there was every reason to believe that before many years the Tees district would hold a leading position in the industrial enterprise of the North-East Coast. The Cleveland Co. in its early days suffered through not having behind it a nucleus of profit to go on with, such as the Newcastle Co. had in its lighting load, and the result was that the Cleveland Co. had nothing to assist it while its money was being expended on capital account from which no adequate return was immediately received. The Cleveland Co. benefited very much from the fact that the majority of the waste-heat stations were in its immediate area; in fact, it obtained the bulk of its power from the waste-heat stations, and it was only when the war broke out and the effect of the war on collieries was such that their output was reduced, that there was a considerable falling off temporarily in waste heat from these stations. The result was that the Cleveland Co. had to fall back on the coal-fired generating station at Grangetown, from which it had to get a very considerable portion of its supply, and that had a very adverse effect on the profits of the past two years for the station named, partly owing to its situation, and partly owing to the class of plant installed, which was far from an economical one. The Cleveland Co. had received many applications for additional current from its present customers, as well as applications from new manufacturing undertakings, but from the difficulties with which it was faced they did not see their way to take advantage of the position. This position became acute before the end of last year; hence the negotiations. The chairman indicated the advantages that would accrue to the Newcastle Co. from the acquisition of the Durham Co., and said that certain developments could be carried out much more cheaply by them than by the Durham Co., adding that if the stations were run conjointly considerable economies would be possible. The directors of the Newcastle Co., realising the many advantages that would so accrue, and also the advantage it would be to the interests of power supply, which had become a matter of great national importance, urged that advantage should be taken of the opportunity now offered of closer union with the Cleveland Co., and strongly recommended the approval of the scheme. They reserved the right to withdraw the offer in the event of their not receiving a satisfactory response from the Cleveland shareholders. He formally moved that the proposals for acquiring the shares of the Cleveland and Durham Electric Power, Ltd., be approved. The report was adopted without opposition.

Cleveland and Durham Electric Power, Ltd.

Mr. James Falconer, M.P., presided at the annual meeting, held on March 23rd. He said that the gross profit showed an increase of £5,972. It was proposed to pay a dividend of 2 per cent. on the preference shares. There had been some inquiries as to why they were not paying more than that amount, but it was all that they could safely and prudently give. With reference to the proposed arrangement with the Newcastle Electric Supply Co., as the result of a conference between the Cleveland board and that of the Newcastle Co. terms were adjusted, subject to the approval of the Newcastle Co., which approval had been given that day. In due course an offer would be made, accordingly, to each shareholder in the Cleveland Co. for his shares on the terms adjusted subject to the condition that if there was not an adequate response to the offer the Newcastle Co. was at liberty to withdraw it. The directors unanimously recommended the acceptance of the offer. With regard to the progress and position of the company, the best method of showing it was to look at the revenue and costs of the company and of its associated companies for a period of years. He gave the figures for the last four years. In 1913 the revenue was £131,933, in 1914 £141,482, in 1915 £151,512, and in 1916 it was £192,434. The costs were: 1913, £91,640; 1914, £95,911; 1915, £110,368; and 1916, £141,312. These figures showed that a large and progressive business had been established, the revenue having increased by £60,501. It was not possible to arrive at an actual comparison between the results of the war period and those of the pre-war period, as the conditions were different in many material respects, but, making every allowance, it was evident that the development had been substantial and well maintained. The increase in the cost in the period named was from £91,000 to £141,000, an increase of £49,672. It would thus be seen that the increased cost had absorbed about four-fifths of the revenue in the last four years. By far the greater part of that increase was due to the increased cost of generating current by coal-fired stations in consequence of the war. This was shown by the following figures: The cost was in 1913, £845; in 1914, £5,338; in 1915, £16,400; and in 1916, £37,753. That increased cost seriously affected the company, and the company, notwithstanding the development of its business, had been unable since the war began to pay the full dividend on the preference shares. The amount paid on those shares had been from 5 per cent. down to 2 per cent. In these conditions of increased volume of business and increased cost, they found themselves met with a demand for additional supply from existing consumers and urgent requests to meet proposed developments in the district. The iron and steel industries had been called to make large extensions of the plant, and all the indications were that there would be other large extensions, as well as the establishment of new works in the area. Thus there would be a large demand for current, much larger than in the past. They had made some steps to meet that additional supply, but the directors had been met with the necessity of extending the plant at a time when the raising of additional capital was a matter of exceptional difficulty. The directors had found it impossible to arrange during the war either for the construction of additional waste heat plant or to obtain the capital necessary for an adequate extension of coal-fired generating plant. It was under those circumstances the conference he had mentioned took place with the board of the Newcastle Co., and the arrangements set out in the circular they had received were framed. With regard to the terms proposed, he might at once say they were not based on the present market price, because the shares were not quoted, nor yet were they based on the war results, but they endeavoured to arrive at terms fair to both parties having regard to the value of the area and the future prospects of business. Their only regret was that while they had advanced so far they had not secured the full measure of success for the shareholders which, under ordinary circumstances, they would have obtained. The report was adopted. It was intimated that the shareholders would have until April 14th to consider the Newcastle Co.'s offer, and if a sufficient number of shareholders accepted, the matter would be carried through.

Minehead Electric Supply Co., Ltd.

Lighting restrictions reduced the sale of energy for lighting purposes. Fuel and all materials increased in cost, and the repairs were unusually heavy owing to the fracturing of the crankshaft of the six-cylinder high-speed vertical suction gas engine. Units sold for heating and cooking show an increase. Total units sold 236,533, against 230,416 for 1915. Units generated 341,158, used on works 24,532, not accounted for, 80,093. Average price obtained fell from 3.40d. to 3.36d. per unit. Profit, after paying debenture interest, £1,166, plus £142 brought forward. After paying the preference dividend and 8 per cent., less income-tax, on the ordinary shares, paying bonuses to certain officials £60, and putting £850 to depreciation and reserve, £56 is to be carried forward.

Brompton and Kensington Electricity Supply Co., Ltd.

The credit balance for 1916 is £23,938, plus £6,012 brought forward, and £177 interest. Seven per cent. is paid on the preference shares, £5,104 is put to depreciation, £2,000 to reserve, 9 per cent. is paid on the ordinary shares, directors' additional remuneration takes £501, and there is to be carried forward £5,075. The number of consumers increased from 6,512 to 6,678, and the 8-c.p. lamps connected by 18,452, making 315,711. The gross receipts decreased from £56,469 to £55,878; expenditure increased from £30,074 to £31,940, net receipts fell from £26,395 to £23,938; the average price obtained per unit increased from 1d. to 1.1d.

Automatic Telephone Manufacturing Co., Ltd.

Mr. J. Taylor presided at the annual meeting, on Monday, at Liverpool. He said that during 1916 the factory had been working day and night. They had, however, been able to complete the automatic installations at Portsmouth, Paisley, and Blackburn, and all the exchanges erected to date were giving satisfaction, which was a good augury for the future. They had every reason to believe that the Leeds exchange—the largest automatic exchange to be erected in this country—would be finished for service as soon as the Post Office was ready for it. Owing to shortage of staff and other calls, this department had not been able to proceed with its part of the scheme as rapidly as expected. The cash balance, £139,877, was a large increase on 1915, but Excess Profits Duty had to be met out of it. The balance was due to increased trading and a quicker turnover. The works were fully employed, and were likely to continue so until the end of the war. When the end came they were bound to suffer, inasmuch as it would be quite impossible to cease the manufactures on which they were now engaged and revert to their ordinary business without considerable loss of time and money. They were doing their best to anticipate the situation. It was mentioned later that Mr. E. A. Mellinger, a director, was at present in America keeping alive in various parts of the world the trade that under war conditions they could not possibly do in this country.

British Insulated & Helsby Cables, Ltd. Dr. E. K. Muspratt presided at the annual meeting, held at Liverpool on Monday. He said that the good results shown in the report were the outcome of a much larger volume of business in money value during the year than ever before. The changes made to enable them to manufacture articles comparatively new to them, and the curtailment of their ordinary trade, and the stoppage of almost the whole of the export business, all pointed to the fact that after the war new and strenuous efforts would have to be made to enable them to resume the important position that they formerly held. Doubtless some of the new departments would help to attain that end. The difficulty of retaining sufficient skilled men had been very great, and the employment of women workers had been greatly increased wherever it had been possible. The amount of the capital expenditure was reduced from £651,175 to £645,522, as they had provided by depreciation £5,653 more than was expended upon capital account; this it was considered wise to do, having in view that after the war some rearrangement of the plant and machinery would be necessary. The employment of so much unskilled female labour had unduly increased the wear and tear of the plant, and had necessitated the provision of a larger sum for depreciation. The conditions under which business had been conducted during the year had been very onerous. The committees set up for the control of raw material, the provision of men, the adjustment of taxation, the welfare of workpeople, &c., were very numerous, and the difficulty in satisfying the desires of conflicting bodies, such as those who wanted the company's men and those who were desperately in need of the product of their labour, had made the position very difficult, and, in addition to having had to carry on with a reduced staff, there was now required by these numerous committees an unprecedented number of returns, and forms to be filled in with minute particulars, involving a very great deal of labour. In ordinary times it would have been possible to create a new department for the conduct of this additional business, but the work had to be done by a staff which had lost many of its well trained workers, and he told the shareholders this that they might understand that the thanks he offered on their behalf to the staff and workpeople were sincere. He would like specially to name the general manager, Mr. Dane Sinclair, Mr. Nisbett, Mr. Brotherton, and the secretary, Mr. Kerfoot, upon whom so much of this additional strain had fallen.

The adoption of the report was seconded by Sir Harmood Banner, M.P., who referred to the necessity for them all to consider well, and to use their best efforts to arrange proper terms for, trade after the war. Their company was well equipped and quite ready to meet any competitors, but they were bound to see that conditions of trade after the war were somewhat better than before in the protection of British interests, and to see that Great Britain got her fair proportion of the work to be done in the world. They must not let anyone intervene. All the labour they had prepared and which after the war would be available for commercial work ought to be protected in such a way that they would have in the future as much success as in the past.

Folkestone Electricity Supply Co., Ltd. The profits for 1916 are very satisfactory. 4,480 lamps (8-c.p.) added bring up the total equivalent to 157,931. Owing to high price of fuel and freightage difficulties, charges to consumers have had to be raised. The company holds £15,000 War Loan. Including receipts from hired installations, the profit on the revenue accounts of the three undertakings is £16,373, plus £2,602 brought forward. After paying debenture interest and preference dividend, and Excess Profits Duty for two years ended December, 1915, £5,000 is put to depreciation fund and £1,000 to reserve, and 7 per cent. dividend is paid on the ordinary shares, carrying forward £2,594. Units generated, 2,310,837; units sold, 1,618,000.

W. T. Henley's Telegraph Works Co., Ltd. The profit for 1916 was £198,270, less £87,154 for directors' and auditors' fees, debenture interest, income-tax, and amount written off for depreciation on buildings and machinery, plus £55,264 brought forward, making £166,380. There is transferred to reserve in respect of depreciation of trustee securities £7,650, to reserve account £20,000, to special war allowance reserve account £5,000, preference dividend £9,000; 15 per cent. dividend on the ordinary shares, plus a bonus of 10s. per share, both less income-tax, £50,000, to staff pension and benefit fund £5,000, carrying forward £69,730. A reserve has been made in the accounts in respect of liabilities for special taxation under the Munitions of War and Finance Acts. As the greater part of the factory machinery has been running day and night on special work, a considerable sum has again been provided for depreciation on this account, and provision has been made also for machinery which has been bought specially for war purposes, and which will be useless after the war. The number of women employed exceeds 800. The company's holding in the new War Loan is £200,000, of which £105,000 is new money. Of the staff and workmen 796 have joined the Forces, and there have been 133 casualties, including 30 deaths. Six have been awarded honours. Annual meeting: To-day (Friday).

Madras Electric Tramways (1904), Ltd. The gross profit for 1916 is £24,408. After debiting interest and London office expenses, providing for debenture stock sinking fund, putting £6,000 to depreciation and renewal account, the balance is £13,124, plus £4,273 brought forward. Six per cent. is paid on the preference shares, and 8 per cent. on the ordinary; £2,500 is put to general reserve; £4,315 is carried forward subject to Excess Profits Duty (if any). The traffic receipts increased by 8.3 per cent. The cost per mile run rose 6.1 per cent., due chiefly to increased prices of materials and higher rates of freight The undertaking has been maintained out of revenue, and special improvements and renewals have been debited to the depreciation and renewal account.

South London Electric Supply Corporation, Ltd. At the annual meeting, on 20th inst., the Chairman said that the results for 1916 were satisfactory, the total receipts having increased by £4,255, or 7.8 per cent., and £28,388 had been carried to net revenue, against £27,229 in 1915. Coal had cost £3,226 more, and rates £546, but there had been economies, so that the total expenditure increased by £3,096, or 11 per cent. They hoped that by continued economy it would not be necessary to further increase the charges for supply. The lighting restrictions and the Summer-Time Act had adversely affected the output, but the increase for power was over half a million units. Power consumers took about 75 per cent. of the whole output. Sixty employés had already joined the Forces, and their places had been temporarily filled by women, by invalided men, or by unfit men. The chairman referred to the successful efforts of Mr. Renwick, one of the directors, to get the statutory percentage for Excess Profits Duty increased to 7½ per cent. The connections to the mains were better than in 1915, and the units sold increased by 380,217. The profit earned by the sales department increased from £1,733 to £2,034, the turnover for the year exceeding £10,000, and the central showrooms at Brixton had largely contributed to this record result. So far as the current year was concerned, there was a record increase in output; up to the end of February it was 1,879,000 units, or nearly 20 per cent. above 1916. This augured well, but the prospects for the year were difficult to forecast owing to the abnormal conditions. The growth in demand had engaged their serious attention for some time past. As they must look ahead, and machinery and plant were almost unobtainable, they opened negotiations last summer for a supply of energy in bulk from the County of London Co. They had concluded a seven years' agreement on favourable terms for a bulk supply, which was to be available in the late autumn of 1917. It would be initially for 1,500 kw., capable of extension as and when necessary, and would link up the two large generating stations of the County Co. with the South London power house. This would promote economy, safety against breakdown, and would be an asset when negotiating with important factories, &c., for supply. It would also relieve them of considerable capital expenditure, and their invested funds would still be available for feeder and mains extensions. The requisite works for connecting the two companies' systems would be actively taken in hand as soon as official consents had been obtained.

Chelsea Electricity Supply Co., Ltd.—The profit for 1916 was £31,679, plus £3,293 brought forward and £1,810 for interest. Interest on debenture stock absorbs £6,678, there is put to reserve for renewals, depreciation, and contingencies £15,300, to debenture stock premium redemption fund £816, written off cost of extinction of founders' shares £1,089, 6 per cent. is paid on the preference shares, and 3 per cent. on the ordinary shares, carrying forward £3,684. There were added during the year 7,688 new lamps making the total 327,528; units sold, 4,271,470, an increase of 78,578. During the year £53,212 debenture stock acquired by the company was cancelled, reducing the debenture debt to £121,788. Annual meeting: April 4th.

Direct Spanish Telegraph Co., Ltd.—After payment of income-tax and Excess Profits Duty for 1914 and 1915, the balance for 1916 is £57,708. After paying the 10 per cent. pref. dividend, and 5 per cent. dividend and a bonus of 2 per cent., tax free, on the ordinary shares, £5,000 is put to reserve, £3,134 is put to investment fluctuations, and £42,049 is carried forward, subject to the special taxation of profits at present unascertained. The cables and land lines continued in good working order throughout the year.

Launceston & District Electric Supply Co., Ltd.—During 1916 the revenue receipts amounted to £1,102, against £1,233, and the working expenses to £635, against £516. Lighting restrictions and the Summer-Time Act caused the decrease in sales of current. The increased expenditure was largely due to battery cleaning and renewal, and the purchase of two new motors for blowing the fires. The number of consumers increased from 205 to 227, and the lamps connected from 5,631 to 6,413. Gross profit, £466. After deducting bank charges and preference dividend, the net profit is £340, plus £88 brought forward. A dividend of 2½ per cent. is being paid on the ordinary, and after putting £125 to depreciation and smaller sums to reserve and other matters, £37 is to be carried forward.

Coalite, Ltd.—The report states that during the year under review further patents for improvements in the Coalite process have been taken out in all the principal foreign countries, thus maintaining the strength of the company's position in respect of the patent rights. The company's arrangements with the Barnsley Smokeless Fuel Co., Ltd., and British Coalite Co., Ltd., secure for it the benefit of all new inventions, plans, and drawings for the erection of low temperature plants. The plant of the Barnsley Smokeless Fuel Co. is now on the eve of completion as to the first series of retorts, serious delays having occurred in the delivery of materials owing to the existing stringent war conditions.—*Financier*.

British L. M. Ericsson Manufacturing Co., Ltd.—Mr. W. M. Crowe, presiding at the annual meeting, said that the work they were engaged upon was important, and satisfactory to the Government. The profit on trading was a record, and a large increase over 1915. The stocks in hand and work in progress was £146,647, and had practically all been put in hand against firm orders. They had paid off the £24,000 bank loan, and had £36,843 cash in hand and at the bank. In addition to £13,963 put to depreciation, they had put to reserve for extra depreciation £5,000 to allow for the extra wear and tear to which the plant and machinery had been subjected through working day and night.

Scarborough Electric Supply Co., Ltd.—At the annual meeting, on March 22nd, Mr. G. Alderson Smith said that they had made £67 more from electrical energy, and £63 from meter rents and lamp sales. Coals cost £375 more, and insurances £104 more, but on rents and taxes they had saved £158, and on the distribution of electricity £116. The net result was an increased cost of £314. Mr. A. A. C. Swinton said they were going through very trying times, but he hoped that after the war they would have a good time again. When he arrived at Scarborough on the previous night he drove through the darkened streets, and it was obvious that no electricity company could be prospering.

Bromley (Kent) Electric Light & Power Co., Ltd.—During 1916 the connections increased from 4,254 to 4,499 KW., but lighting restrictions and the effect of the Daylight Saving Bill caused a large reduction in revenue. The profit was £8,573, against £10,529 in 1915, and after paying debenture interest and trustees' fees, amounting to £2,956, and adding £1,672 brought forward, 5 per cent. for the year is paid on the ordinary shares, £2,000 placed to general reserve account, and £1,538 is carried forward. £5,000 has been invested in the new War Loan.

Browett, Lindley & Co., Ltd.—The directors cannot at present submit the audited accounts for 1916 as many questions remain to be decided with regard to Excess Profits Duty and special allowances. The interim preference dividend to June 30th, 1916, has already been paid, and the results of trading justify the payment of the full dividend on the preference shares for the year, also a further 3 per cent. on preference shares on account of arrears (both less tax), also a dividend of 4 per cent. per annum on the ordinary shares (less tax).

Vickers, Ltd.—The directors announce that, under the existing circumstances, it has not yet been possible to present the accounts for the year ended December 31st, 1915, and that the accounts for the year ended December 31st, 1916, must be necessarily also delayed. In the meantime it has been arranged that the final dividend for the year 1916 of 2½ per cent. on the preferred 5 per cent. stock and on the 5 per cent. preference shares will be paid. *Financial Times*.

British Electric Transformer Co., Ltd.—After paying all manufacturing costs and expenses of administration, the net profit for 1916 is £21,277, plus £4,604 brought forward. There is put to reserve £7,500, and to depreciation reserve £1,500; 6 per cent. on the preference shares absorbs £3,719; 7½ per cent. on the ordinary shares £6,412; directors' extra remuneration £969; carry forward £5,781.

Salisbury Electric Light & Supply Co., Ltd.—The profit for 1916, including £2,289 brought forward, was £7,171. After paying £868 interest on debentures, writing £87 off investments, and paying 6 per cent. for the year on the ordinary shares, £2,000 is carried to depreciation and reserve, carrying forward £2,118.

Robey & Co., Ltd.—Dividend on preferred and ordinary shares for 1916, 6 per cent., less tax, carrying forward £15,121.

P. R. Jackson & Co., Ltd.—Dividend, 10 per cent. for 1916, against 7½ per cent. for 1915.

American Telephone & Telegraph Co.—The report for 1916 states that the net earnings were $41,743,376, which is $3,625,889 more than for 1915. Interest charges were $6,730,098, and dividends at the regular rate of 8 per cent. per annum absorbed $31,122,187. There was carried to reserve $2,500,000, and to surplus $1,391,090.

Cornwall Electric Power Co. According to the "Financial Times," the company is paying a dividend of 3 per cent. for 1916, against nothing for 1915. £4,000 is put to reserve for plant renewals, and £913 carried forward.

Huelva Gas & Electricity Co., Ltd.—During the first week in January the Association of Mineral Exporters in Huelva took over the working of the electricity department on terms which are still under negotiation.

O. C. Hawkes, Ltd.—Dividend on ordinary shares for 1916, 2½ per cent., free of tax; £500 written off investments, and £6,366 carried forward.

Shawinigan Water & Power Co., Ltd.—Dividend, 1¾ per cent. for the quarter ending March 31st on the common shares.

STOCKS AND SHARES.

Tuesday Evening.

The opening of the market in the War Loan stock has been the principal financial feature of the week. It was expected to have a depressing effect upon other securities; and prices, as we noted last week, were disposed to give way in advance. The establishment of the market, however, has been accomplished with the minimum of disturbance to other securities; and the tone of the gilt-edged markets is distinctly good. This is apparent more particularly amongst Home Railway prior charge issues. Business generally is on the quiet side; and although there remains noticeable animation amongst rubber shares, in other parts of the House, apart from that which deals with the War Loan, no great activity prevails.

It will be noticed that we have added this week the dividends for 1916 in three of the groups of stocks and shares given in our price lists. The tale of 1916 has been practically completed by the issue of the report of the Brompton and Kensington Co. The dividend, as already recorded, will be 9 per cent., as against the 10 per cent. declared since 1903. The net revenue account, however, is only £2,460 down on the year; and the board could have maintained the 10 per cent. dividend had they not pursued the excellent policy of strengthening the reserve fund. The price of the shares remains at 6½.

Westminsters are ⅛ lower, following upon their rise of 3/16 last week. Preference shares are wanted. City preference and County preference are both ⅛ up. South Metropolitan second preference have risen to 17s. 6d., which is ex the dividend recently paid. The first preference continue to change hands about 21s. 3d.; and the ordinary shares, also ex dividend, are a trifle under £1.

The Telegraph market is better, outstanding features of strength being Eastern ordinary, with a rise of 2, and Great Northern Telegraphs, also £2 to the good. There is little stock to be obtained in this market, and buyers are being continually disappointed in not being able to get what they want. Globe preference continue on offer, and have receded another ⅛. West India and Panama shares gave way to the same extent. Marconis are 1/16 easier, due, as before, to the absence of interest for the time being.

For big figures, the report of the American Telephone and Telegraph Co. is interesting. The total operating revenues of the Bell System were 264½ million dollars, an increase of 30 million dollars. The net non-operating revenues came to a little over seven million dollars; and the total gross income, using the term officially provided by the Inter-State Commerce Commission, was 79 million dollars. The company pays 8 per cent. per annum, and carries forward a surplus of four million dollars.

Home Railway stocks tend to the lower side, but there are no changes worth mentioning in the Underground group, with the exception of falls of 6s. in the "A" shares of the Underground Electric Co., and of a point in the income bonds. Apparently the threatened strike in the North has aroused anew the apprehension of labour troubles elsewhere, and the drastic cutting-down of the omnibus services in London led to a little selling on the part of those who regarded this as a hint that earnings would be further reduced.

In the foreign group, Brazilian Traction common have regained a point at 46½. There has been further inquiry for the British Columbia Electric Railway stocks, and this week the preferred put on 3 points to 46. Most things connected with Canada continue firm, but the stocks and shares of the various industrial corporations are wavering with New York prices, according to the mood of the moment on the point of the United States' going to war.

Sir Arthur Stanley's suggestion that considerable economies of working could be effected by closer association of electrical supply and power undertakings is likely to receive more consideration now than the same proposals used to do in bygone days, when there was no war to point the advisability of such a course. The idea carries one back to many a period of controversy in the electrical world, and revives memories of the almost insuperable difficulties that have been found in the past in the way of harmonising different interests. In spite of all obstacles, a good deal has been done in London in the direction of the linking-up of conflicting interests; but far greater economy is possible, and the present offers a fine opportunity on a national scale—an opportunity which it may be hoped will fructify into substantial reform, so far as waste of energy, time, and enterprise is concerned.

Mexican issues are quiet, with scarcely a ripple to disturb the market; and other foreign securities maintain their prices.

British Aluminium ordinary had their rise in advance of the declaration of the dividend of 6 per cent. on the ordinary shares, making 10 per cent. for the year, which goes against 7 per cent. in 1915. The interim dividend had prepared shareholders for a pleasant final distribution, and the company has more than doubled its profits over the period. Industrial shares in this department are decidedly strong. British Insulated ordinary have risen 10s., and so have Henleys; while Callenders are ⅜ up, and several rises have occurred amongst the preference shares. Telegraph Constructions, however, continue dull.

The most active part of the industrial market is that concerned with rubber shares, where the buying went on merrily until the middle of this week, when something of a check took place and prices gave way a little here and there after their rapid advance. Some of the copper shares are better, too, thanks to a favourable dividend announcement by the Rio Tinto Co.; and tin still soaring has quickened the inquiry for shares in companies dealing with the metal.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1915.	Dividend 1916.	Price Mar. 27, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	9	6⅝	—	£7 11 0
Charing Cross Ordinary	5	—	3⅜	—	7 8 2
do. do. do. 4½ Pref.	4½	—	8 3/16	—	7 1 2
Chelsea	4	8	3	—	6 18 4
City of London	8	—	11½	—	6 19 2
do. do. 6 per cent. Pref.	6	—	10	+ ⅛	6 0 0
County of London	7	—	10¼	—	6 16 7
do. 6 per cent. Pref.	6	—	9¾	+ ⅛	6 3 1
Kensington Ordinary	7	10	5¼	—	5 11 7
London Electric	3	—	1	—	Nil
do. do. 6 per cent. Pref.	6	4	3¾	—	5 6 8
Metropolitan	8	8	2 5/16	—	6 9 9
do. 4½ per cent. Pref.	4½	—	8⅛	—	7 4 0
St. James' and Pall Mall	8	—	6⅛	—	6 10 8
South London	5	—	2⅞	—	6 19 0
South Metropolitan Pref.	7	—	21/-	—	6 13 4
Westminster Ordinary	7	7	5⅝	— ⅛	6 5 9
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	94	—	6 7 8
do. Def.	£3.6	£1.1½	22	—	6 16 4
Chile Telephone	8	—	6 15/16	—	5 15 3
Cuba Sub. Ord.	5	—	7¼	—	6 13 4
Eastern Extension	8	—	13¾	—	*5 16 4
Eastern Tel. Ord.	8	—	139	+2	*5 15 1
Globe Tel. and T. Ord.	7	—	11½	—	*5 19 2
do. Pref.	6	—	9	— ⅛	6 6 4
Great Northern Tel.	22	—	36½	+2	6 1 0
Indo-European	13	—	46½	—	6 19 9
Marconi	10	—	2 13/16	— 1/16	8 11 0
New York Tel. 4½	4½	—	101	—	4 9 0
Oriental Telephone Ord.	10	—	2⅛	—	4 14 1
United R. Plate Tel.	8	—	6 9/16	—	*6 2 0
West India and Pan.	6d.	—	⅞	— ⅛	2 12 6
Western Telegraph	8	—	13¾	—	*5 16 4
Home Rails.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	24	—	4 3 4
do. District	Nil	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A"	Nil	—	5/-	—6d.	Nil
do. do. Income	6	5	79	—1	*6 6 7
Foreign Trams, &c.	Dividend 1914.	Dividend 1915.			
Adelaide Sup. 6 per cent. Pref.	6	6	4 15/16	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	2⅞	—	9 11 4
do. 2nd Pref.	5½	5½	2⅝	—	—
do. 5 Deb.	5	5	64½	—	7 15 0
Brazil Tractions	4	4	46½	+1	8 12 0
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	62	—	8 1 4
do. do. Preferred	—	Nil	46	+3	Nil
do. do. Deferred	—	Nil	39½	—	Nil
do. do. Deb.	4½	4½	62½	—	6 16 0
Mexico Trams 5 per cent. Bonds	—	Nil	27½	—	Nil
do. 6 per cent. Bonds	—	Nil	25	—	Nil
Mexican Light Common	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	14½	—	Nil
do. 1st Bonds	Nil	Nil	27½	—	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	2 25/32	+ 1/32	5 8 0
British Aluminium Ord.	5	7	28/6	+6d.	7 0 4
British Insulated Ord.	15	17½	13¼	+ ½	6 12 1
British Westinghouse Pref.	7½	7½	2½	—	6 0 0
Callenders	15	20	12⅝	+ ⅜	7 18 5
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	8 5/16	—	6 13 0
Edison & Swan, £3 paid	Nil	—	[illegible]	—	Nil
do. do. fully paid	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	66	—	6 1 3
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9½	—	6 6 4
do. Ord.	10	10	14½	—	6 18 0
Henley	20	25	15½	+ ½	8 1 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11⅞	+ ⅛	*8 8 4
Telegraph Con.	20	20	36	—	*6 13 4

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, March 28th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	,,	£54	..
a Bisulphide of Carbon	,,	£23	..
a Borax	,,	£38	..
a Copper Sulphate	,,	£63	..
a Potash, Chlorate	per lb.	2/6	..
a ,, Perchlorate	,,	2/-	..
a Shellac	per cwt.	135/-	10/- inc.
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers	,,	£32	..
a ,, Lump	,,	£28	..
a Soda, Chlorate	per lb.	1/-	..
a ,, Crystals	per ton	120/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c ,, Tubes (solid drawn)	,,	..	..
c ,, Wire, basis	,,	..	..
c Copper Tubes (solid drawn)	,,	1/8¾ to 1/9¼	..
g ,, Bars (best selected)	per ton	£174	..
g ,, Sheet	,,	£174	..
g ,, Rod	,,	£174	..
d ,, (Electrolytic) Bars	,,	£151	..
d ,, ,, Sheets	,,	£176	..
d ,, ,, Wire Rods	,,	£159	..
d ,, ,, H.C. Wire	per lb.	1/7	..
f Ebonite Rod	,,	3/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/3	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	3/2½	½d. inc.
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
l ,, Wire, galv. No. 8, P.O. qual.	,,	£38	..
g Lead, English Pig	,,	..	..
g Mercury	per bot.	Nom.	..
e Mica (in original cases) small	per lb.	6d. to 3/-	..
e ,, ,, ,, medium	,,	3/6 to 6/-	..
e ,, ,, ,, large	,,	7/3 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/10	..
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	,,	..	..
n ,, Wire, Nos. 1 to 16	per lb.	8/3	3d. inc.

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Electricity in Dock Construction.—In discussing the recent paper by Mr. P. D. Donald before the Institution of Engineers and Shipbuilders in Scotland, Mr. D. Quinton Bell said with regard to the adoption of steam or electric power in the construction, electricity would have made an undoubted saving in cost and in wear and tear of the plant, but for pile extracting and grab digging, of which a considerable amount was done, electric power was not so suitable as steam, and it was therefore decided to retain steam all through.

Mr. William Burnside, in touching on the same subject, said Mr. Bell started off with a kind of apologia for the use of steam plant, principally cranes, on the work. Steam was preferred to electricity because it was considered more flexible in the operations of grabbing and pile-drawing. He could not commend Mr. Bell's preference. Of course, a steam engine on a crane was a fine buffer, and the control was very sensitive and quick in the hands of a competent crane-driver. Think, on the other hand, of a coal bill reaching to £100 a month on a job of this size, to say nothing of fire hazard. Electric cranes were used every day for grabbing in ore and coal. The use of special gear was probably necessary, such as the Hollick Crypto arrangement and others. As to pile-drawing, he knew of a contract on which over 3,000 piles had been drawn in the last 18 months by means of an extractor used with ordinary electric derrick-cranes. Five-minute rated resistances were used on the steps of the controller, and between these and the brake the piles were drawn without untoward accident, although, perhaps, the practice of using cranes not specially fitted for the purpose was not to be recommended.

Accrington Football.—A football match took place on March 24th, at Moorhead, between the outside staff and the gas plant staff of the Accrington Corporation electricity works. A well-contested game resulted in a win for the outside staff by four goals to one. Following the match, a social evening was spent at the Station Hotel, about 30 attending. Mr. Clegg, the borough electrical engineer, presided.

Electroculture at Minehead.—We understand from Mr. Swarbrick, manager of the Minehead Electric Supply Co., that it is intended to carry out an electrocultural experiment in his district on 1½ acres of potatoes. The company has already made a little progress in power and light supply amongst local farmers.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING FEBRUARY, 1917.

The February returns of electrical exports and imports show a considerable falling off in values as compared with the previous month, in which, however, business in both sections reached exceptional limits.

The exports of electrical material for the month, valued at £394,062, compared with a total of £556,984 in January, when some £120,000 worth of telegraphic material was included, but not so badly with the December total of £406,000.

The imports reached a total value of £183,192, as compared with £309,381 in January, and with £246,252 in December last, the falling off being, therefore, even more marked in this case.

The re-exports at £31,445 did not fare so badly, the January total being only about £2,000 higher, and both figures being appreciably above the average which obtained during the previous year.

The exports show a general falling off in values, the only exceptions being electric lamp and carbon exports; the value of the telegraphic exports were, however, only fractionally lower than in January. In the case of the imports every section shows a decreased value, and the machinery and lamp imports more particularly so.

One of the most marked features of the war period has been the increasing importance of the European market for our electrical trade. During February, Russia and the Scandinavian countries (principally Norway) formed our best market, while French purchases come next in amount, India being third. American electrical imports into this country were on a greatly reduced scale, as also Dutch and Japanese imports, but French values slightly increased, as compared with the previous month.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	7.290	28,005	659	734	13,062	2.037	22.807	716	247	3,216	12.975	3.975	95.723
Netherlands, Java and Dutch Indies ...	576	3,303	45	45	...	46	186	...	471	...	1,288	742	6.702
Belgian Congo...	...	...	...	...	...	...	...	...	...	...	...	...	...
France	5.472	1,115	1.329	410	1.073	119	14.509	3,225	1,058	37	14.072	211	42.630
Portugal	18	1,067	62	772	...	153	1,008	...	104	2	602	172	3.960
Spain, Canary Isles and Spanish N. Africa...	1.143	662	86	20	...	1,520	2.354	448	...	30	...	46	6,309
Switzerland, Italy and Austria-Hungary ...	644	80	57	52	...	324	8.630	154	578	62	763	1,763	13.107
Greece, Roumania, Turkey and Bulgaria ...	...	...	...	...	...	...	...	...	...	...	...	...	...
Channel Isles, Gibraltar, Malta and Cyprus...	116	79	41	74	...	...	...	...	16	...	101	950	1.377
U.S.A., Philippines and Cuba	1,218	...	133	...	180	20	239	...	...	61	4	12	1.867
Canada and Newfoundland	3	...	52	876	130	124	2,472	25	97	...	...	8.278	12.057
British West Indies and British Guiana ...	7	20	51	40	12	79	66	...	...	60	39	127	501
Mexico and Central America	...	...	28	...	...	...	257	...	...	...	...	...	285
Peru and Uruguay	67	...	4	547	...	...	...	114	11	11	8	9.618	10.380
Chile	138	88	18	176	...	323	180	...	118	3	6	29	1.079
Brazil	77	729	300	391	...	...	645	324	22	...	...	32	2.520
Argentina	1.472	4,507	401	656	...	548	2.179	4.009	2.756	...	1.443	580	18.551
Colombia, Venezuela, Ecuador and Bolivia...	29	125	18	...	...	22	547	29	36	13	38	170	1.027
Egypt, Tunis and Morocco	95	170	167	119	...	64	699	177	...	14	10	...	1.515
British West Africa	69	59	...	95	...	226	140	...	53	8	255	660	1.565
Rhodesia, O.R.C. and Transvaal	682	2,687	1.591	870	...	159	4.774	1,910	1.417	232	185	...	14.507
Cape of Good Hope	714	782	850	733	...	84	6.566	324	213	...	157	266	10.689
Natal	116	1.555	360	285	...	82	1.198	22	703	46	3	65	4.435
Zanzibar, Brit. E. Africa, Mauritius & Aden	66	811	448	372	...	40	55	19	64	...	...	108	1,983
Azores, Madeira and Portuguese Africa ...	...	199	73	23	...	...	1.046	...	...	...	...	77	1,418
French W. Indian Colonies and Madagascar	...	...	...	...	...	...	...	...	...	...	...	12,016	12,016
Persia	35	15	16	...	...	...	...	...	...	...	...	...	66
China and Siam	307	163	750	586	...	2,897	1.808	1.033	135	...	131	972	8,782
Japan and Korea	325	...	9	54	...	569	4.904	...	1,200	1.771	...	...	8,832
India	4,060	10.717	2.624	1.433	42	377	8.177	1.857	3,210	98	844	944	34.383
Ceylon	93	147	180	110	...	79	224	...	80	...	104	154	1.171
Straits Settlements, Fed. Malay States and Sarawak	4	176	597	88	...	51	727	1.427	69	148	114	361	3,762
Hong Kong	91	135	478	...	...	...	378	193	...	...	...	...	1.275
West Australia	330	1.365	1.256	102	...	222	2.920	80	30	...	77	...	6.382
South Australia	174	97	425	43	...	38	1,533	318	1,061	4	78	...	3.771
Victoria	2,364	6,077	71	617	...	441	3.202	...	639	...	1,332	...	14.743
New South Wales	783	5,036	1.789	838	...	1.046	9,854	1,623	679	55	83	23	21.809
Queensland	32	...	25	93	...	15	440	...	...	...	30	5	640
Tasmania	273	...	12	...	...	...	25	...	...	...	...	...	310
New Zealand and Fiji Islands	167	1,308	1,665	1.840	...	700	4.793	1.002	1.548	133	1.003	7.774	21,933
Total. £	29,050	71.279	16.670	13,094	14.499	12,405	109,542	19,029	16.615	6.004	35.745	50.130	394.062
Registered Imports into the United Kingdom of Electrical Goods from all Countries.													
Russia, Norway, Sweden and Denmark ...	...	...	...	49	1,118	...	115	...	...	...	335		1.617
Netherlands	44	...	...	8.499	4.379	...	5	...	2.059	...	5		14.991
France	596	...	...	189	129	590	674	...	7.410	3.639	25		13.252
Switzerland	829	...	...	...	...	165	1,635	6	920	...	53		3.608
Italy	9	3.417	...	...	...	...	...	...	...	...	...		3.426
Japan	204	4.664	4.309	432	...	...	...	...	1,973	...	...		11,582
United States	8,695	1,257	1,302	1,902	303	1.417	7.304	66,062	20,489	7.903	16,586		133.226
Total. £	10,377	9,338	5.611	11,071	5,929	2,172	9.733	66.068	32.851	11.542	17.004		181.696

Additional imports.—Spain, carbons, £1,440; Canada, lamp parts, £43; electrical machinery, £57; batteries, £56.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above ...	4,439	12,138	...	4,870	...	1.852	2.637	...	17	701	3.791		31.445

TOTAL EXPORTS: £394.062 TOTAL RE-EXPORTS: £31.445 TOTAL IMPORTS: £183,192

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned which is not necessarily the country of origin.

THE INTERNATIONAL ALUMINIUM INDUSTRY.

A Prospective Productive Capacity of 150,000 Tons per Annum.

The war has brought to a temporary end, and, in all probability, to a final conclusion for many years, if not for ever, certain international agreements for the regulation of the export trade in different parts of the world. Among these may be mentioned the International Rail Syndicate, the International Dynamite Syndicate, and the International Aluminium Syndicate, whilst the syndicate relations which have existed for years past between certain large groups of electrical manufacturers in the United States and Germany have continued down to the present time.

After the dissolution of the International Aluminium Syndicate in 1908, the sale price of the metal declined from 1s. 7½d to about 1s. 3½d. per kilogramme, or to a figure which almost represented the cost of production, whilst a further fall took place in the following year. The price, however, was advanced to 1s. 9½d. on the formation of a new syndicate at the beginning of 1913, but no joint sales organisation was associated with the new combination, which naturally expired with the outbreak of hostilities. According to a series of articles published in recent issues of the Paris *Information*, the world's production of aluminium amounted to 46,700 tons in 1911, 50,000 tons in 1912, and 68,200 tons in 1913. The statistics collected by the Chambre Syndicale des Forces Hydrauliques of France show that the United States produced 22,500 tons in 1913, Canada 5,900 tons, Great Britain 7,500 tons, Norway 1,500 tons, Italy 800 tons, France 18,000 tons, and Germany, Austria, and Switzerland 12,000 tons. Before the war the industry was concentrated in comparatively few hands, two groups controlling the production in the United States and Canada, and three in Europe, if the Italian company is left out of consideration for the moment; and as the requirements of the New World absorbed practically the whole of the output there, no interchange of trade took place with Europe. Apart from the imports into British India, the production of the European works was almost entirely consumed in Europe, and, although both France and Great Britain were importing countries to some extent, the Central European countries consumed nearly twice the amount of their own production. In Germany alone the imports of aluminium rose from 8,600 tons in 1909 to 15,500 tons in 1912, of which 6,000 tons were furnished by Switzerland, 4,160 tons by France, and 1,900 tons by Great Britain. At the same time, the German imports of bauxite reached 24,000 tons in 1905, 59,900 tons in 1907, and 38,000 tons in 1913.

The outbreak of war at first produced no effect upon the market for aluminium. On the one hand, the home demand in North America was met by the output there, while, on the other, the Allied countries turned out a quantity in excess of their particular requirements. Gradually, however, the call for the metal became more active for motor cars and for aviation, and since the spring of 1915 prices at New York have rapidly advanced. The consumption in the United States is declared to have increased from 7,000,000 lb. in 1900 to 47,734,000 lb. in 1910, 79,129,000 lb. in 1914, and 99,806,000 lb. in 1915. The price in New York reached as high as 65 cents per lb. in 1916, whilst the price in England, which fell to £60 per ton in the years of depression previously mentioned, has in the past three years varied between £70 and £290.

The augmentation in prices and the development of the consumption have imparted a great stimulus to production. The German group, however, has been much inconvenienced through being deprived of French bauxite. Not only did the group formerly possess various deposits in Provence, but it also owned a works at Saint Louis-les-Aygalades, near Marseilles, for the extraction of alumina from the bauxite, and 126,193 tons of alumina, of the value of £582,000, were sent to Germany in 1913, of which 54,706 tons were re-exported to the United States, Russia, and Great Britain. At present the German and Swiss works have been reduced to the necessity of using the inferior bauxites of Silesia, Hungary, and Dalmatia, and, perhaps, also have to utilise koalin. It is stated in this connection that the Aluminium Industrie A.G., of Neuhausen, exported from 12,000 tons to 14,000 tons of aluminium to Germany in 1915, and of the company's four works, that at Chippis has been specially developed since the outbreak of hostilities. On the other hand, the Swiss-German Giulini company owns alumina works at Ludwigshafen, Germany, and aluminium works at Martigny, Switzerland.

The French newspaper asserts that similarly to the German and Swiss works, the works in France and Great Britain have not been able to be greatly developed under existing circumstances. In contradistinction to this state of affairs, the production in the United States has been considerably increased, and that country now supplies about one half of the world's output. The output of bauxite in the United States is reported to have grown by 35 per cent. in 1915, as compared with the previous year, and to have amounted to 297,000 tons, whilst the production of aluminium advanced from 45,000,000 lb. in 1914 to 80,000,000 lb. in 1915. In this connection, it is mentioned that the Aluminium Co. of America has recently expended £4,000,000 on the development of its plant; a new works of 20,000 H.P. at Maryville, Tennessee, is to begin production this year; the capacity of the Whitney works is being raised to 100,000 H.P. this year; and rolling mills and stamping works at Edgewater, on the river Hudson, were brought into operation in 1916. In addition, the company has acquired certain interests in France, and American groups now own bauxite deposits, it is said, on the river Demerara, in British Guiana, and on the banks of the Surinam, in Dutch Guiana. The Northern Aluminium Co., in Canada, which had a productive capacity of 6,000 tons in 1913, has also extended its works, whilst the Aluminium Corporation, which is the only competitor of the British Aluminium Co., has increased its share capital for the purpose of expanding the Dolgarrog mines. In Norway, five works are either in operation or in course of erection for a combined total output of 16,600 tons; the Bussi works, in Italy, has been greatly enlarged, and a second works is in course of construction in the Aoste Valley for the account of the Società Hydro-Elettrica, of Villeneuve, in which French capital is also interested.

It is estimated that the present capacity of production throughout the world amounts to 100,000 tons per annum, and if the schemes in process of execution are also taken into consideration the capacity will rise to 150,000 tons in the near future. The figures given on this point are as follows:—

	Annual productive capacity in tons.
United States and Canada	75,000
France	20,000
Switzerland and Germany	20,000
Great Britain	12,000
Norway	16,000
Italy	7,000
Total	150,000

The prospects of aluminium becoming dear in price seem rather scanty on the basis of an annual output of 150,000 tons, as it would be necessary for the markets to be greatly developed if over-production were to be avoided. But such a large quantity of metal pre-supposes an output of 300,000 tons of alumina, or 600,000 tons of bauxite, together with a large production of cryolite, fluoride, graphite, &c., for the metallurgical treatment of the metal; and it is considered uncertain whether all these conditions can be fulfilled simultaneously in order to meet the needs of the works.

In conclusion, the newspaper states that the French aluminium industry is protected by the following import duties per cwt. of 50 kilogrammes:—

French Import Duties.

	General tariff.	Minimum tariff.
Ingots and scrap	£3 0 0	£2 0 0
Rolled, wrought or cast	4 9 7	3 0 0
Sheets	12 0 0	8 0 0
Wire	6 0 0	4 0 0
Aluminium powder	8 0 0	6 0 0
Aluminium bronze having a maximum aluminium content not exceeding 20 per cent. ...	10 5	8 0

[The rates in sterling have been converted on the assumption that 25 fcs. are equivalent to £1.]

THE FARADAY SOCIETY.

General Discussion on "Chemical Engineering."

The Faraday Society initiated a discussion on "The Training and Work of the Chemical Engineer" at their last meeting on 6th inst. The meeting, at which there was a very large attendance, was held at the Chemical Society, and was presided over by the President, Sir Robert Hadfield, F.R.S. The opening paper was read by Sir George Beilby, F.R.S., himself not only an eminent chemist and investigator, but withal a successful chemical manufacturer, so that it could not have been in better hands. The academic aspects of the subject were, at the outset, placed in the no less able hands of Prof. F. G. Donnan, F.R.S.

In his introductory remarks the President dwelt on the shortage of the highest class of labour, mental and physical, that will result from the war, and said it therefore behoved us now to set about planning wisely to meet the new conditions. Careful deliberation as a preliminary to action was, however, never more seriously needed, for war conditions were a most fruitful soil for unbalanced proposals, often resulting in panic legislation or action. He fittingly closed his speech on a note that called forth unanimous agreement, namely, an appeal for liberal support of the Ramsay Memorial Fund that was being inaugurated to honour the memory of one of our greatest chemists, and part of which was to be devoted to the establishment of a laboratory for dealing with the very subject under discussion, "Engineering Chemistry."

Sir George Beilby gave the keynote to the discussion in his definition, "*Chemical engineering has for its function the design and construction of apparatus required for the carrying out of chemical processes on a manufacturing scale.*" The discussion practically centred round two standpoints: On the one hand, the view of the great majority that for the construction of chemical plant a man combining within himself the qualities of both chemist and engineer is the type to be aimed at; on the other hand, the view that a man cannot be both chemist and engineer, and that what is needed is closer co-operation between the two. This aspect of the subject was emphasised by Dr. E. F. Armstrong, who, in a very able speech, reminded the meeting that, after all, the chemical industry needed above all *chemists*. Many an existing process might be revolutionised by putting into the works a man closely in touch with modern development in chemistry, say an expert in the phase rule or in colloids. Such men can only be produced by the universities, and if it was true, as the majority maintained, that the university must enter the works, it was no less true that the manufacturer must enter the university, advise it, and support it. The research chemist generally, however, was left somewhat in the background—perhaps too much so—by most of the speakers.

Prof. F. G. Donnan, who spoke on "The Training of the Works Chemist," sub-divided chemists into (1) research chemists, (2) engineer chemists, (3) chemical engineers, and the sub-division was generally adopted as useful. Men of class 1 are the discoverers of new compounds and reactions, and are, of course, absolutely necessary, but to be useful in industry, they should, in Prof. Donnan's opinion, be men of broad outlook whose horizon is not confined to the laboratory. To this end, he advocated teaching them engineering principles and the elements of such practice as may bear on their work, so that they can co-operate intelligently with the other classes. The danger to be borne in mind was stated by Prof. E. G. Coker and others, and was clearly indicated by Sir George Beilby. There is an essential difference between the chemist's and the engineer's type of mind. The former thinks in terms of molecules, the latter in terms of masses. Many a first-rate chemist might be, and is, quite uninterested in engineering, and the training should, therefore, be permissive to some extent, and not obligatory. Dr. W. Rosenhain rightly remarked that the proper man, with the right scientific foundation, is bound in the end "to make good."

Men of the second class—engineer chemists—are required in large numbers, and, although essentially chemists, they should received a considerable amount of specialised engineering training, in which stress is laid on thermophysics and thermochemistry, the properties and testing of materials of construction, the principles of design, and the problems of power. The work of these men is really applied physical chemistry. Men of class 3 are thoroughly trained engineers with a chemical sense and some chemical knowledge, the more the better. Prof. Donnan went on to outline the manner in which the work of the three classes of industrial chemists should be co-ordinated for the successful development of a new process after the research chemists have worked it out in the laboratory. Men of classes 2 and 3 should combine to design and test a small trial plant in order to obtain special chemical engineering data, and all three classes should then combine to deal with a technical unit plant fully working, above all quantitatively the thermochemistry and thermodynamics of the process. There can be no doubt that our tendency to keep apart the work of the chemist and the engineer has seriously impaired our industrial efficiency, and Prof. Donnan's suggestions merit the most serious consideration.

Now, as regards the training of our engineer chemists, Sir George Beilby summarised his scheme as follows:—

1. A sound and practical training in chemistry and chemical physics extending over three years. During the third year special subjects to be introduced.
2. At the end of the third year at latest the case of each student to be considered by the heads of the departments, so that he may be advised in what direction he should specialise.
3. Average students with no special bent to complete their course by general advanced studies during the fourth year.
4. No degree or "hall-mark" to be given in chemistry till the complete four years' curriculum has been taken.
5. Chemical engineers, research chemists, and specialists in other branches to devote one or two years to higher post-graduate study.

Mr. W. R. Cooper put in a plea for what he called the forgotten factor in chemical training, namely, the economic factor—will any particular process pay? He considered that even in the educational stage this aspect should not be neglected, and, so far from the commercial consideration placing a problem on a lower plane, it actually introduces an additional factor, and thus renders it more difficult of solution. Perhaps the question of the time at the disposal of the teacher and student is a factor which Mr. Cooper has forgotten! At the Massachusetts Institute of Technology, not only economics and modern languages, but many other branches of knowledge, the utility of which to any citizen nobody can doubt, are included in the curriculum. The meeting was certainly sympathetic to Prof. E. G. Coker, who thought some of the American courses erred on the side of overloading, and who preferred the English method of taking fewer subjects and doing them very thoroughly.

Many other interesting points in schemes of training were emphasised by different speakers. Thus, in talking of the research which should be the culmination of the training of the engineer-chemist, Prof. Donnan suggested that it should take the form of a study of some process promising industrial results, consisting in the investigation of the precise quantitative optimum conditions for the reaction and the actual construction of a small experimental plant for the purpose. To this end, cheap, rough buildings, with the necessary practical equipment and adjuncts, should be attached to our colleges, forming the real "laboratories" of our engineer-chemists.

Mr. Charles R. Darling described the course of physics which chemical students take at the Finsbury Technical College, and Mr. J. W. Hinchley described the teaching of chemical engineering which is being developed as part of a larger scheme of post-graduate study and research in chemical technology at the Imperial College, South Kensington. Many speakers thought the practical training in the laboratory different in kind from that obtained in the works. Mr. A. P. M. Fleming and Mr. W. Gathorne Young therefore advocated the American system of sending students into works during their third or fourth year, and Mr. E. B. R. Prideaux thought the smaller universities should co-operate more closely with the local industries to the same end. Mr. H. L. Heathcote gave voice to the warning that training for the works must be *induced* by the needs of industrial process rather than *forced* by the examination syllabus. Mr. F. H. Carr went so far as to advocate the establishment in colleges of a department which could be conducted something like a factory, carrying on side by side with lectures the production, say, of fine chemicals on the scale of technical experiments. Sir A. McDougall Duckham, on the other hand, thought students should enter works before college. He also advocated teaching chemistry to all engineers as well as engineering to all chemists. Finally, Prof. A. K. Huntington and Mr. T. G. Elliott referred to a really fundamental difficulty in any scheme of training, and that is the miserable equipment, usually altogether useless, in mathematics and elementary science received at present in the secondary school. In truth, until we reform our schools it is not of very much use to reform our colleges, but that is a subject too wide to consider further at present.

The discussion had the great merit of presenting almost every conceivable point of view of the subject it set out to consider, and it should go far to help crystallise the way of the golden mean, which in practical matters of this kind is the safest way and the best way.

FREQUENCY CHANGERS.

The paper by Mr. R. Townend was read and discussed at a meeting of the Manchester Local Section of the Institution of Electrical Engineers on February 13th.

Prof. Miles Walker said that it was not discreet to connect two large power stations together by means of a synchronous frequency changer unless the motor generator had a fairly large output compared with the output of the power station. In cases of this kind asynchronous sets could be used, and if required to circulate power either way, two sets could be used, one having the synchronous motor connected to the mains of one power supply, and the other having a synchronous motor connected to the other power supply. If it were permissible to introduce a commutating machine into the rotor circuit of the induction motor, as proposed by Leblanc 20 years ago, all sorts of possibilities presented themselves, not only of controlling the power factor of the induction motor and making it take wattless load as an asynchronous generator, but also of circulating power in either direction through the set, independently of the speed of the connected power stations. For example, a frequency changer might consist of a 12-pole, 50-cycle synchronous generator direct connected to a 10-pole induction motor connected to the 40-cycle supply. The set would run at 500 R.P.M., so that the induction motor would be running at 4 per cent. above synchronous speed, and would tend to deliver power to the 40-cycle circuit. If now the rotor circuit of the induction motor were connected to a phase advancer whose excitation was so arranged that it boosted against the E.M.F. generated in the rotor conductors, the asynchronous machine could be made to operate as a motor, notwithstanding the fact that it was running above synchronous speed; and, at the same time, by suitable arrangement of the field coils the power factor could be kept near unity or leading. Moreover, when the asynchronous machine was required to supply a generator load, the phase advancer could be used to supply the wattless component of the load. The type of frequency changer referred to under class 2 in the paper had the advantage that the size of the unit for a given output could sometimes be made considerably smaller than the class 3 type, and when combined with a Leblanc exciter this type of frequency changer seemed very attractive. The phase advancer could be made to operate as successfully as the exciter of a synchronous motor, and the future would show many valuable uses to which it could be put. By the addition of a phase advancer to the induction type of frequency changer all the advantages possessed by the synchronous type were obtained, and at the same time the great objection to the rigidity of the coupling, incident to the synchronous frequency changer, was entirely removed. In cases where the synchronous frequency changer was employed, if the field magnet of one of the synchronous machines was wound with a polyphase winding, say as a three-phase machine, it was possible to shift the position of the poles of the magnet relatively to the iron, and in this way secure the same effect as by rocking the stator. The diagram (fig. 1) showed how a three-phase generator could be connected to an exciter and two rheostats, so as to obtain a shifting of the pole through an angle of 60 degrees. If all the exciting current was passed through phases A and B, the resultant field would be A B. If the current after passing through A was equally divided between B and C, the line of the poles would be in phase with A. If all the current was passed through phases A and C, the line of the poles would take a position A C. It was also possible to build a special exciter which would give any required phase position of the excitation on the rotor, and in cases where perfectly synchronous running was required, the exciter operated as a continuous-current generator. If it was required slowly to change the pole position on the rotor in order to produce a slip, the exciter could be operated at the frequency required to produce the desired result.

Mr. H. A. **Ratcliff** raised the question of the efficiency of a synchronous set, as it appeared that such a machine would have to run at loads sufficiently low to avoid the risk of pulling out of step when linking-up two systems. He asked whether the characteristics of the transmission line had any significant bearing on where the frequency changer was placed, *i.e.*, the high- or low-frequency station. Rocking stators seemed quite correct for small machines, but it was questionable if they could be used for large units. It appeared possible to use resistances or reactances between an incoming machine and a machine on load, in order to reduce the shock on paralleling. He asked whether the adjustment of load between two synchronous frequency changers could not be carried out by varying the excitation of the motors. The operation of reversing the excitation, to "slip a pole," would be rather too severe for the type of field switch generally supplied.

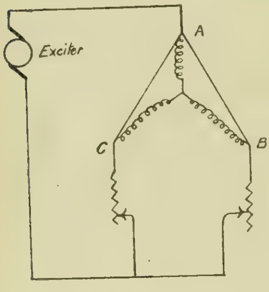


Fig. 1.

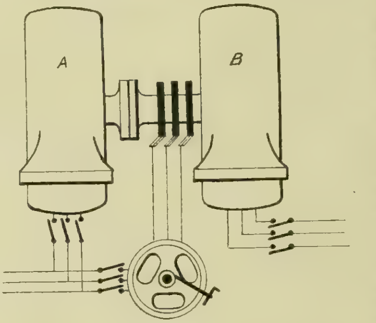


Fig. 2.

Mr. J. **Frith** suggested the use of a friction clutch between the two machines of a synchronous frequency changer in order to simplify the operation of paralleling. Each machine would be started up as a motor set, and the two gradually brought together by means of the clutch.

Mr. J. S. **Peck** described a motor converter with slip rings connected to the connections between the two machines. If the two machines had the same number of poles, the slip-ring frequency would be half the supply frequency, consequently with a 50-cycle supply there was obtainable D.C., 25-cycle A.C., or the two together; or by reverse action D.C., 50-cycle A.C., or both, 25 cycles being supplied to the slip rings.

Prof. A. B. **Field** said the second class of machine, in which part of the energy was converted mechanically and part electromagnetically, had many points of interest, and its size might be greatly reduced in comparison with the straight synchronous set. Considering the case in which the outfit consisted of two rotating-field machines coupled together, the low-frequency one "A"—assuming this to be the motor—might be an ordinary separately excited synchronous machine, and the generator "B" might comprise a similar stator, and a polyphase-wound rotor fed from the low-frequency side through a potential regulator, as shown diagrammatically in the figure (fig. 2). The maximum mechanical speed of this set consistent with the frequencies was the same as for a straight synchronous set, but the number of poles of the generator corresponded to a higher speed, since the field rotated at a speed greater than that of the shaft. The relative size of the generator stator per kilowatt output depended upon the speed of rotation of its field, not its shaft, and consequently, in comparison with the straight synchronous set, this size was reduced in about the proportion of the shaft speed to the field speed, or in the ratio of the difference of frequencies to the higher one; the same applied, roughly, to the remainder of the set. It would be seen that the advantage in size became greatest when the two frequencies were near together, provided the output was not greater than could be conveniently taken care of with the small number of poles involved for the "B" machine. For example: a linking together of 40 and 50 cycles would allow a maximum speed of 600 R.P.M. with the ordinary synchronous outfit; this corresponded to 8 and 10 poles; 600 R.P.M. would also be the maximum mechanical speed available for the arrangement shown in the figure, but while the "A" machine would retain eight poles, the "B" machine would have two, and would gain the electrical advantages of a speed of 3,000 R.P.M. with only the mechanical difficulties of 600 R.P.M. For a 5,000-KW. transfer, the "A" machine would only be rated at 1,000 KW., plus losses, or less than one-fourth the normal size, while the "B" stator would be that of a 5,000-KW., 3,000-R.P.M. machine instead of a 5,000-KW., 600-R.P.M. It became necessary in order to take care of the variations in voltage on each system to introduce a polyphase induction regulator, and the size of this would depend entirely upon the amount of voltage variation to be provided for, and the reactive drops in the double-wound machine. For example, in a certain 30- to 60-cycle case the possible variations in voltage on both systems under extreme conditions of load and power factor, were estimated to be well taken care of by a ± 15 per cent. voltage regulation. As this regulation needed to be effected in respect of the electrical input to the rotor only, *i.e.*, about half the rating of the set, and as the voltage introduced by the regulator could either assist or oppose the supply, the rating of the potential regulator amounted only to some 8 per cent. of that of the set. However, the use of this subsidiary piece of apparatus, and the necessity of obtaining part of the excitation by alternating current, were distinct drawbacks to this type of frequency changer

Mr. **Swinburne** said that since the question of linking-up had become a matter of national interest standardisation of systems, &c., was most desirable. He considered it the duty of the Institution to decide which type of frequency changer should be adopted, and, if necessary, make the adoption compulsory.

Mr. **Juhlin** referred to the advantages of the synchronous type of machine, also the disadvantage of the induction type when used as a generator owing to the fact that it could not supply any wattless component of the load on the system. He considered the rocking stator to be essential in the case of high-voltage machines of large output in order to avoid shock when paralleling loaded and unloaded machines.

The **Author**, in reply, said there was no doubt that the use of a phase advancer, in conjunction with an induction frequency changer, would give operating characteristics which were on an equality with, and in some respects better than those of the synchronous set, but in the majority of cases the cost of the former would be higher than that of the latter, also the cost of attendance and maintenance would be slightly greater. The efficiency of synchronous frequency changers would depend upon the rating of the set, but a 1,000-KW. frequency changer having a speed of about 500 R.P.M. would have an overall efficiency of approximately 89 per cent. at full load and 82 per cent. at half load. It was quite correct that the characteristics of the transmission line and the general lay-out of the cable system might in some cases determine whether the frequency changer should be installed at the high- or low-frequency station, but when the line characteristics were of no importance, it was usually immaterial in which station the set was installed. It was not usually practicable to run synchronous and induction frequency changers in parallel, but in some cases it might be done, *e.g.*, 25- and 60-period systems could be linked-up by means of a synchronous set running at 214 R.P.M., and by an induction set operating at 720 R.P.M. When two such sets were running in parallel, the induction set would always carry the load which would give a rotor slip of 4 per cent. There was no great difficulty in building machines with movable stators, and this had been satisfactorily done with machines having a capacity of at least 5,000 K.V.A. With large machines it was advisable to move the stator by means of a motor controlled from the switchboard. The shock caused by paralleling unloaded and loaded synchronous sets could be reduced by inserting resistances or reactances between the loaded and unloaded machines, but this involved additional apparatus and was not so simple as using the movable stator. It was possible to obtain a variation in the load distribution between two synchronous sets running in parallel by varying the motor excitation, but the variation would be small, only about 10 per cent. of full load. There was no difficulty in making a field switch for reversing the field excitation, provided it was mechanically strong, and fitted with an efficient discharge resistance. A friction clutch could be used between the two machines of a synchronous set in order to simplify the paralleling operation if only one set had to be run, but if a second set had to be paralleled with it, it would be necessary to give the requisite angular displacement between the motor and generator of the incoming set before closing the clutch in order to make the latter set take its share of the load. This, of course, was impracticable. The type of frequency changer described by Prof. Field might be considerably smaller than machines of the third type, but the necessity for an induction regulator and for obtaining part of the excitation by alternating current were distinct disadvantages. It was also necessary to collect the greater portion of the power from slip rings, and in the case of high-voltage machines this was very undesirable. The author did not consider any one type sufficient to meet the requirements of every case, and the only satisfactory method was to adopt the type of machine best suited to the case under consideration. A frequency changer having an A.C. commutator motor instead of an induction or synchronous motor would enable a variable ratio of frequency transformation to be obtained, but the set would not be reversible.

DIESEL ENGINE USERS' ASSOCIATION.

At the January meeting of the Association the President, Mr. Geoffrey Porter, produced an amended and completed table of data concerning lubricating oils, which he asked the Hon. Secretary to circulate among the members and subscribers. A paper on the "Chemistry and Examination of Lubricating Oils" was then read by Mr. Elliott A. Evans, who said that the only oils which could be recommended for lubricating purposes were mineral oils, semi- and non-drying fatty oils, and liquid waxes. Fatty oils alone as lubricants were obsolescent. Mineral oils had won popularity by virtue of their comparative inertia, their cost, and the fact that they could be obtained in almost any degree of viscosity. Texas oils had a specific gravity ranging about 0.950, Californian oils 0.930, and Pennsylvanian oils 0.876/0.910. Mineral oils were mixtures of hydrocarbons belonging to the various homologous series, ranging from the most saturated normal paraffins to the most unsaturated hydrocarbons of the aliphatic series; saturated and unsaturated cyclic hydrocarbons; and aromatic hydrocarbons. In the manufacture of lubricating oils it was the endeavour of the manufacturer to eliminate the unsaturated cyclic hydrocarbons, and all the aromatic hydrocarbons, from the most expensive lubricating oils, because not only were they of very doubtful lubricating value, but their instability might give rise to excessive carbonisation and acidity of the oil. Some Californian oils were on the market, but they could not be recommended universally as lubricants. Texas oils were used to a considerable extent for many purposes, but were very liable to decompose at elevated temperatures, and perhaps at high pressures. It had been found that if a hydrocarbon oil were heated under pressure decomposition took place, and lighter oils resulted. The products of decomposition were generally governed by the temperature and pressure at which the reaction was conducted. When an oil was converted in this manner into lighter oils, the latter were said to be "cracked." During the cracking, carbon was deposited, and some extremely unstable hydrocarbons were formed which decomposed with explosive violence. It was quite conceivable that the explosion in an air compressor at Smithfield occurred through the production of these unstable bodies, and that the vapour of the light oils was exploded by the detonation of these very unstable olefines. That the explosion was caused by the ignition of oil-fog in the compressor might be a very convenient working hypothesis, but it was a little difficult to understand how ignition was effected. The suggestion that a compound oil should be used as a lubricant for air compressors must be condemned. The hypothesis of the oil-fog had created a belief that an oil with a high vaporisation point was essential, but such an oil had a high viscosity, and so unnecessary work was thrust upon the compressor. The vaporisation point as usually determined gave no indication as to the temperature at which vaporisation would take place in the compressor, because the vaporisation point was governed by the pressure of the atmosphere, and the rate of vaporisation was dependent upon the concentration of the vapour in that atmosphere. Mr. Evans expressed the opinion that an oil with a specific viscosity of about 70 (water = 1), or in seconds 2,500, and a closed flash point of about 400 deg. F., could be safely used if the temperature of the compressor was carefully regulated.

At the February meeting of the Association a discussion took place on Mr. E. A. Evans's paper.

In a communication, Mr. T. C. Thomsen said he did not agree that paraffin-base oils changed materially during the process of distillation. He maintained that Pennsylvanian oils were better in quality as lubricants than asphaltic-base oils.

Mr. C. O. Milton referred to the corrosion noted in some air compressors which, he suggested, might possibly be caused by the formation of acids in compressor coils, due to the "cracking" of the lubricating oil used. His own experience had shown that it was possible for the temperatures in an air-compressor to vary over a wide range while the machine, judged by the delivery of air, was working quite well. He thought that possibly the formation of acid might be due to abnormal temperatures in some compressors, the causes of which were now becoming well understood. He had noted a fact in connection with the working of an air compressor at Maidenhead which seemed to confirm this idea. The delivered air was abnormally hot, and there was strong evidence of acid formation in the coils of the higher stages. The engine was overhauled, and the opportunity was taken to fit a non-return valve on the delivery pipe of the compressor. The running of the compressor was then much improved, the delivered air being quite cool, and evidence of acid formation entirely disappeared. The same brand of lubricating oil had been used throughout. He thought it was possible that the former high temperatures were due to lack of tightness of the H.P. valves, and that the added non-return valve had simply improved the efficiency of the delivery valves and prevented pulsating of the air at that point. It was known that leaky valves would cause overheating of the air, and that it was a difficult matter to keep compressor valves continuously tight.

Mr. G. W. F. Horner asked if an air-compressor had ever been designed to work in conjunction with a Diesel engine in which no lubricating oil was used for the compressor cylinders, but in which water was taken in with the air supply to the low-pressure cylinder. Compressors for other purposes were working under such conditions, and he believed that distilled water was the only means of cylinder lubrication for hydrogen compressors. The piston speeds might not be so high, but the pressures were far greater than those required for Diesel engine purposes. He was of the opinion that the most satisfactory lubricating oil for air-compressors was one in which the viscosities had a minimum difference between the temperatures of 60 deg. F. and 140 deg. F.

Mr. W. Fennell thought it was quite possible that the fuel oil now being delivered for use in Diesel engines was, owing to war conditions, much richer in sulphur contents than that supplied previously. The sulphur was likely to have a deleterious effect on the lubricating oil in the engine cylinders, especially in the case of a compounded lubricating oil.

Mr. Geoffrey Porter (President) said he would be glad if investigation could be pursued further to ascertain if any particular hydrocarbon base was more liable to favour the formation of unstable hydrocarbons during the decomposition of an oil than was another, and to determine, further, at what critical temperatures these unstable bodies might be formed. One would like to know at what temperature working was safe. If the risk of explosion was more or less in direct proportion to the rise in temperature, one might reasonable conclude that the compression ratios in multistage compressors should be arranged at lower values than was generally the case. Generally speaking, all the oils which might be termed "standard" gave satisfactory results under normal conditions; they were chiefly concerned with the endeavour to elucidate the behaviour of oils under abnormal conditions.

Mr. Elliott A. Evans replied at length to the various points raised in the course of the discussion.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

TRANSIT OF GOODS THROUGH FRANCE.—The attention of exporters is drawn to the necessity of obtaining a French import licence for goods which are to pass through France (by parcel post or otherwise) in transit for Switzerland, Spain, or Italy, when such goods are covered by the various prohibitions of importation imposed. Full particulars as to these prohibitions, and as to the procedure to be followed in obtaining French import licences, can be obtained from the Department of Commercial Intelligence, 73, Basinghall Street, E.C.

SOUTH AFRICA.—The following are among recent decisions by the Commissioner of Customs as to the rates of import duty leviable on the articles named:—

	Rate of import duty.	Rebate on goods manufactured in the U.K. and reciprocating British Colonies.
Electrically-heated photographic mounting machine	20 % ad val.	3 % ad val.
Printometer (an electric meter which records the quantity of current used at stated intervals) ...	3 % ad val.	Whole duty
Telephone twine and rubber bands used respectively to lace up cables and deaden vibration of telephone transmitters	3 % ad val.	..

RUSSIA.—With reference to the temporary prohibition of importation of all goods on private account to Vladivostock [illegible] the Electrical Review of December 22nd—it has now been definitely announced by the Russian Government that, until further notice, no licences for such importation will be granted.

NORWAY. The exportation of manganese ore, ferro-manganese, emery, and artificial abrasives has been prohibited.

ITALY.—The Italian Government have denounced the existing Treaties of Commerce with Japan, Roumania, Russia, Serbia, Spain and Switzerland. These Treaties will go out of operation at the end of the current year.

BRITISH INDIA.—A Customs Circular has been issued by the Department of Commerce and Industry fixing, with effect from January 1st, 1917, the tariff valuations on various articles imported. The valuations differ in many instances from those previously in operation. Among items of interest to the electrical industry are the following :—

	Tariff valuation. Rs. a.	Duty.
Telegraphic instruments and apparatus, and parts thereof, imported by a railway company...	ad val.	2½ %
Implements, instruments, apparatus and appliances, & parts thereof, not otherwise specified... ...	..	7½ %
Electrical machinery, and component parts thereof (including belting of all materials for driving machinery)	,,	2½ %
Brass sheets, flat or in rolls, and sheathing, weighing less than 1 lb. per sq. ft. : brass wire ...	ad val.	7½ %
Copper, bolt and bar, rolled ...	,,	..
.. braziers, sheets, plates and sheathing	cwt. 84 0	,,
,, nails and composition nails	ad val.	..
.. old	cwt. 50 0	..
.. pigs, tiles, ingots, cakes, bricks, and slabs	,, 80 0	..
.. China, white, copperware ...	lb. 2 4	,,
.. wire, including phosphor-bronze, and all other sorts of copper	ad val.	..
Lead, all sorts (except sheets for tea chests)	,,	..
Quicksilver...	lb. 3 4	..
Tin, block	cwt. 140 0	..
,, foil and other sorts	ad val.	..
Zinc or spelter, tiles or slabs, soft ...	cwt. 100 0	..
.. .. hard...	.. 75 0	..
.. all other sorts ...	ad val.	..
Trade catalogues and advertising circulars imported by packet, book, or parcel post	—	Free

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

3,579. "Arrangement of inspection glasses for magnetic brakes." Naamlooze Vennootschap Haarlemsche Machinenfabriek voorheen Geb. Figee. March 12th. (Holland, March 14th, 1916.)

3,581 & 3,582. "Diaphragms for galvanic cells, &c." R. Schuster. March 12th.

3,583 & 3,585. "Galvanic cells." R. Schuster. March 12th.

3,584. "Galvanic primary cells." R. Schuster. March 12th.

3,592. "Ignition apparatus of submarine mines, and mechanism for automatically raising same." S. J. Williams. March 12th.

3,604. "Electric cables." C. J. Beaver & E. A. Claremont. March 12th.

3,610. "Electric switch-boxes." W. T. Henley's Telegraph Works Co. and E. Moor. March 12th.

3,615. "Electric couplings." H. de La Valette. March 12th. (France, March 31st, 1916.)

3,618. "Electromagnetic switches for train lighting, &c., installations." A. H. Darker and J. Stone & Co. March 12th.

3,652. "Electric circuits linked by relay or repeater." W. H. Grinstead. March 13th.

3,657. "Systems of control." British Westinghouse Electric & Manufacturing Co. March 13th. (U.S.A., March 13th, 1916.)

3,658. "Transformation of single-phase alternating electric currents into polyphase currents." British Westinghouse Electric & Manufacturing Co. March 13th. (U.S.A., March 13th, 1916.)

3,664. "Electric switches." A. H. Darker and J. Stone & Co. March 13th.

3,665. "Brush and terminal contact mechanism of dynamo-electric machines." A. H. Darker and J. Stone & Co. March 13th.

3,686. "Insulated brush-holders and terminals for magnetos." P. Green. March 14th.

3,687. "Electric heaters." G. S. Bent. March 14th.

3,717. "Electric couplings or connections." G. Green & F. May. March 14th.

3,719. "Electromagnetic clutch." Vulkan Maschinenfabriks Akt. Ges. March 14th. (Austria, October 22nd, 1913.)

3,720. "Electromagnetic friction clutch." Vulkan Maschinenfabriks Akt. Ges. March 14th. (Austria, October 22nd, 1913.)

3,727. "Electric control apparatus." British Westinghouse Electric and Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.). March 14th.

3,748. "Rollers for tramway overhead equipment." J. Duggan. March 15th.

3,765. "Sparking plugs for internal-combustion engines." A. G. Francl. March 15th.

3,767. "Brushes for dynamo-electric machinery." Troup, Curtis & Co. and J. H. Wickett. March 15th.

3,768. "Brush gear for dynamo-electric machinery." Troup, Curtis & Co. and J. H. Wickett. March 15th.

3,780. "Electromagnetic friction clutches." W. Langdon-Davies & A. Soames. March 15th.

3,798. "Driving mechanism for magnetos." Soc. Lorraine des Anciens Etablissements de Dietrich et Cie de Luneville. March 15th. (France, April 3rd, 1916.)

3,802. "General and electric joint-making washer." C. J. Beaver and E. A. Claremont. March 15th.

3,807. "Electric batteries." Svenska Ackumulator Aktiebolaget Jungner. March 15th. (Sweden, August 8th, 1916.)

3,811. "Crystalline, &c., detectors for electric waves." H. Hurm. March 15th. (France, March 21st, 1916.)

3,864. "Electrically depositing metals." E. H. Jones. March 16th.

3,865. "Electric selectors." G. A. Betulander. March 16th. (Sweden, March 17th, 1916.)

3,874. "Rheostats." Cutler-Hammer Manufacturing Co. & Igranic Electric Co. March 16th.

3,881. "Appliances for shaping telegraph, &c., insulators." P. Cooper and Taylor, Tunnicliffe & Co. March 16th.

3,884. "Commutators or switchboards for field telephone systems." N. V. Fearnehough. March 17th.

3,914. "Magneto-electric ignition machines." Bosch Magneto Co. & O. Imray. March 17th.

3,916. "Electric bells." F. G. Bell, W. C. Davey and Sterling Telephone & Electric Co. March 17th.

PUBLISHED SPECIFICATIONS.

1915.

17,962. Electric Switches. H. K. Trechmann & British Thomson-Houston Co. December 23rd.

1916.

The numbers in parentheses are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

731. Wireless Telegraph Transmitters. G. Marconi & C. S. Franklin. January 17th, 1916. (104,188.)

732. Wireless Telegraph Transmitters. G. Marconi & W. S. Entwistle. January 17th, 1916. (104,189.)

2,569. Dynamo-electric Machines. British Thomson-Houston Co. (General Electric Co., U.S.A.). February 21st, 1916. (104,197.)

2,576. Remote Control of Projectors. J. Brockie and Johnson & Phillips. February 21st, 1916. (104,198.)

2,660. Semi-automatic Telephone Exchange Systems. C. A. W. Hultman. February 23rd, 1915. (100,113.)

2,701. Ignition Dynamos. C. T. Mason. March 15th, 1915. (100,173.)

2,714. Elastic Fluid Turbines. British Thomson-Houston Co. (General Electric Co., U.S.A.). February 23rd, 1916. (104,208.)

2,725. Electrical Impulse Responders or Selectors. Relay Automatic Telephone Co. & H. J. Herink. February 23rd, 1916. (104,212.)

3,164. Means for Suspending and Insulating Electrical Conductors. Marconi's Wireless Telegraph Co. & H. A. Ewen. March 2nd, 1916. (104,226.)

3,390. Alternating-current Electromagnets. Waygood-Otis, Ltd. (Otis Elevator Co., U.S.A.). March 7th, 1916. (104,229.)

3,391. Vacuum Apparatus. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 7th, 1916. (104,230.)

3,474. Overload Electric Switches or Cut-outs. P. G. van Wijk. March 8th, 1916. (104,233.)

3,501. Railway Signalling Apparatus. T. Blackburn. March 9th, 1916. (104,235.)

3,798. One-piece Framing for Magnetos. E. J. J. Salmson. March 14th, 1916. (104,239.)

3,871. Apparatus or Means for Signalling in connection with Railways and the like. J. D. Benson. March 15th, 1916. (Cognate application 13,138/16.) (104,240.)

4,430. Tumbling Machines and Electroplating Barrels. L. Schulte. March 25th, 1916. (104,245.)

5,171. Elbows and like Fittings for Electric Conduits. J. Gray & J. Wilkie. (October 7th, 1916.) (104,248.)

5,377. Dynamo-electric Machines. British Thomson-Houston Co. (General Electric Co., U.S.A.). April 12th, 1916. (104,250.)

5,874. Magnetic Blow-out Fuses. Switchgear & Cowans and G. H. Neep. April 25th, 1916. (104,257.)

6,809. Sealing and Bonding Glands for Electrical Junction Boxes. G. S. Boothroyd and Callender's Cable & Construction Co. May 12th, 1916. (104,269.)

9,105. Electric Spark Gaps. F. G. Simpson. June 28th, 1916. (Convention date not granted.) (100,795.)

11,752. Electric Motor Gyroscopes and means for making Electrical Connection therewith. Crucible Steel Co. of America. April 3rd, 1915. (Divided application on 17,895/15.) (101,225.)

12,099. Electric Dry Cells. G. L. Tarver. August 26th, 1916. (104,298.)

13,888. Magnetos and Dynamos. P. C. Rushen (Bosch Magneto Co.). September 29th, 1916. (104,308.)

15,054. Control Switches for Electrically-controlled Apparatus for Measuring Liquids. O. Anderson. November 11th, 1915. (102,143.)

16,065. Means for Supporting Electric Lamps. Benjamin Electric, Ltd., and E. Fowler. November 9th, 1916. (104,142.)

16,202. Electric Contact-breakers or Interruptors. G. F. Cooke. November 11th, 1916. (104,144.)

16,861. Apparatus for the Circular Grinding of the Commutators of Electrical Machines. A. Norrel. November 24th, 1916. (104,148.)

17,273. Cells for Secondary Batteries. G. Pearson. December 1st, 1916. (104,320.)

18,064. Ornamental Shades and Reflectors. F. A. Andrews & T. G. Allen. December 15th, 1916. (Addition to 22,781/14.) (104,149.)

1917.

249. Apparatus for Automatically Retransmitting through successive lines Telegraphic Messages received from a Distant Station. Eastern Telegraph Co., A. Fraser & S. E. Appleton. January 5th, 1917. (104,152.)

314. Ignition Dynamos. C. T. Mason. March 15th, 1915. (Divided application on 2,701/16.) (103,300.)

315. Ignition Dynamos. C. T. Mason. March 15th, 1915. (Divided application on 2,701/16.) (103,656.)

THE
ELECTRICAL REVIEW.

VOL. LXXX. APRIL 6, 1917. No. 2,054.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: April 6, 1917. [No. 2,054.

	Page
The Metric System ...	365
Our Export Trade with Spain ...	366
The Rochdale Corporation Electricity Supply Undertaking (*illus.*) ...	367
Electric Fires, by "Hot Air" ...	368
Public Electric Vehicle Charging Stations in Great Britain (*illus.*) ...	368
A Large Carron Electric Cooking Installation (*illus.*) ...	370
Decimal Coinage and the Metric System ...	372
Some Points in Connection with Engineering Specifications...	373
New Electrical Devices, Fittings and Plant (*illus.*) ...	374
Legal ...	375
Correspondence—	
Decimal Coinage ...	375
War Items ...	376
Comparison of Electric Winding Systems ...	376
An Internal-Combustion Turbine (*illus.*) ...	378
Business Notes ...	379
Notes ...	381
City Notes ...	384
Stocks and Shares ...	386
Some Notes on Bonding and Earthing the Lead Sheathing of Underground Cables, with Special Reference to Solid Systems, by G. W. S. ...	387
Equipment of King George Dock, Hull (*illus.*) (*concluded*) ...	388
New Ash and Clinker Equipment for Central Stations (*illus.*)	389
Reviews ...	390
Foreign and Colonial Tariffs on Electrical Goods ...	391
New Patents Applied for, 1917 ...	392
Abstracts of Published Specifications ...	392
Contractors' Column ...	Advertisement page xx

THE ELECTRICAL REVIEW.
Published every FRIDAY, Price 4d.
The Oldest Weekly Electrical Paper. Established 1872.
TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE 1–4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.
Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.
AUCKLAND N.Z: Gordon & Gotch, Albert Street: The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.
BRISBANE: Gordon & Gotch, Queen St.
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LAUNCESTON: Gordon & Gotch, Cimitiere Street.
MELBOURNE: The Mining & Engineering Review, 90, William Street; Gordon & Gotch, Queen Street.
MILAN: Fratelli Treves.
NEW YORK: D. Van Nostrand, 25, Park Place.
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto 1° 307.
SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.
WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE "ELECTRICAL REVIEW'S"
ELECTRICAL & ALLIED TRADES DIRECTORY
(THE RED BOOK),
1917 EDITION
IN THE PRESS.
H. ALABASTER, GATEHOUSE & KEMPE,
4, Ludgate Hill, London, E.C. 4.

THE METRIC SYSTEM.

THE arguments in favour of the adoption of decimal coinage and metric weights and measures were admirably stated by Mr. Harry Allcock in his lecture before the Institution of Civil Engineers last week. In passing, we may be allowed to congratulate the Institution on the progressive spirit which it has displayed in organising these series of lectures on commercial and financial aspects of the engineering industry; however laudable may be the desire to maintain the proceedings of our great engineering societies on a high plane of technical propriety, it cannot be denied, even though it has been ignored in the past, that the engineer is everywhere confronted in his work by the all-important question of costs and balance-sheets, and himself is usually under the necessity of earning a livelihood by his profession. Hence, an ostrich-like pretence that trade and finance have no concern for him is mere affectation, and we are glad to see that both the civil and electrical engineers have begun, somewhat shyly it may be, but effectively, to recognise their responsibilities in this connection.

While we do not profess to have covered all the ground that was so ably traversed by Mr. Allcock—though he did us the honour to quote freely from our pages, with frank acknowledgment—we may at least claim that in the main our efforts and his to bring this matter to a head have proceeded upon parallel lines, and we are so fully in agreement with his contentions that we need not discuss them at length—our views are well known to our readers. The conversion of our coinage to a decimal system is so simple a matter that it hardly calls for comment; the tide seems to be flowing strongly in the direction which, we have contended, involves the least disturbance to accustomed values—namely, the retention of the sovereign as the fundamental unit, decimally sub-divided. The value of the British sovereign is familiar to all nations, but if any system based upon the penny were adopted, not only would the whole of our gold and silver coinage have to be scrapped, but also we should throw away that useful, though not indispensable, world-wide acquaintanceship, and the difficulties to be overcome at home in effecting the change would be magnified a hundredfold.

With regard to metric weights and measures, it is interesting to note that while our canvass of 1915 showed a result of 80 per cent. in favour of the change, that of the British Engineers' Association in January last showed from 83 to 87 per cent. in favour—a decided advance upon our figures.

In the discussion which followed the lecture, the weight of opinion and the sentiment of the audience appeared to be distinctly favourable to the author's contentions. Sir Guilford Molesworth, Mr. Oliver Bury, Mr. C. P. Sparks—speaking for the Council of the sister Institution—Mr. E. C. Barton, and Dr G. B. Hunter all spoke with deep conviction as to the necessity, not merely the desirability, of making the change, especially in view of the imperative requirements of our foreign trade. Sir Archibald Denny, while opposed to the movement, apparently on the ground that it might lead to such extravagances as the adoption of 10 hours in lieu of 24, and the division of the year into 10 months, &c., admitted that he was advocating an unpopular cause. May we point out that the very essence of the movement is to promote international uniformity, and that this purpose could not be served by such proposals as those to which he objected? Prof. Unwin remarked that five-eighths of the trade of the world was carried on by the United States and the British Empire, on the basis of English units of length (he had no objection to the adoption of the kilogram); has it not occurred to him that of that trade the vast bulk consists in the import or export of unwrought materials, such as coal, cotton, wool, grain, other foodstuffs, oil, metals, &c., the whole of which are measured in terms of weight or volume? Not only does Prof. Unwin's argument afford no support to the inch unit of length—it does not appear to be based upon correct premises, for according to *Whitaker's Almanack*, the value of the world's trade amounted to about 6,000 millions sterling in 1911, of which the British Empire and the United States together were responsible for some 2,500 millions—less than half; allowing for the countries not committed wholly to metric units, we find that roughly one-half of the world's trade in 1911 was conducted on the metric system. The fact, mentioned by Prof. Unwin, that on the issue of the standard sections of the British Engineering Standards Committee, the Germans at once began to make those sections, merely proves their eagerness to export iron and steel to us—not that there was any special virtue in inch measurements.

Mr. Aspinall cited the opinion of Mr. Coleman Sellers in opposition to the use of the metric system in the workshop. Be it noted that Mr. Sellers is stated to have used the metric system in his shops for *twenty years*! before he arrived at that decision; either, therefore, he was exceedingly slow in making up his mind, or the disadvantages were of so little moment that they did not become apparent to Mr. Sellers until after an extraordinarily long period of probation. On the other hand, we think Mr. Sellers may have been influenced by the consideration that his customers, mainly American and British, used the English system, and therefore he had to do the same: now, *our* customers use the metric system very largely, and soon almost all our foreign markets will be wholly metric. As for the argument put forward by Mr. Aspinall, that every one of one and a half million wagons would have to be reweighed and retared at a cost of no less than 5s. each—a total of about £400,000—surely he does not expect us to take him seriously. Are the present tares correct? If so, a reference to a table of equivalents, and a few minutes' work with a pot of paint and a set of stencils will effect the change at a cost more fairly stated at 5d. each. On the other hand, is it not the case that every railway wagon has to be retared in English units at frequent intervals? Mr. Aspinall further asked whether our internal trade within the Empire or our foreign trade was the most important to us. Possibly he is not aware that Australasia, as Mr. Barton pointed out, will not wait; the legislatures of both Australia and New Zealand have placed the metric system on their statute books, with only one clause preventing its immediate enforcement—a clause providing that it shall await the action of the Mother Country. If we do not act now, that clause will surely be repealed. We shall soon be left behind by the rest of the Empire—and can it be seriously questioned whether our internal trade is more important than our external trade? As Dr. Hunter vigorously pointed out, the question is a commercial one. It is not for us to choose—we must meet the wishes of our customers, and that quickly.

Our Export Trade with Spain.

We trust that British manufacturers and exporters, both with and without the assistance of the Foreign Office, which was recently organising a Spanish trade tour, are devoting a greater measure of attention to the possibility of developing trade with Spain. If they do not do so they may leave the Germans in possession of the field to a much greater extent after the war than was the case prior to the outbreak of hostilities. Some of the Spanish newspapers have already pointed out the gravity of the German danger to Spanish trade and industry, and suggested that prompt steps should be taken to meet the evil. It is estimated that, including the additions which have been made during the past two years, there are now 80,000 Germans in Spain, forming a nation within a nation, and being, in the words of the Madrid *Liberal*, an organised nation within a nation which is asleep. The newspaper also publishes extracts from an official document, which is stated to have been forwarded to one of the Allied Governments by "an illustrious sailor who had come to Spain as an official representative."

According to this extraordinary document, "the Germans who have sought refuge in Spain have profited by the frank and democratic nature of the people in order to introduce themselves everywhere and form friendly relations in particular with the provincial authorities, the mayors, military chiefs, naval commanders, officers of the gendarmerie, Custom House officials, and the heads of public services such as the posts and telegraphs, police, civil administrations, &c." As a consequence, it is affirmed that all diplomatic notes presented by the Allies receive evasive replies. "Practically, the Germans have all the Spanish services in their hands, and utilise them as they please. This organisation, to which the Allies have nothing similar to oppose, extends all over the country, and is particularly manifested in the ports. The refugee ships enjoy great liberties—the fruit of numerous kindnesses—and are the general quarters of the Germans." The document is held, further, to demonstrate that "Spain is a vast German naval base, favoured by the authorities of the country." It seems, the newspaper adds, "that the Government may at last decide to react. It can regulate the situation simply by applying the elementary rules of strict neutrality. As to the Allies, their action is inorganic; they are even incapable of directing, encouraging, and enlightening their Spanish partisans."

The fact that such a staid and respectable newspaper as *El Liberal* has given publicity to extracts from the remarkable document in question shows that the reality of the German danger is becoming recognised in the Spanish capital. It is unfortunate, however, that the Madrid newspaper has not presented any facts of its own—facts which must of necessity be known in Spain. It is to be hoped that our Madrid contemporary, and the other newspapers which have now realised the Teutonic danger, will investigate thoroughly the question as to the extent to which the Germans are endeavouring to secure control over Spanish natural resources. If they would also throw some light on the manner in which contracts are placed with German firms by the military authorities, the information would be of value in circles outside of Spain. At the same time, we must bear in mind that a considerable amount of German business in Spain has been done from stocks held in the country by branches or agents of German firms in different parts of Spain, with headquarters in Madrid. If British firms desire to have a large increase in their turnover with Spain, they will have to follow this example, either individually or in combination, since the larger orders generally pass into the hands of those who also carry out the small, or comparatively small, transactions, even in electrical manufactures and accessories, light, railway materials, &c.

THE ROCHDALE CORPORATION ELECTRICITY SUPPLY UNDERTAKING.

The total capacity of the plant installed in the power house of the Rochdale Corporation amounts to 9,000 kw. The original equipment comprised three 1,000-kw. "Witton" turbo-generators driven by Howden turbines, these working at 5,800/6,600 volts, three-phase, 3,000 r.p.m.; while the later instalments of generating plant took the form of two 3,000-kw. "Witton" turbo-alternators coupled to Howden turbines, also running at the high speed of 3,000 r.p.m. The Howden turbines are of the pure impulse type, designed to give their output at a high efficiency, with a liberal margin of overload. The casing and diaphragms are divided on the horizontal centre line, the first three stages being arranged for partial admission and the later stages for all-round admission. The disks are constructed of special Siemens-Martin steel forgings, accurately balanced. The rim of each disk is provided with an inverted T-shaped slot to receive the blades and spacers, the gateway at which these are introduced being subsequently closed up by a patented process. The running clearances of the plates in both the axial and radial directions are approximately $\frac{1}{8}$ in.

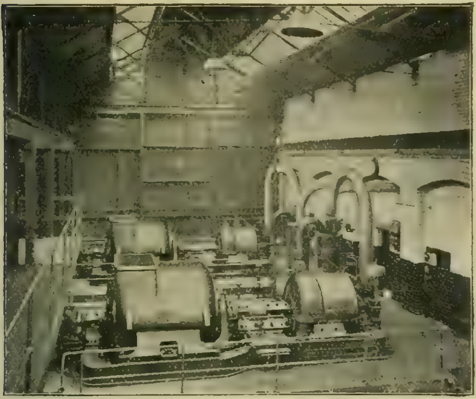


Fig. 1.—Howden-G.E. Co. 3,000-kw. Turbo-generators.

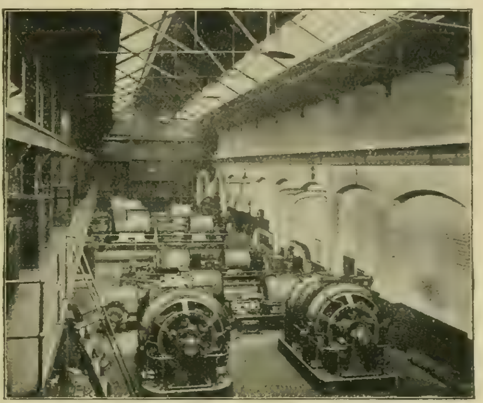


Fig. 2.—General View of the Rochdale Turbine Room.

As will be observed from the accompanying illustrations, continuous bedplates are provided to take the turbines and alternators. The oil tank is situated in the middle section of the bed-plate, and is equipped with a cooling arrangement which maintains the oil in circulation, and also the bearings at a very moderate temperature. A powerful governor is provided, and is driven by worm gear from the turbine shaft. By means of an oil relay acting on the throttle-valve, the governor controls the speed within very close limits, approximately 1 per cent. variation from full-load to no-load. The "Witton" alternators are of the General Electric Co.'s design and construction, having solid steel rotors with machined slots, in which the exciting conductors are laid, the mouths of the slots being subsequently closed by metallic wedges.

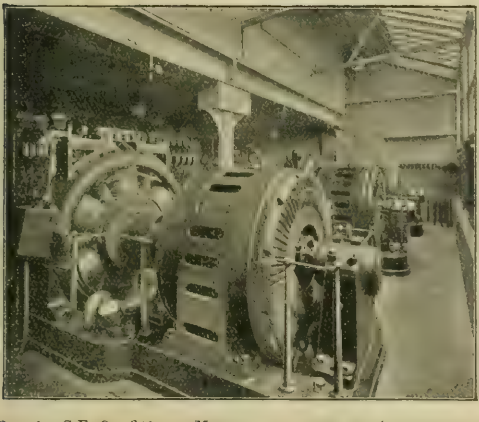


Fig. 3.—G.E. Co. 300-kw. Motor-generators in Sub-station.

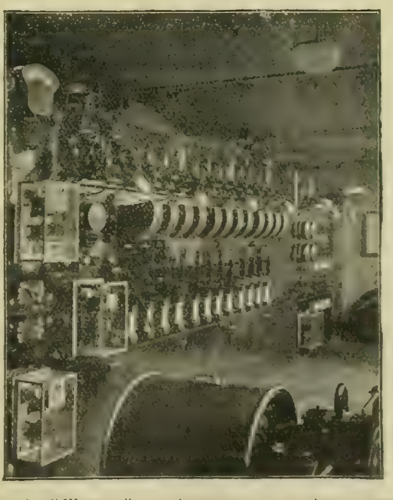


Fig. 4. "Witton" d.c. Switchboard in Sub-station.

In the turbo-generators, as is usual in "Witton" machines, great attention has been devoted to the ventilating arrangements, separate cooling draughts of air being drawn in through wet air-filters by fans carried on the rotor shaft for cooling the rotor and the stator respectively. The windings are strongly braced, giving adequate protection against short circuits. The machines are liberally rated, as proved by the fact that both generators are frequently run by the Corporation with a load of 4,000 kw. for 12 hours on end, without showing any sign of overheating either in the stator or in the rotor.

The station plant includes two 500-kw. motor-generaters for supplying the local continuous-current requirements, the town mains being supplied at a pressure of 240—0—240 volts on the three-wire system; the machines can also be utilised to supply power to the tramway, at a pressure of 500 to 550 volts, through a change-over switch. These motor-generator sets are shown in fig. 2, and run at a speed of 500 R.P.M., the motors being of the synchronous type.

The Rochdale Corporation has a number of outlying sub-stations for supplying various works, and a typical example of these is illustrated herewith. This sub-station contains three "Witton" synchronous motor-generators, running at a speed of 750 R.P.M., which are illustrated in fig. 3, while a view of the controlling switchboard distributing the direct-current supply to the works is shown in fig. 4.

The electrical generating plant for this installation was supplied by the General Electric Co., Ltd., of Witton, Birmingham, Messrs. James Howden & Co., Ltd., of Glasgow, being the main contractors and manufacturers of the steam turbines.

We are indebted to Mr. F. H. Rudd, A.M.I.E.E., the acting borough electrical engineer, for permission to publish these particulars and illustrations.

ELECTRIC FIRES.

By "HOT AIR."

"For each kilowatt-hour of electrical energy put into any type of electric heater, the same amount of heat is furnished. There may be some minor advantages in using one type of heater in preference to another type, but this advantage never consists in getting more or less heat units from a kilowatt-hour of electrical energy. This fact needs to be kept constantly in mind when discussing the advantage of electric heaters."—Prof. Osborn, in the *Electrical World*.

The theory that "all the heat which goes into a radiator must come out of it, and that therefore the efficiency of every radiator must be 100 per cent.," may pass muster in the lecture room; but without attempting to controvert any law like those of the Medes and Persians, I submit that in practice this equality is not apparent. Speaking from the experience of one who has this winter sold (not hired) 1,000 electric fires from a showroom displaying fires by 10 different makers, I submit that two fires can be produced, each with the same current consumption, giving results as dissimilar as a 16-C.P. carbon lamp taking 64 watts and a 60-watt metallic lamp. The laboratory experts' claim that the heat must come out does not concern the purchaser. When a 3-KW. fire of a certain well-known maker is put against a 2-KW. fire of another make, I will guarantee that five times out of six the 2-KW. fire will be preferred for actual radiant heat, quite apart from the saving in current consumption. Where does the heat thrown off by the inefficient fire get to? Does it lurk around the fire frame, or does it hover around the ceiling? Probably the latter; but as our fires are sold to human beings, and are not intended to benefit ceiling-walking flies or Mahommed coffins, the heat that gathers above the head of the average man is as good as wasted.

I can understand the cool reception given to "Experiment's" suggestions by the makers, because it is obvious that when one has to get a fire by a "well-known maker" sent on by rail when he succeeds in making a sale, his experience hardly warrants him in assuming the *rôle* of adviser, and his ideas are apt to be a trifle crude. Let him stock at least one or two of each of the various makers' fires, and he will, I suggest, discover that there are already on the market several fairly satisfactory designs. My own experience has been that makers gladly adopt any sane modification or suggestion put forward regarding their apparatus.

"Experiment" holds up the American manufacturers as models in this respect, but while I admit they are in a class by themselves for electrical table cooking appliances, irons, and vacuum cleaners, I find that we have nothing to learn from them in the matter of electric fires. This indiscriminate decrying of ourselves should cease.

I think most electrical men will agree that the experience of the past two winters has gone to show that heating by electricity has a greater future than some of the quidnuncs were wont to credit. Altogether, I should say the future is very hopeful. Prof. Osborn, already quoted, opines that for dwelling houses electric heating at 1 cent per KW.-hour costs three times as much as heating by coal (with coal at 30s. per ton), but this statement may be fairly put alongside of that of a speaker at the American N.E.L.A. that "the best electric water heater on the market is the coal stove." "Evidently," he added, "the Almighty didn't put enough calories into each kilowatt to make electric water heating feasible." Strange, indeed, that we should have to encounter this damning talk from electrical men. But the business will go ahead, in spite of these gentry.

PUBLIC ELECTRIC VEHICLE CHARGING STATIONS IN GREAT BRITAIN.

In view of the interest which attaches to the official list of charging stations recently published by the Electric Vehicle Committee, to which our readers are referred for full information in regard to charging facilities, tariffs, &c., and in order to stimulate those supply undertakings—still very numerous—who have as yet taken no steps to support the Committee in its endeavour to secure that such facilities shall be available wherever practicable, we have decided to publish the accompanying map indicating, as far as possible, the localities which are mentioned in the official list as offering charging facilities.

The practice of publishing route maps indicating where charging stations are to be found, is one which is followed by the New York Electric Vehicle Association in connection with its annual handbook of charging stations in New York City and vicinity, and one which our own Vehicle Committee might well adopt, either now or in the near future in connection with the metropolitan area. Our small inset map shows the position of London in regard to public battery charging stations, the main roads being indicated by dotted lines.

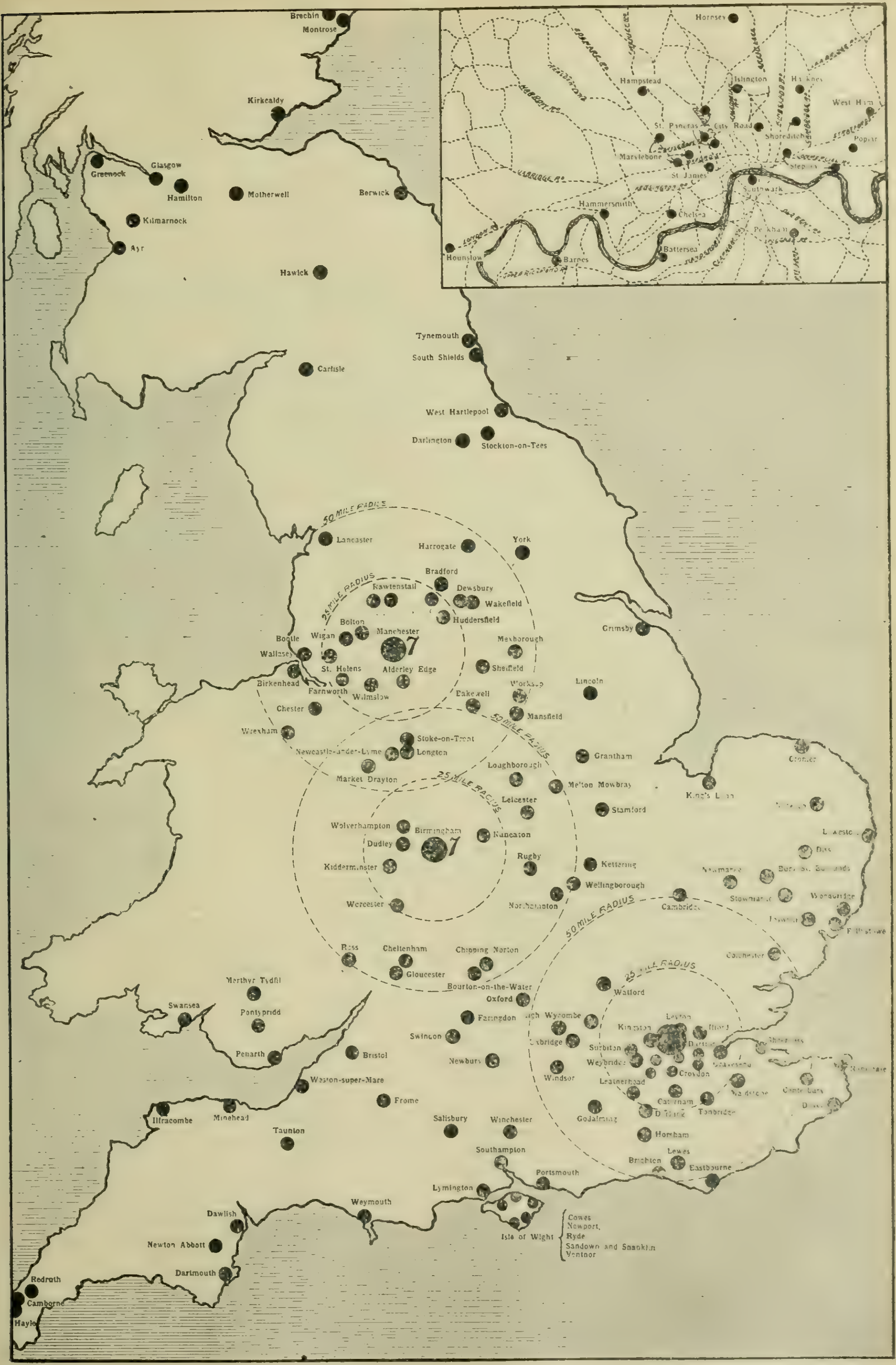
The stations are situated as follows:—

Barnes, High Street, Mortlake; Battersea, Lombard Road: Chelsea, 19, Cadogan Gardens; Southwark, Sumner Street: Clerkenwell, Graham Street; Peckham, 124, Hill Street; Hackney, Dalston Lane: Hammersmith, 85, Fulham Palace Road; Hampstead, Lithos Road, Finchley Road; Hornsey, Tottenham Lane: Hounslow, Bridge Road; Islington, 50, Eden Grove, Holloway: Poplar, Violet Road, Bromley-by-Bow: St. James (Westminster), Marshall Street, Golden Square; Marylebone, (1) Richmond Street, St. John's Wood, (2) Blandford Street, (3) Edison Acc., Ltd., Stourcliffe Street; St. Pancras, (1) Regent's Park, (2) Tavistock Place, (3) Highgate; Shoreditch, Whiston Street, Haggerston; Stepney, (1) 27, Osborn Street, Whitechapel, (2) Narrow Street, Limehouse: West Ham, Bridge Terrace, Stratford High Street.

The list is a modest one, all things considered, for such an ideal electric vehicle area as London, but we hope that progress under normal conditions will enable us to state in the not-distant future that, like the New York City Map, that of London is dotted with charging stations and garages.

On the question of garages, an American contemporary states that the Central Park Electric Garage, which is operated under the auspices of the New York Electric Vehicle Association (and which was illustrated and described in our issue of July 2nd, 1915), used during the year 1916 nearly 300,000 KW.-hours for charging purposes, and made more than 30,000 deliveries of, and calls for, cars. In February, 1915, when it opened, 77 cars were garaged; now that number has been practically doubled. Another contemporary from across "the pond" quotes Mr. Edison as deploring the lack of charging facilities as a hindrance to the growth of the electric vehicle business. He considered that central stations should go into the electric garage business because of the intelligent supervision which they can give, and suggested that they should sell electric current in the form of mileage, and perhaps rent out under contract the washing and repairing of vehicles at fixed and reasonable charges.

Mr. Edison is, of course, an enthusiast, but even so—having regard to his personal interest in the matter—his view that "the growth of the electric vehicle has been hindered by the lack of charging facilities," should carry



Public Battery-charging Stations for Electric Vehicles in Great Britain. Charging Stations in London shown inset.

considerable weight with electrical men on this side, and induce those who are in a position to do so, to provide such facilities when required.

Although battery charging facilities do not necessarily involve the establishment of a garage, the latter should always include the former, and, in view of the opposition of certain sections of the motor (car) trade to the proposed clause in the Bill to be promoted by the M.E.A., to enable appropriate charging and garaging facilities to be provided by municipal authorities, it would be interesting to learn whether these motor traders are willing themselves to install the requisite electrical charging plant, and to provide the necessary technical supervision.

Up to the present they have shown no disposition to do this, and were the electrical contractor a little more enterprising, we know of no reason why the sale, repair and garaging of electric battery vehicles should not remain in the hands of the electrical trader, instead of being tacked on, as a sort of side line, to the petrol-car industry.

A LARGE CARRON ELECTRIC COOKING INSTALLATION.

Through the courtesy of Messrs. Carron Co., we are able to illustrate some of the features of the apparatus, comprising a large installation of over 300 kw., which has recently been completed, also of other apparatus manufactured at their works in Stirlingshire.

Fig. 1 illustrates one of many electric ranges consisting of three standard ovens measuring 22 in. wide by 22 in. deep, by 20 in. high, constructed of cast-iron, with porcelain-enamelled steel linings throughout; it is double cased and heavily lagged, whilst the usual top and bottom heaters are fitted in all of them. Each oven is fitted with a toughened glass inspection window, and thermometer if required. The hobs on these ranges carry their standard fillings, of which there are two, each measuring 29 in. by 22½ in., and another filling under which is mounted the grill. These fillings, which are machined quite flat, each have three boiling sections of various sizes and loadings, and the whole plate can be utilised for cooking operations, whilst, of course, the individual sections are working at a much higher temperature than the rest of the plate.

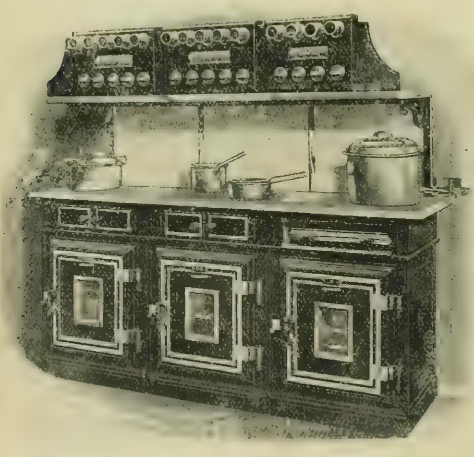


Fig. 1.—Range of Three Standard Ovens.

Some of these have been in operation over a year for many hours at a time, with very satisfactory results. The loadings of this range are: ovens 5.5 kw. each, grill 4 kw., hob fillings 6 kw. each, making a total of 32.5 kw.

At the back of the hob is mounted a white porcelain enamelled splash plate, on which brackets are fixed for carrying the switchboard which has been extended over the hob, thus making it much more convenient for the cooks to operate the switches. Each heating element is arranged for three heat series-parallel control by means of the rotary indicating switches, which, with the fuses and pilot lights, are mounted on the board. Also, the ruby glasses in the pilot lights have etched upon them the element or section corresponding to that which the switch beneath it operates.

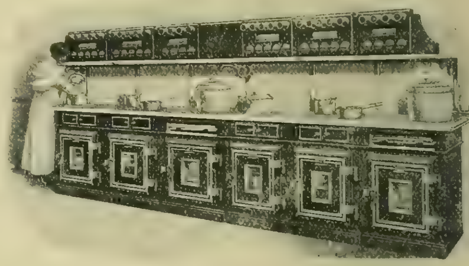


Fig. 2.—Large Carron Electric Cooking Range for Factory use.

The finish on four of these ranges installed in one particular factory engaged on Government work is bright nickel-plate and bright stove black enamel. Fig. 2 illustrates a bank of six of these ovens.

The Carron method of standard units of ovens, hob fillings, &c., lends itself admirably to extension and ready assembly on site, as well as handling for transit.

The hot closet illustrated in fig. 3 is one of eight installed in the same works as the ranges described above. Each measures 22 ft. overall in length by 2 ft. 9 in. high by 2 ft. 6 in. deep, and contains four compartments, with three shelves, all separately heated by standard interchangeable patent Carron elements. The bodies are of cast-iron, with mild steel sliding doors, whilst the linings and shelves are all of white porcelain-enamelled steel sheets with facings of half-round steel, nickel-plated, and polished.

Each section is rated at 5.25 kw., making a total of 21 kw. per hot closet, and the heat regulation is such that three heat series-parallel control is obtained in each shelf. In this case, the rotary indicating switches and fuses are mounted on the ends and in the centre of the equipment, the finish of which is bright stove black enamel, with hob and facings nickel-plated and polished.

The boiling table illustrated on fig. 4 is one of five in the same equipment, and is designed on the same principle as the standard fillings described in the ranges, the only difference being that they are cast in one solid piece, carefully machined quite flat on the top and the element receiving surfaces underneath.

These tables each measure 6 ft. long by 2 ft. 6 in. high by 2 ft. deep, and are arranged for seven rectangular boiling sections, which are shown in our view, rated at loadings varying from 2.5 to 1.2 kw., and giving a total of 17 kw. per table.

All the elements are interchangeable, and are readily accessible, but owing to the robust construction, renewals are cut down to a minimum.

Solid bus-bars are used for the main connections where possible, and heavy-gauge nickel wire for the remainder, no loose beaded wires entering into their construction whatever.

On the back of the table is mounted a 16-in. cast-iron skirting, and over this is mounted the control board, which carries a rotary indicating switch to give three-heat series-parallel control for each section. These, along with the fuses and pilot lights, with numbered etched ruby glasses to correspond with the sections, complete the equipment of a table. the finish of which is bright black stove enamel with nickel-plated and polished facing and mouldings.

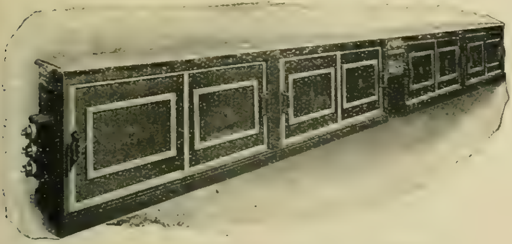


Fig. 3.—Hot Closet installed at a Factory.

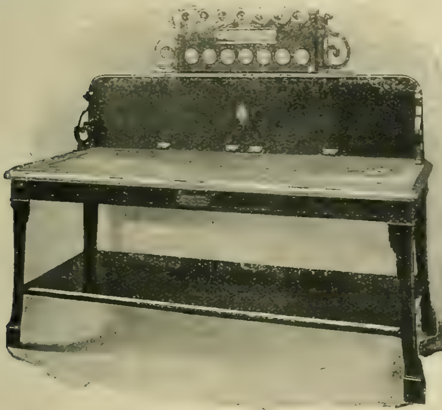


Fig. 4.—Boiling Table, showing Rectangular Boiling Surfaces.

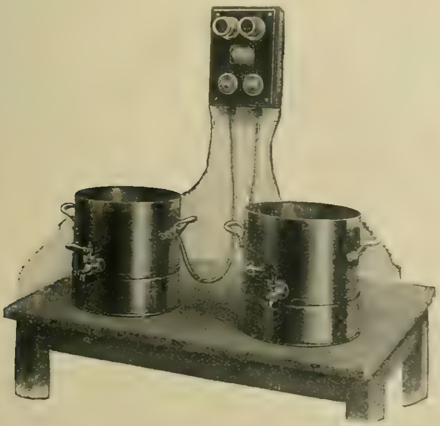


Fig. 5.—Electrically-heated Stock Pots.

Fig. 5 illustrates two six-gallon copper stock pots, each self-contained, and rated at a maximum of 5 kw. These are also wired up to the usual three-heat rotary indicating switches on a standard board.

In addition to the foregoing, a number of Carron standard independent 10-in. boiling disks are used in these kitchens, which are rated at 1.6 kw., and are self-contained, with the usual heat regulation. There is also a 6-ft. hot closet similar to the larger ones, and a 3-ft. boiling table similar to the larger one illustrated, only rated at half the loading, these bringing the total loading of the plant up to 332.8 kw.

The installation of this plant has been going on for over a year, and it has not yet been working at its maximum capacity, but the results so far obtained are very satisfactory, and will no doubt lead to similar developments in other factories and works now that the welfare of the employés is receiving more attention at the hands of our industrial concerns.

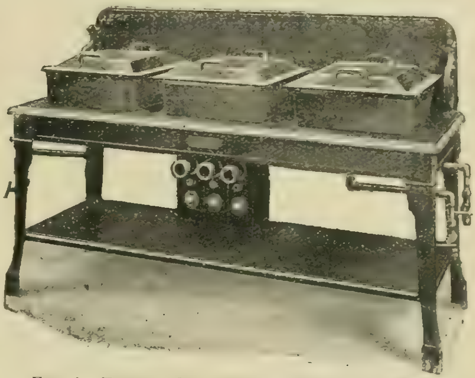


Fig. 6.—Electric Fish Frying and Boiling Suite.

In addition to this installation, the Carron Co. have, during the last two years, supplied equipment for kitchen and canteen installations in many controlled and Government establishments throughout the country.

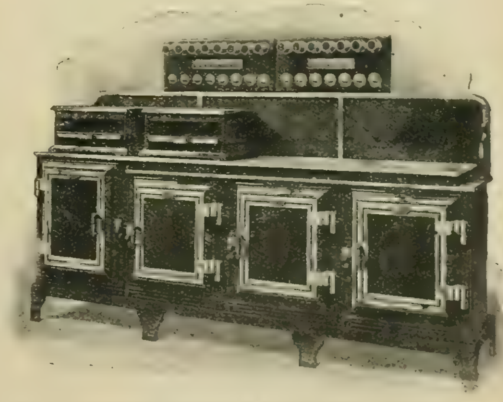


Fig. 7.—Cooking Range with Pastry Oven and Grill.

The fish frying and boiling suite shown in fig. 6 consists of three pans, each measuring 20 in. by 18 in. by 4½ in., fitted with wire basket, lid, and draw-off tap, and rated at a loading of 4 kw.

These pans are separately controlled by three-heat rotary indicating switches, mounted in cast-iron switch boxes, along with the fuses and pilot lights and fitted underneath the table. The switch boxes are built up on the elastic principle, and can be extended to any capacity required. A deep skirting is fitted at the back, and the total loading of this suite is 12 KW., the finish being bright black stove enamel.

The range shown in fig. 7 is similar to the earlier ones described, except in capacity, and the addition of the grills. The smaller ovens are the standard size, loaded to 5.5 KW. each, whilst the larger one on the left-hand side is a pastry oven, having three compartments each measuring 22 in. wide by 22 in. deep by 8 in. high, all heated top and bottom, arranged for three-heat control, and the complete oven having a maximum loading of 5 KW. Over the ovens are two 18-in. grills, and a baking table for scones, &c., the loading of the grills being 5 KW. each, whilst they are arranged for various degrees of heat regulation. The baking table measures 4 ft. 6in. by 2 ft., and is loaded to a maximum of 10.5 KW., also being arranged for various degrees of heat regulation.

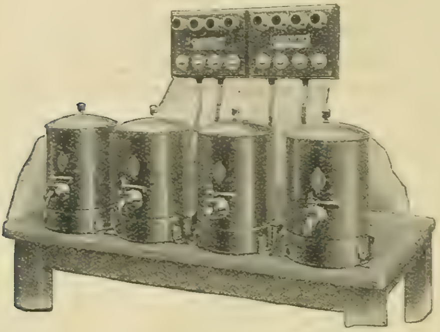


Fig. 8.—Battery of Electrical Boilers for Ships' Use.

The total loading of the equipment therefore amounts to 42 KW., and the overall dimensions of the suite are 9¼ ft. long by 6 ft. high by 2 ft. 6 in. deep, whilst the total weight is 1½ tons, but being built in sections it is easily portable.

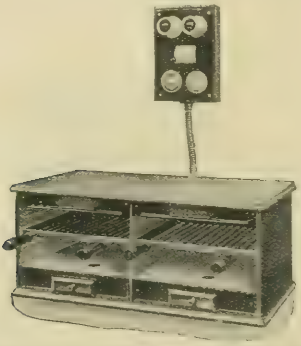


Fig. 9.—Double Compartment Electric Grill.

In fig. 8 we illustrate a battery of four five-gallon boilers, strongly but plainly made of heavy-gauge tinned copper; these are wired for 5 KW. each, and are arranged for various degrees of heat regulation. They are connected to a switchboard which mounts pilot lights and fuses in addition to the rotary indicating switches. These boilers have been specially made for use in ships' galleys, and are accordingly equipped with suitable swill ledges and strong lugs for fixing to the tables, whilst all the leads are enclosed in water-tight flexible metallic tubing.

The grill illustrated in fig. 9 is a double-compartment appliance, loaded to a maximum of 8 KW.; it has the usual fittings, and is finished in white porcelain enamel inside.

DECIMAL COINAGE AND THE METRIC SYSTEM.

In accordance with the decision of the Council of the Institution of Civil Engineers to hold a series of meetings to discuss questions relating to the economic aspects of the engineering industries, on Tuesday last week, on the invitation of the Council, Mr. Harry Allcock delivered a lecture on the decimal system of coinage, weights, and measures. The lecturer emphasised the necessity of preparing for the development of trade after the war, and remarked that international trade tended to follow the lines of least resistance; we must, therefore, smooth the ways in order to facilitate the flow of abundant trade to our workshops, and thus to provide employment and ensure prosperity in the future. Dealing first with our monetary system, Mr. Allcock traversed the history of the subject in this country, and, having shown that the vast majority of the world's peoples had adopted decimal systems of coinage, he discussed the objections which had hitherto prevented the introduction of such a system in this country, in spite of the persistent demands of chambers of commerce, municipal authorities, and other important public bodies for legislation to effect it. Comparing the various proposals that had been put forward, he expressed a strong preference for the adoption of the florin as the standard coin, divided into 100 cents, and showed that the values of the sovereign and half-sovereign, and of all our silver coins, would be unaffected, the only change being a reduction of 4 per cent. in the value of the penny.

Next taking up the subject of weights and measures, Mr. Allcock pointed out the defects of our existing "system," and the widespread adoption of metric units, and argued that any attempt at reorganising our existing standards without making them uniform with those of other countries would be futile. Every country which had reformed its units had adopted the metric system—never the British system. As for the United States, which was still non-metric, the manufacturers of that country had hitherto been engaged mainly in supplying the domestic market and English-speaking non-metric countries, and had not been seriously confronted with the problem. If we adopted the metric system the United States would be certain to do likewise—and the converse was equally true. Russia, the third important State that had not yet adopted the metric system, nevertheless employed it to a great extent; our adhesion to British measures greatly hampered commercial intercourse with that country, and Russian correspondents of the lecturer continually urged our adoption of metric units. It had been argued that we might adopt the metric system individually and by degrees; but, just as the "Daylight-saving" scheme was only made possible by making it compulsory, so it was impossible for individual firms to put themselves out of harmony with their neighbours in respect of weights and measures. By a canvass of engineering firms carried out by the Electrical Review in 1915, it was shown that there was a majority of 4 to 1 in favour of decimal coinage and the metric system, and a canvass carried out by the British Engineers' Association on a larger scale recently showed a majority of 83 to 87 per cent. in the same sense. Owing to a clause in the draft Bill, manufacturers were protected from interference with their plant and processes, and each could fix the date of change to suit himself, or continue to employ English units if he preferred. Existing patterns, &c., could continue to be used until they were worn out, when they could be replaced on metric lines. Mr. Allcock proceeded to read lengthy extracts from our last article on the subject (Electrical Review, March 23rd, pp. 313-316), showing that the workshop objections to the adoption of the metric system were largely based on misapprehension, that standards and tools need not be scrapped, and that the British Engineering Standards Committee's specifications would not be rendered useless by the change. He concluded by emphasising the importance of adopting metric units in design.

Opening the discussion, Sir **Guilford L. Molesworth** described how he had been instrumental in introducing the decimal system of coinage in Ceylon, in the teeth of influential opposition; although the population consisted mainly of Cingalese and South Indian natives, no difficulties were experienced in effecting the change; the results gave general satisfaction, and within six weeks the matter was forgotten. At a later date he had almost succeeded in bringing about the adoption of the metric system on the Indian State Railways, when political events intervened and prevented the consummation of his efforts.

Mr. Oliver Bury suggested that the advantages of the decimal system were obvious to members of that Institution, who probably used decimals more than any other profession Many official reports had been presented in favour of the system, yet the Bills were thrown out by Parliament in spite of the mass of petitions in support of them. Was it due to conservatism, or to our having made money in the past too easily to be disposed to take the trouble of changing? But the times had changed. In the course of 16 years' residence in South America he had experienced the disadvantages of our existing systems, and he could not too forcibly impress upon his hearers the urgent necessity of learning the language and adopting the metric weights and measures—the two great factors essential to the maintenance of our trade with South

America. Spanish was now taught in London, and Portuguese was being provided for; but we must quote only in the metric system. He urged that a Member of Council should be deputed to impress upon the educational authorities the point that decimals must not only be *taught* in the schools, but also *learnt*—a very different thing. Finally, he suggested that a vote of the whole of the members of the Institution should be taken on the subject of the lecture.

Mr. C. P. Sparks (Pres. I.E.E.) said that these lectures on commercial questions were of the very greatest value, and the closer cohesion of the engineering societies must give the best results. The Council of the Institution of Electrical Engineers, in its recommendations to the Board of Trade Committee on the Electrical Industries, had advocated the compulsory adoption of the metric system. It was easy to see why the electrical industry was in favour of that system, but it could not be adopted sectionally, and the matter was primarily a trade question. If we were satisfied with our existing trade, there was no more to be said; but if we wanted the oversea trade, we were bound to have the metric system. Whether the United States or Great Britain took the initiative, the other must follow; let us, then, lead the way! The adoption of a universal standard system was quite feasible, and must make for the advantage of civilisation.

Sir A. Denny said he was surprised that 90 per cent. of engineers were in favour of the decimal system, but many people confused "decimal" with "metric" unnecessarily. Laplace stated that the metre was purposely chosen with a different value to any other measure to prevent jealousy; it would have been infinitely better if he had chosen the fathom. The original metric system had embraced many other matters besides weights and measures, all of which had been dropped. What would be forced upon us after metric weights and measures had been adopted? Why did not the metric people change the metre to 40 inches? Our inch was a good unit of length—why be hounded into changing it?

Prof. W. C. Unwin said he had no objection to decimal coinage, or the kilogram, but to change the unit of length would most seriously affect the work of engineers. As regarded foreign trade, five-eighths of the trade of the world was carried on by the United States and the Birtish Empire on the English system of units. Scientific men used the metric system because science was international, but it did not follow that it would be equally advantageous to engineers. The American Association for the Advancement of Science had formed an Association to promote the adoption of metric measures, but the American Society of Mechanical Engineers had formed an Association to defend the British units, and clearly America was not ripe for the change. He was informed that for trade with Russia there was no need to use any other than the English units; hence Russia was not ripe for change. In Japan the old units were in popular use, as well as the English units, except in the Army. The British Engineering Standards Committee, in translating its specifications into French, Spanish, and Russian, would place the metric values alongside of the English units; the Committee had also decided that certain metal sections should be standardised purely on the metric system. When our standard sections were first introduced, the Germans took steps to obtain identical sections from their rolling mills.

Mr. J. A. F. Aspinall cited Mr. Coleman Sellers's conclusion, after 20 years' experience of the metric system, that the system was not suitable for use in a mechanical engineer's workshop, and pointed out that Mr. Sellers occupied in the United States a position analogous to that of Sir Joseph Whitworth in this country. He had made inquiries as to the effect on different railway departments of the adoption of the metric system, and found that the change would involve a large outlay; all weighing machines would have to be altered, as well as all gas meters, and the tares of all wagons, private or railway owned. For this purpose 1,600,000 wagons would have to be weighed, and allowing 5s. per wagon the cost would be £400,000 for this purpose alone. The Metric Bill alone would not suffice to cover many points, which would require further legislation. It was proposed to develop trade with our Colonies, and, if we adopted the metric measures, should we not have to maintain a dual system? The question was whether our internal or our external trade was the more important; if the latter, that must settle the matter.

Mr. Ravenshaw remarked that of drawings which came before him some were in inches, some in millimetres, and some a mixture of both; in design it was important never to mix units—one or other system should be used, and if an exception was necessary, the dimension should be enclosed between brackets.

Mr. E. C. Barton said that Australasia had sent her premiers, not once or twice only, to ask us to do something in the matter, as they were sick and tired of the old units. Australia was not lagging behind; she had backed the decimal weights and measures. She had children to educate, and could not wait. He had been lecturing all over the country on the subject, but was wasting his time, for he found every meeting in favour of the change. The reason why Mr. Coleman Sellers and the other United States toolmakers opposed the metric system was because they were accused of being in league with Dr. Stanton, of the Bureau of Standards, to compel manufacturers to replace their tools, and they therefore declared themselves against the change.

Prof. Lupton said that the advocates of the metric system had failed to convince engineers and now sought to impose the system on them by compulsion. Once compulsion was started, where would it stop? He had nothing against the metric system, except that people tried to make it compulsory.

Mr. E. A. W. Phillips said it was difficult to work with vulgar fractions in the metric system. The metre was not international, being based on the Paris meridian, whereas the inch was the 500,000,000th part of the polar axis. We had a British metre of 39.6 inches directly descended from the old Belgian yard, and he saw no reason why we should change our units.

Mr. Monckton, whose remarks were almost inaudible, stated that the Japanese Navy was adopting metric standards, and that Russia employed them.

Dr. G. B. Hunter said he had not heard any arguments against the decimal or metric system. Our oversea customers wanted it—why should we not adopt it? The opposition was due to conservatism and old-fogeyism; whether the metre were right or wrong, we must adopt it eventually—it was the only unit that would help us as a trading nation. Let us be practical—where a change would do good, let us adopt it; where otherwise, leave it alone.

Mr. Hanson considered that the educational aspect of the question had not been sufficiently pressed. Millions of children were learning obsolete, useless tables, and it was a most serious matter; the time saved could be utilised for useful studies. In Russia the metric system had practically been adopted; there were four other systems in vogue, and all of them might be met with on the same drawing. He urged that we should come into correspondence with the rest of the world.

In reply to the discussion, Mr. Allcock welcomed the sound advice of Mr. Oliver Bury with regard to South America, which applied equally to other parts of the world. He had that day heard our system called the British "wastes" and measures. Mr. Sparks's support was evidence that electrical engineers were wholeheartedly in favour of the metric system. With regard to Professor Unwin's remarks, he stated that, in an American symposium on the subject, the mechanical engineers were the only body opposed to the metric system. In reply to Mr. Aspinall, he pointed out that the longer the change was delayed the greater would be the cost. If our external trade were not already more important than our internal trade, it certainly must be in the future if we were to survive. Mr. Ravenshaw's remarks were in favour of the use of a *single* system. The word "compulsion" seemed to be an obsession with Professor Lupton, but unless compulsion were accepted the present condition of dual measures must persist. With regard to Mr. Phillips's arguments, it was impossible to consider a third system. He was obliged to Mr. Monckton for his information regarding the Japanese Navy; China also was contemplating the early adoption of the metric system.

SOME POINTS IN CONNECTION WITH ENGINEERING SPECIFICATIONS.

The paper by Mr. J. Shepherd was read and discussed at a meeting of the Manchester Local Section of the Institution of Electrical Engineers on February 27th.

Mr. S. J. Watson said there were a number of difficulties in purchasing fuel on the calorific value basis. Although several collieries in the Lancashire district had been approached on many occasions, not one would enter into a contract for a supply on this basis. The percentage moisture varied very considerably with the same quality of coal, particularly the "washed-fuel" grade; in some cases this figure was about 15 per cent. Coal allowed to remain in railway trucks for some days during summer, for instance, would absorb 7 or 8 per cent. moisture. The grading of fuel on the basis of size had a considerable effect on the burning value, and the speaker suggested that the specification should provide for dividing up the fuel into definite sizes starting, say, with washed fuel at 1½ in. and going down to, say, ¼ in., or even smaller. With regard to cable conduits, undoubtedly for thickly populated districts with expensive excavations the "draw-in" system was the correct one; in other cases, however, cables laid on the solid system would give better results. The author's suggestion to allow extra-difficult work to be included in the total contract price, rather than to make provision outside the contract itself by means of a schedule, was a very valuable one.

Mr. G. D. Seaton said the best method of drawing up specifications was to define the conditions and results to be obtained, leaving the contractor to meet the requirements with standard products, if and when suitable. The lengthy general conditions in some bulky specifications suggested that many engineers were not aware how simply a satisfactory result could be obtained. In municipal trading rigid adhesion to the policy of accepting the lowest tender had been responsible for very serious losses.

Mr. S. Ferguson said a manufacturer should not be required to read through a lot of superfluous matter when preparing a tender. General conditions, for example, should be standardised on the lines laid down by the Institution of Electrical Engineers, thereby obviating the necessity of special attention. Municipalities would help manufacturers considerably if they deleted the 10 per cent. retention money on small contracts, say, less than £500 For quite large Government contracts for plant, full payment had been made after the final test. Regarding the technical requirements, switchboard specifications should be either (*a*) complete in every detail, including drawings or diagrams, or (*b*) a bald statement as to the plant to be controlled, leaving the manufacturer to offer the most suitable gear. An important item sometimes omitted from specifications was the current density in current-carrying apparatus. Specifications for oil-break switches rarely specified the inherent reactance of the plant to be controlled, and this was a vital matter; reactances varied from 2½ per cent. to 15 per cent., which meant that the duty imposed upon the former switch was six times that on the latter for the same size of plant. The system of inviting tenders as outlined by the author was not liked by manufacturers, on account of the fact that standard apparatus was not usually suitable, the design of the purchaser having to be adopted. This demanded special tools and, furthermore, it was quite conceivable that purchasers' designs would not take advantage of the progress being continually made. Government inquiries for switch-gear called for magnetic blowout circuit-breakers and knife switches without hinged contacts; both these requirements had been abandoned by leading manufacturers. The bill of quantities was very rarely included in present-day specifications.

Mr. W. Kidd said there was in many cases a preference for an intermediate course between the purchaser specifying in detail and simply asking for results; if carefully drawn up, intermediate-type specifications would obviate a tremendous amount of correspondence by giving the contractor details of conditions affecting the scheme. The guarantees should also be clearly stated. Purchasers should specify that curves showing effect of variation of such matters as steam pressure, vacuum, &c., in the case of turbines, temperature and humidity of atmosphere in the case of cooling towers, be submitted with tenders, otherwise the guaranteed results could not be checked. The method of test should also be specified. Trouble frequently arose from insufficient information as to accessibility of site, use of tackle, builders' work, &c. Pipe work and supports were matters for which the purchaser should take full responsibility. The general arrangement and principal dimensions of sub-station switchgear should certainly be standardised. Other points to be specified by purchasers were limits of current density and temperature rise, performance of transformers, and power factors of motors. A more general adherence to the B.E.S.C. specifications would benefit both purchaser and contractor.

Mr. Robertson said that no engineer would attempt to issue working drawings or draft close specifications for such items as turbo-generators, but it was essential to give a description of such plant and the nature of the tests to be applied, in order to prevent misunderstanding. The old-time procedure in regard to the detail in specifications was not at all necessary nowadays. Whilst he did not defend the biased conditions of contract issued by purchasers 10 or 15 years ago, he thought the B.E.A.M.A. conditions went to the other extreme and caused a good deal of trouble, which had not been altogether removed by the conditions of contract put forward by the Institution of Electrical Engineers. What was the object of advertising if only firms of ripe experience were to be selected? If this practice were adopted, each class of work would become confined to two or three firms and the smaller firms would gradually be frozen out. As experience had already proved, such a condition would result in being tied to standard designs and standard prices. Those who had been purchasing coal during the past few years looked upon the idea of purchasing on calorific basis as a vision quite unattainable at the present time. The principle was undoubtedly correct, but the market had to be properly educated to it. Some years ago he purchased coal on this basis from about 16 pits, but a coal agent offered to supply any quantity of coal from the same pits in certain proportions at 9d. per ton less than the colliery proprietors' agents offered, provided the calorific clause was dropped; the experiment was tried and found quite successful. This proved that the severe conditions in the specification caused the collieries or agent to put a margin on the price to safeguard themselves. Some 15 or 16 years ago a pipe system was laid down in a district adjoining Manchester, and in changing from low to high tension recently, cables and wall boxes had been withdrawn of sufficient value to pay for the new high-tension and substation mains. This was mainly on account of the rise in residual values. He did not consider it desirable to give public work on contract where the local authority was also the supply authority; it would probably pay in every case to engage a sufficient number of workmen or call in help from other departments. There was an unknown risk which the contractor had to cover when pricing his tender. A system of measurement such as indicated by the author meant constant supervision and checking, and even then disputes arose. There was still plenty of room for co-operation between purchaser and manufacturer, at least in standardising ideas.

Mr. J. Frith agreed with Mr. Robertson's criticism of the B.E.A.M.A. conditions, as they were certainly not to the advantage of the purchaser, and, in the long run, not to the advantage of the manufacturer. In the present state of the industry it was not always sufficient to state what was wanted and leave it to the manufacturer. The purchaser knew the local conditions which rendered certain methods of manufacture unsuitable, and in that case it was necessary to state both results and methods to be used in getting the results. In the specification for the purchase of coal it was not stated whether the higher or lower calorific value was used. The Institution of Civil Engineers had lately decided that the lower calorific value was to be used in power plant testing, also the lower value was to be the higher calorific value minus 1,055 times the moisture plus nine times the hydrogen in each pound of coal. The use of the lower calorific value was an admission that the moisture in the flue gases should not be condensed.

The Author, in reply, said it was an extraordinary thing that coal, of which there was an output of something like 300 million tons per annum in this country, was really the only mineral practically all sold without analyses. Regarding moisture, claims could be made against the coal dealer, but for every sixpence allowed the next tender would cover it. Mr. Watson said the percentage moisture varied according to mode of transit. This was not so, as coal conveyed by steamer showed a difference of 1 to 1½ per cent. after shipment, whereas the moisture in Yorkshire coal might be as high as 14 per cent. Regarding Mr. Seaton's view that the proper way to buy plant was to state views to the manufacturer and leave it to him to attain the desired result, engineers had their opinions on this point, and whilst many turbines had been specified and sold in this way the designer had not in every case acquired the knowledge to build reliable turbines. If exact requirements were specified, experience had shown that tenders could be accepted from unknown firms, provided the shops were visited in order to ensure that they had the tools and tackle to handle the contract. Regarding retention money, it was quite equitable wherever there was maintenance to retain a small proportion, say, 10 per cent., until the maintenance period expired. A point was raised about causing contractors trouble in making patterns and drawings. The contracts referred to never included less than two or three dozen articles. It might be the ideal method for the seller to supply standard articles, but when buying switchgear, say, 20 times, and getting 20 different types and sizes, the matter had a different aspect. It was surely up to the customer to pay for what was demanded. Regarding Mr. Kidd's valuable remarks on general conditions, British trade in the future was not likely to be built upon large documents, or even small documents like the B.E.A.M.A. conditions. It would have to be built on the system of trust and fair dealing, which had always been a criterion of British industry. Everyone would agree that the purchaser should get out his own pipes, otherwise there would be considerable trouble. The British Standard Specifications were all right up to a point, but they did not go far enough. The coal specification had worked successfully for 10 years.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Simplex Combination Pin Plug and Lampholder Adapter.

Messrs. Simplex Conduits, Ltd., of Garrison Lane, Birmingham, have introduced a useful accessory in the shape of a combined pin plug and lampholder adapter, illustrated in fig. 1, which enables a lamp standard, small heater, toaster, or suction cleaner to be connected up to either a standard two-pin wall plug or a lamp socket, whichever connection is most convenient for the particular situation where it is to be used. The two parts of the combination are connected by a small brass chain. When used to connect any small circuit to a lamp socket, the combination converts the lamp socket for the time being into a two-pin socket, and the pin plug can be used to connect up in the ordinary way; if, however, temporary disconnection is required, the pin plug can be removed and remains ready to hand (suspended by the chain) for reconnection. It thus gives the convenience of a switch, breaking circuit on both poles, and the pin points are "dead," and therefore safe, after removal, no portion of the circuit remaining alive.

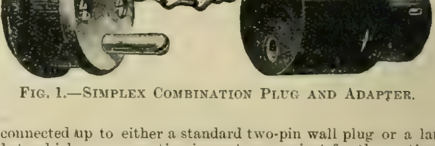


Fig. 1.—Simplex Combination Plug and Adapter.

The adapter is substantially constructed, the lampholder attachment consisting of the brass connecting plugs moulded into fireproof material, or cocus wood, and the plug points being mounted on a china head with fibre disks for convenience in wiring. It is suitable for any temporary circuit up to 5 amperes at 220 volts, and is made in two sizes, to fit 3 and 5-ampere standard plugs and holders.

"Calorite" Electric Heating Apparatus.

A list recently issued by the British Thomson-Houston Co., Ltd., of Mazda House, Upper Thames Street, E.C., gives particulars of a wide range of lamp radiators, electric fires, convectors, irons, &c., of British manufacture. In electric fires, a large variety is shown, from the simple one-bar portable type loaded to 1 kw., for heating small offices, bathrooms and the like, to powerful fires taking up to 4 kw., and suitable for the largest apartments. The coil type fire-bars are of the Quead type, standardised at 1 kw., and can readily be renewed if necessary; the elements reach a red heat within a few moments of being switched on. Several forms of "Calorite" non-luminous and semi-luminous convectors are illustrated, suitable for use in entrance halls, corridors, public rooms, workshops and other places where no glow is required, and are listed in a number of forms. "Calorite" wire is used for the elements, the loadings ranging from 500 to 2,000 watts, according to size and type.

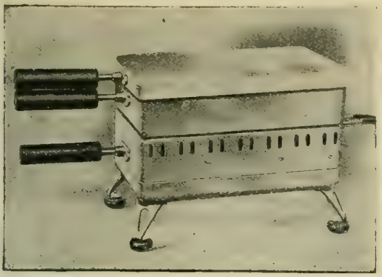


Fig. 2.—"Calorite" Radiant Grill.

The famous "Calorite" flat irons are listed, covering all sizes of smoothing irons with "Calorite" elements, for both domestic and laundry use. The new "leaf" detachable heating unit is designed to heat the sole evenly without raising unduly the temperature of the handle and upper part of the body. Domestic irons are supplied in sizes from 4 to 8 lb., and with loadings from 400 to 600 watts, the laundry models being made up to 18 lb., with proportionately higher ratings. For industrial and domestic purposes, "Calorite" hot plates and soldering irons are offered. The former is rectangular in form, and of cast-iron, mounted on four substantial legs, and fitted with elements loaded to 1,000 watts. Electrically-heated soldering irons operate continuously at the correct soldering temperature, and may be used out of doors without risk of cooling. Other useful devices listed include the "Calorite" radiant grill and toaster for table use, and the "Calorite" kettle. The radiant grill is an extremely neat and handy cooker, which may be used for grilling, toasting, stewing, or frying. The device, which is here illustrated (fig. 2), takes 600 watts only, and may be operated from any lampholder.

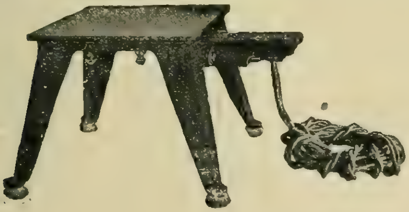


Fig. 3.—"Calorite" Hot-Plate.

The kettles are listed for 2—¾ pints, and are rated at 500 to 700 watts.

An Improvised Military Telephone Exchange.

This type of improvised exchange has been used in the battery, and has been found to work very well. It is made quite easily from very simple materials, which can be obtained always, says Lieut. W. P. K. Warren, R.A.G., in the *Journal of Artillery*. It is an eight-line exchange, and two telephones are used. The scheme of working is as follows:—

Referring to the diagram, fig. 4, strips of thin brass A are screwed to the base block, and have their ends bent up to clear strip B. Strips C are also screwed to the block, and are bent to clear strips A and also strip D. Contact between the various strips can be made by inserting a plug, of bent brass, at any of the points where the strips cross. Normally plugs are kept in all along bars B and D, and calls from the various stations are received in one or other of the telephones. The diagram shows the arrangement of the plugs when Billets is speaking Flank O. P.

They get no interference from other lines, and the battery exchange operator can tell when they have finished by putting in his plug to telephone now and again.

When shooting is in progress, and a clear line from a battery telephone to an O. P. (observation post) is needed, the other three lines are transferred to the other telephone by moving their plugs up one place. Thus no line is, even temporarily, cut off.

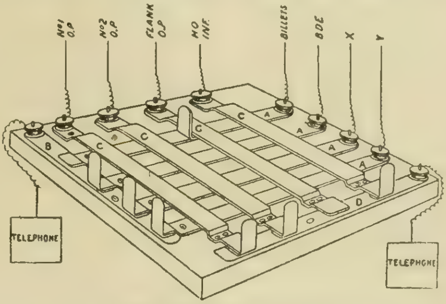


Fig. 4.—Improvised Telephone Exchange.

The brass is cut from an 18-pounder cartridge case. The terminals come from worn-out telephone cells. The base is 8 in. square and 1 in. thick, and should be well soaked in melted candle grease. The two terminals X and Y are used for the other section of the battery and the other battery of the brigade.—*Telephone Engineer.*

LEGAL.

Agreements with German Cable Companies Ended.

A series of motions for judgment in default of defence on behalf of the Eastern Extension, Australasia, and China Telegraph Co., Ltd., the Eastern Telegraph Co., Ltd., and the Europe and Azores Telegraph Co., Ltd., against the Deutsch-Niederlandische Telegraph Co. and the Deutsch-Atlantische Telegraph Co., which had taken over the business of the German Submarine Telegraph Co., came before Mr. Justice Coleridge in the King's Bench Division on March 29th.

Mr. R. O. B. Lane (instructed by Bischoff, Coxe, Bompas, and Bischoff), who appeared for the plaintiff companies, said the motions were all in actions brought for declarations that certain cable contracts and agreements with the German companies were void owing to the war, and should be terminated. The plaintiff companies took action after full consultation with the Foreign Office, and with their concurrence. No appearance had been entered on behalf of the defendants, though all proper steps had been taken.

His Lordship made an order in each case as asked, terminating the contracts and agreements.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Decimal Coinage.

Having read the able article in your issue of the 23rd inst. with much interest, I venture to suggest some simplification of the scheme proposed for the reform of our coinage.

Why should we not simply retain the sovereign and its tenth part, the florin, as proposed by the Electrical Review, but, instead of importing such a very un-English coin as the cent, continue to use the half-florin, or shilling, and make ten pennies go to a shilling instead of twelve?

The useful sixpence could still be retained, but it would have to be called "fivepence" instead. The half-penny would also be retained, at the rate of 20 to a shilling.

Crowns, half-crowns, four-shilling pieces, and even the ecclesiastical threepenny-bit should be abolished, as they only tend to confuse foreign visitors (and even natives), and give an enormous amount of unnecessary trouble in banks and counting houses where large quantities of cash are handled.

Farthings should be abolished. It is difficult to see what is the use of a farthing to a country that spends six and a-half million pounds a day on war. They are merely a nuisance: the product of the "retail mind," which ought to be scrapped along with them.

The change-over would be simplicity itself: the scrapped silver coins would be called in, and re-struck into florins shillings and five-penny pieces. The copper would also be called in, and pennies and half-pennies re-issued the following day at the rate of 10 and 20 a shilling respectively, instead of 12 and 24.

Steps would, of course, have to be taken to prevent enterprising persons from accumulating copper for the rise in value. That would present no real difficulty.

Retail shopkeepers might scream, but all they would have to do would be to consider the enhanced value of the penny and the halfpenny when writing out new price tickets on the next weekly turn of the profiteering screw. Incidentally, the delusion that the draper makes only a farthing per yard on materials sold at, say, 11¾d., would disappear. The advantage of this scheme would, I venture to submit, be enormous. In the first place, the retention of the penny would save from the scrap heap all the existing penny-in-the-slot meters, telephone apparatus, toffee machines, automatic weighers that wón't weigh, and other plant. The system would have British characteristics, but, at the same time, it would be a true decimal system lending itself to every operation of arithmetic and book-keeping with the greatest facility.

I venture to assert that it would have a definite effect on the number of our allies and friends visiting this country after the war, who would no longer have to add an extraordinary and mystifying coinage to the other difficulties of our strange land. At the same time, unless I am ignorant of some important factor, the scheme presents the very minimum of difficulty or delay in its adoption.

G. W.

[We welcome our correspondent's letter; but would his scheme really retain the *penny?* He takes the ".5-cent" piece and calls it the "penny," but the change in the value of the nominal penny would be 20 per cent. increase, whereas the 4 "cents" would have a value only 4 per cent. less than that of the existing penny. We are unable to agree that a smaller coin than a halfpenny is unnecessary.—Eds. Elec. Rev.]

WAR ITEMS.

Prohibited Imports and Exports.—Proclamations signed on March 30th, prohibiting a large number of imports and exports, appear in the *London Gazette* for March 30th.

Trading with the Enemy.—The "London Gazette" for March 30th contains a list of additions, &c., to the list of bodies and persons with whom trade is prohibited in Argentina and Uruguay, Brazil, Chile, Colombia, Netherlands, Spain, Sweden, &c.

From Bangalore.—A Lieutenant with the Forces at Bangalore writes:—"The Review reaches me regularly each week, and it is always a pleasure to dip into its pages and so keep in touch with familiar names and associations, and all that goes on at home affecting electrical interests."

Hong Kong and Enemy Trading.—A Press dispatch states that the Hong Kong Chamber of Commerce at the annual meeting passed a resolution confining membership of the Chamber to British subjects. Resolutions were also passed favouring legislation limiting Government orders to British firms, for the prevention after the war of revival of the use of enemy trade-marks, and opposing the return of enemy subjects to the colony.

The British Trade Corporation.—In reply to a question in Parliament, Mr. G. H. Roberts, M.P. (Board of Trade), said that Lord Faringdon had been invited to proceed with the formation of an institution on the lines recommended by his Committee on Finance and Trade after the War. The preliminary steps had been taken, and the British Trade Corporation would very shortly be formed under Royal Charter. The object of the Corporation would be to afford credit facilities for British trade, especially in cases falling outside the scope of existing banks and banking houses.

Pre-War Contracts.—The President of the Board of Trade has appointed Lord Buckmaster (Chairman), Mr. C. S. S. Guthrie, Mr. Lennox Lee, Mr. F. D. Mackinnon, K.C., Mr. Walter Raine, Mr. F. G. Rice and Mr. T. Worthington to be a Committee to consider and report on the position of British manufacturers and merchants after the war in respect of contracts entered into by them prior to the war with persons or companies in the United Kingdom or in Allied or neutral countries, the fulfilment of which has been prevented or impeded by the war, and as to the measures, if any, which are necessary or desirable in this respect.

Exemption Applications.—At Swindon, the Corporation Tramways Committee appealed for a brake-fitter (33), passed in B1. Mr. A. Dimmack, electrical engineer, said that the Army had failed to find a substitute, as hoped. He had a "scratch" staff now, and it was very difficult to carry on the work. Two months' exemption granted.

At Stoke-on-Trent, Mr. W. Thorn, manager of the Potteries Electric Traction Co., reported that he had agreed with the Military authorities to release 21 men in Class A, who are to be released when substituted. Lieutenant Malkin said that arrangements had been made with the Army authorities for the return to the company's service of skilled men who were not in the higher categories, and as these returned the Class A men would be released. The Tribunal acquiesced in the arrangement.

At Northallerton, the Electric Light Co., Ltd., appealed for a member of the staff, and the secretary intimated that if the man was called up the only alternative would be to close down. Exemption was granted until a substitute is provided.

At Chatham, the Tramway Co. appealed for four motormen, a switchboard attendant, an assistant overhead lineman, the chief clerk, and a storekeeper and traffic clerk. The manager, Mr. W. Jensen, said that the lineman had been passed for general service, although he had a withered hand. The chief clerk and one motorman were each exempted until June 1st, and the others were directed to serve when substitutes were provided.

Rawmarsh Tribunal have granted conditional exemption to a tramway switchboard attendant (21), three motormen, and a stoker and repairer engaged at the tramway depôt.

At Shipley, F. Buckle, an employé of the District Council electricity department, was exempted till July 31st, and T. Hull, an employé of the same authority, was given till September 30th.

At Burnley Tribunal, Mr. Starkie, electrical engineer, appeared in support of the claims for three switchboard attendants, two aged 21, the other 19, and also for an apprentice electrical engineer, aged 18 (all single men). Mr. Starkie stated that his staff had been reduced to an absolute minimum, and he considered it would not only be undesirable, but dangerous if any more were taken unless they were substituted by practical men. The Chairman said the three men were very young. The electrical engineer stated that they were very capable; they had control of the switchboards and were approaching the end of their apprenticeship. They were badged men, and held trade cards. The Chairman said if the men still retained their badges and trade cards they would not be called up. Mr. Starkie withdrew the appeals of the three switchboard attendants. The claim respecting the 18-year-old apprentice was non-assented.

At Brighton, the Military had a review made of conditional exemption allowed to five employés at the Corporation electricity works. The engineer stated that 83 men had enlisted from the works, and the present staff was about 180, as against 220 or 230 before the war. A fuseman (33, in Class B1) was given a final month; a fitter's labourer (38, B1), two months; a labourer (37, C2), a switchboard attendant (40, C1), and a wireman (33, C2), four months each.

At the Shoreditch Tribunal, a firm of electrical engineers and contractors appealed for the second time for J. Green, aged 37, an electrical fitter, class C3. He was engaged on important electrical work, and such men were very scarce nowadays. The Tribunal decided that, in view of the man's classification, he would be much better engaged in carrying on electrical work, which was undoubtedly of national importance at the present moment. The Tribunal granted six months, and advised Green to try to do V.T.C. drills.

COMPARISON OF ELECTRIC WINDING SYSTEMS.

A recent issue of the *Colliery Guardian* contained an abstract of a paper on the above subject, read before the South African Institution of Electrical Engineers, by Mr. S. E. T. Ewing, from which we reproduce the following extracts:—

Sufficient experience is now available with both alternating-current and Ward-Leonard winding plants to make it evident that either type can economically and safely carry out all the present requirements of main winding engines, and that definite advantages appertain to each type, making each commercially and technically preferable under given circumstances. The principal operations which main winding engines are required to perform are: Shaft sinking; winding from one level; winding from several levels; raising and lowering men; lowering timber, pipes, drills, and general machinery and supplies; dead slow winding for shaft and rope examination, repairs, &c. All these operations are normally carried on in balance, *i.e.*, with both drums clutched to the driving shaft. Operations which usually necessitate out-of-balance running, *i.e.*, with one drum unclutched, are: Taking off, turning end for end, or renewing main and tail ropes; adjustments for stretch of ropes; alterations of rope lengths for drawing from different levels, &c.

Apparently only one deep level shaft has been sunk with electric plant, viz., the Cinderella Deep South Shaft. The obvious danger inherent in electric winding in relation to shaft sinking is the possible failure of power after the lighting up signal for blasting has been given. At the Cinderella, where direct three-phase motors were used, the difficulty was got over by the use of a synchronous machine coupled to a flywheel floating on the winder bus-bars, which was put into commission at blasting time. Ward-Leonard plant, with the Ilgner flywheel arrangement, would, of course, equally well meet this difficulty. Further, the adoption of electric blasting would remove the difficulty entirely. Main winding at the present purchased price of power on the Rand being admittedly far more economical than steam winding, the economic advantage of sinking with electricity is patent, provided the load factor of the plant does not fall too low

The economy of the Ward-Leonard system when winding from one level is greater in so far as the acceleration losses are smaller, and, further, if and when the speed-time curve for the wind involves braking in order to secure a rapid retardation near the surface, this braking is performed regeneratively. On the other hand, the economy of the alternating current plant is greater in so far as it has no motor-generator losses. Hence the relative economy under the same mechanical conditions is a function of the frequency of winding. The important point to bear in mind is that while the maximum frequency of winding is limited and defined by the general conditions, the average may be much lower, and it is therefore essential, if a proper comparison is to be arrived at, to estimate this average correctly. It is obvious that the lower the frequency of winding, the greater the gain to the alternating current, and conversely, the higher the frequency the greater gain to the Ward-Leonard. For example, it has been found that the consumption per hour is equal for the two engines discussed at a frequency of 12.5 trips per hour, the maximum frequency being 30, and the average 25.

Assuming that the estimated frequency of winding is sufficiently high to show a clear gain for the Ward-Leonard in power consumption per ton hoisted, it then becomes necessary to consider whether the capitalised value of the power saved is sufficient to cover the additional capital cost of the Ward-Leonard equipment, which would presumably in all cases be in the neighbourhood of 50 per cent. in excess of the alternating current equipment. In general, a winder is operated steadily for a spell of perhaps seven or eight hours, with an idle spell of four to five hours, twice daily.

Experience has shown that the maintenance cost of both types of plant is quite small relatively to that of a steam plant. Other things being equal, the Ward-Leonard plant, with its two large sets of brush gear and commutators, entails more maintenance than the plain induction motor of the alternating current plant. On the other hand, a certain amount of attention is required by the forward and reversing switches and liquid controller of the latter.

From the point of view of safety in winding, neither type offers any marked advantage over the other. Relative ease of handling for winding depends mainly on whether the conditions do or do not require a reversal of the direction of torque on the drum shaft. The simplest condition, most favourable to alternating current control, is the case where uniformly balanced running is secured by means of a tail rope, and at the same time the energy of the moving system is recovered by shutting off power and allowing the engine to "run out," timing the moment of shutting off so that the skip comes to rest in the tip with a minimum application of the brakes. Several large alternating current winders are running under these conditions, and the ease of control leaves nothing to be desired. The contrary condition is that in which no tail rope is used in a deep level shaft, and consequently the weight of down-going empty skip and rope exceeds, at and below a certain point in the shaft, the weight of the full up-coming skip and rope. To tip the skip then necessitates a reversal or torque on the drum shaft, or the application of the brakes. The brakes merely waste energy, and in the case of the alternating current plant a reversal of torque means a corresponding dissipation of energy in the controller. On the other hand, with a large Ward-Leonard control, the negative work is absorbed regeneratively and with perfect ease of control.

The most important point arising from winding from several levels relates to the necessity for frequent clutching and unclutching of drums. The difficulties arising therefrom apply equally to alternating current and the Ward-Leonard plant.

Under ordinary conditions it is not practicable to assure an up-coming load of men to balance a down-going load. Hence, in cases where a large number of men have to be handled, the Ward-Leonard system, on account of its regenerative properties, shows a distinct gain in economy. In a particular case, where approximately 900 men form the complement on one shift, a single Ward-Leonard winder using three-deck cages holding 60 men, and lowering the shift in one hour to 3,800 ft., the net input of energy over the hour is practically nil, the regenerated energy sufficing to wipe out the motor generator and winding motor losses. Raising and lowering men present no particular difficulty to the alternating current plant, but where a large complement is handled the Ward-Leonard plant has a clear economic advantage.

The regenerative property of the Ward-Leonard again offers an advantage where, as in large mines, the quantity of timber, pipes, rails, and drills lowered is very considerable, and is always in excess of the weights of drills raised. One, if not the greatest, source of trouble with the earlier alternating current plants arose out of this matter of lowering. It is, of course, perfectly feasible to lower at synchronous speed, and also to apply reverse current when braking, but designers appear to some extent to have overlooked the fact that under the latter conditions a large amount of additional energy has to be dissipated at the controller. Overheating and flashing over at the latter resulted. The alternating current plant is essentially less economical than the Ward-Leonard when lowering at less than the synchronous speed, and in practice only a small portion, if any, of a lowering trip can conveniently be done at synchronous speed.

Again, no difficulty arises in practice in dead slow winding for shaft examinations, &c., with either type of plant. On the score of ease of handling, the Ward-Leonard has the advantage, because a definite speed, however slow, corresponds to a definite position of the controller lever, whereas in the case of the alternating current plant the liquid controller is sensitive and subject to fluctuations in resistance at low speeds. On the score of economy, the Ward-Leonard is greatly superior, the input being practically proportional to the speed, whereas in the case of the alternating current the input during slow winding amounts to nearly the same as would be required for full-speed winding over the same period. As ropes are examined at least monthly, and shafts at least weekly, and the operation in each case for a 4,000-ft. shaft occupies an hour or more, this latter becomes of some importance.

Every winding engine should be capable of raising its full-rated skip or cage capacity when working single drum, *i.e.*, *unbalanced*. The motor must be capable of exerting the full necessary torque under unbalanced conditions, both to be in accordance with the regulations for safety, and also in order to be able to perform various operations in connection with the replacement of ropes, both main and tail. As these operations are comparatively infrequent, there is a natural tendency to cut down the size of the motor to a point where it can only perform this work under rather severe overload conditions. When this is the case, the alternating current is apt to give trouble at its weakest point, the liquid controller, and the Ward-Leonard probably at the corresponding weak point, the commutator of the motor generator. Anything of this kind which renders probable the opening of the main control switch on overload is apt to be exceedingly dangerous, because at the moment the power fails the engine is supporting its maximum unbalanced load; and an accident can only be averted by the holding power of the brake on one (the clutched-in) drum. It is obvious that this kind of underestimate of the conditions cannot occur in the case of plants that run normally without tail ropes, as do several of the largest electric winders on the Rand. The point is one of considerable importance. The even turning movement of an electric winder renders the use of a tail rope (which is apt to sway with the uneven turning movement of a steam winder) a perfectly simple proposition, and its use naturally reduces the peak load, with a corresponding reduction in the motor rating. On the other hand, it has to be borne in mind that the design of the plant must allow of sufficient torque being developed to raise the full unbalanced load without any signs of overstrain. In the case of the alternating current, owing to the large overload torque possibilities of the induction motor, compromise is not difficult, and resolves itself mainly into an extra large controller. In the case of the Ward-Leonard plant, it seems doubtful whether full security under maximum torque conditions is compatible with the considerable reduction in rating which the use of a tail rope renders possible under normal conditions.

The foregoing remarks apply to the conditions on a number of mines, where the depth is between 3,000 and 4,000 ft., and the tonnage hoisted is not greater than 160 tons per hour. The new deep level shafts will attain depths considerably over 4,000 ft. At such depths it is difficult to secure the minimum requisite factor of safety in hauling ropes, and therefore the pros and cons of two-stage winding are likely to come again under discussion. Further, the additional power required tends to place the single large direct-connected induction motor out of court, owing to the excessive size and low-power factor. Mechanical reduction gear for these large motors is, as far as Rand practice is concerned, quite untried. Altogether, therefore, it may be assumed that a new and highly-interesting series of problems still lies before the designers of electric winding plants, and that finality in size and design has by no means yet been reached. The following summarises such of the foregoing remarks as refer to direct comparison of the alternating current and Ward-Leonard systems under different conditions:—

Conditions.	A.C.	Ward-Leonard.
1. Shaft sinking	Equally effective on all points at approximately equal capital cost.	
2. Rock winding from one level		
(*a*) With tail ropes	Relative economy dependent on frequency winding. Lower capital cost. Equal safety and ease of handling	
(*b*) Without tail ropes	Lower capital cost	Superior economy over all. Easier to handle.
3. Rock winding from several levels	Lower capital cost	
4. Raising and lowering men	Lower capital cost	
5. Lowering supplies	Lower capital cost	
6. Dead slow winding	Lower capital cost	

AN INTERNAL-COMBUSTION TURBINE.

In view of the importance to the electrical engineer of any device offering a prospect of solving the problem of the gas turbine, the following particulars, by Mr. A. W. H. Griepe in *Power*, should be of interest :—

The machine described is rated at 100 h.p., and has made a number of runs. The results so far obtained, it is stated, are promising, an efficiency of about 20 per cent. having been indicated by a rough test.

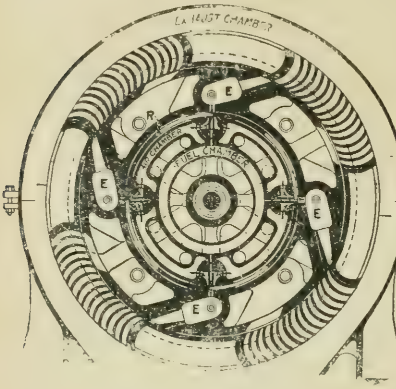


Fig. 1.—Position of Turbine Wheel at Beginning of Admission.

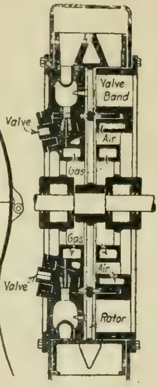


Fig. 2.—Longitudinal Cross-Section of Turbine.

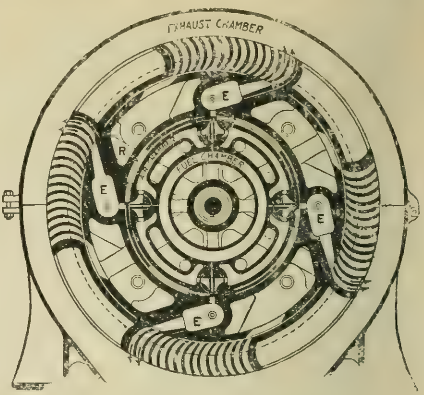


Fig. 3.—Position of Turbine Wheel at Beginning of Expansion.

The turbine consists of a rotor similar to that used in a reaction type turbine, with the blades distributed in four equally spaced groups around the periphery of the wheel. Each group occupies one-eighth of the circumference, as shown in the cross-sectional views, figs. 1 to 3. On the rotor is mounted a valve band R, also shown. The band acts as an admission and cut-off valve between the explosion chamber and the fuel and air supply. The stationary element contains the explosion chamber, also the ring chamber for the fuel and air supply, as shown in figs. 1 and 3. It will be seen that the nozzles are mounted so that the gases flow from the inner to the outer periphery of the wheel.

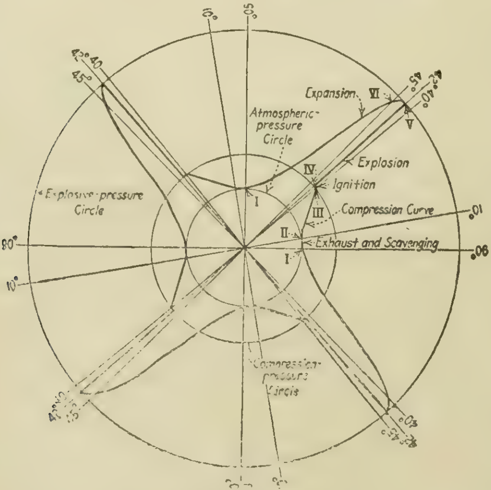


Fig. 4. Cycle Diagram.

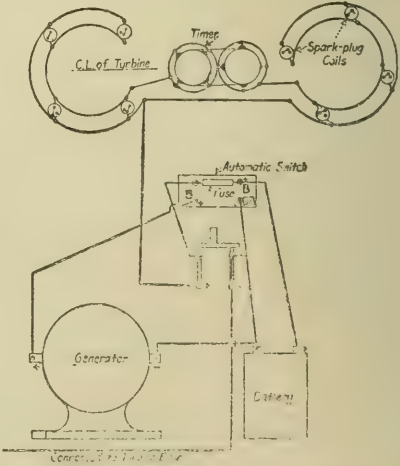


Fig. 5. Wiring Diagram of the Ignition System.

Compressed air enters the air chamber from the storage tank at from 45 to 75 lb., and the gas from the fuel chamber at approximately atmospheric pressure. In fig. 1 the wheel is in a position where the nozzles leading from the explosion chamber to the blades are closed and the ring R has opened the admission from the fuel and air supply to the explosion chamber. The compressed air flows in through the passages indicated by the curved arrows. In doing so it acts as an injector, and draws the fuel in through the small straight nozzle in the centre of each valve, as indicated by the straight arrow. This continues until the wheel has revolved to the position shown in fig. 3. Here it will be seen that the ring R has closed the passage between the fuel and air supply and the explosion chamber, and that the port is open between the explosion chamber and the turbine blades. The valve ring closes the port between the fuel and explosion chamber an instant before the port is opened from the explosion chamber to the blades, and at this instant the charge is ignited and expands from the position of the wheel in fig. 3 to that in fig. 1. The ring R opens one side of the air valve before the gas valve opens, and the nozzle from the explosion chamber to the turbine wheel does not close until the gas valve is opened ; this allows a charge of air to be blown through the explosion chamber, which scavenges it and prevents back-firing.

The turbine is in duplicate, with the nozzles on one side displaced in angular position by one-eighth of a revolution from those on the other side, so that when one side is in the expansion stage the other is taking in a charge in the explosion chamber. This gives approximately a constant turning effort on the turbine wheel.

The operation of the turbine may be explained from the cycle diagram in fig. 4, as follows:—Starting at I, expansion is complete and the ring valve is just beginning to open the air valve, with the explosion chamber still open to atmosphere. Air is admitted to the explosion chamber, blows out through the exhaust and scavenges the explosion chamber. This continues for 10° of the revolution, as indicated, at which point the nozzle from the explosion chamber is closed by the inner rim of the rotor. At point II the valve band E opens the fuel valve, admitting a fresh mixture into the explosion chamber, and the pressure rises, owing to the pressure of the compressed air. At III, 40°, the valve band closes the admission opening. When the valve band has overlapped 1° at IV, 41° to 42°, ignition takes place. At this point the highest pressure is obtained, V. From 42° to 45° the nozzle is opening from the explosion chamber and expansion begins. From 45°, VI, to 90° the nozzle is wide open and expansion takes place. At 90° the cycle is complete and begins over again. As no complete data were available for the quantity of compressed air necessary, it had to be determined by experiment. The first installation was a 3 × 4-in. Gardner compressor. The amount of air delivered was large enough for two explosion chambers, one on each side, the least number of chambers the turbine can be throttled down to. The air leakage between the tank and the explosion chamber was at that stage about 25 per cent. This loss proved to be too large, and adjustable nozzles were installed, as shown in figs. 1 and 3. This reduced the losses to about 10 per cent.

A 6 × 6-in. double-cylinder Curtis compressor was then installed, and proved sufficiently large to run the turbine, producing 85 to 90 H.P. at 2,500 R.P.M. The loss of air by leakage was still 9 per cent. A floating valve was next installed near the valve band opening in the explosion chamber (not shown), and the leakage or loss was reduced to the following figures:—With tank pressures of 50, 60, and 75 lb., the pressures in the explosion chamber with the nozzle closed were 48, 57, and 70 lb. (gauge) respectively. The power necessary to compress the air was about 15 per cent. of the whole power developed, and later was improved to 12 per cent.

The combustion, it is claimed, never gave any trouble. When starting, the pressure on the fuel was about 3 lb., but after a short run the mixing valve acted as an injector and forced the fuel into the explosion chamber by suction, thus making a carburetter unnecessary.

A heating coil in the exhaust base heats the fuel to a high temperature, thus assisting in vaporisation. The turbine has been operated with two, four, six, and eight explosion chambers in action. By turning the mixing valve 45° and switching the spark plug coils out, the relative explosion chambers become active or inactive, thus saving fuel and current when the full output of the turbine is not needed.

The vane-blade sections are made of cast-iron and inserted in the rotor. They have stood the various trial runs well. The sections are cast in one piece, and can easily be replaced by simply lifting the exhaust hood without disturbing the whole unit. The thickness of the blade ranges from ⅛ in. near the edge to ¼ in. in the middle. Fringing occurred only on places where the core left a very thin edge, due to irregularity in the loam core.

The electrical equipment—the ignition system, the part of the turbine that apparently would seem the easiest of all—nearly proved a stumbling block. Several experts recommended schemes that took up considerable space, but none of them proved successful. However, the inventor of the turbine, by using spark-plug coils, four on each side, successfully solved the difficulty. This did away with the lag in the current, and has proved entirely satisfactory. Current is supplied from a battery while starting. After the turbine comes up to speed, an automatic switch throws the sparking system over on the generator and the battery on charge.

The wiring for the sparking system is shown in fig. 5. The current produced by the generator is conducted through the automatic switch, where one circuit goes through the battery and keeps it charged, while a second circuit leads to the spark-plug coils and the timer. The timer is made up of eight contact points, each representing an explosion chamber. The points are alternately connected, four for either side. A separate circuit from each of the rings leads to the plug coils, so it will be seen that the rollers make the contacts for four coils simultaneously. This arrangement proved successful even up to a speed of 3,500 R.P.M.

BUSINESS NOTES.

For Sale.—A two-ton Edison electric omnibus is offered for sale by the Loughborough Road Car Co., Ltd., as announced in our advertisement pages to-day.

Electric Vehicle Sales.—According to the *Commercial Motor*, the Jowett Motor Manufacturing Co., of Bradford, has received a repeat order from the Bradford electricity department for two more five-ton G.V. vehicles; the Bootle electricity department has ordered two similar vehicles, and the Manchester electricity department one such vehicle. Other sales of G.V. electrics have been to Mr. J. B. Wilkinson, a local chemical manufacturer, and to the Low Moor Iron Co. (repeat), these being for 3½-tonners, which size of vehicle has also been sold to Messrs. Robinson and Peel, of Dudley Hill, in this case for wool cartage. Messrs. A. Priestman & Co. have brought a two-tonner, and other users in the district include the Lingfield Dyeing Co., Messrs. Lister and Co., and Shaw & Co. (Shipley), Ltd.

A Leigh Canteen.—We have received a copy of a brochure issued by CALLENDER'S CABLE AND CONSTRUCTION CO. LTD., as a souvenir reprint of the opening of a canteen at the Anchor Cable Works, Leigh, in November last. The speeches are given in full, and there is a description of the canteen. Interesting photographic groups appear of the directors and their wives and the officials present at the ceremony, also one of the staff; another shows the canteen itself.

Book Notices.—"A National System of Economics." By J. Taylor Peddie. University of London Press, Ltd. Price 5s. net.

"The Driving of Machine Tools." By T. R. Shaw. London: Scott, Greenwood & Co. Price 4s. net.

"Electrical Equipment." By H. W. Brown. London: Hill Publishing Co. Price 12s. 6d. net.

"Electric Traction." By A. T. Dover. London: Whittaker and Co. Price 18s. net.

Machinery Prices in Germany.—It is announced that the 10 firms working together in the matter of prices have just decided to raise from 40 per cent. to 75 per cent. the amount charged as extra prices on machines made with metallic substitutes (iron and steel and zinc., &c.) for copper.

Capital Expansion in Italy.—The Dinamo Hydro-Electric Works, which belongs to the BROWN-BOVERI group, is increasing its share capital by £200,000 to £1,000,000, for the purpose of extending the works on the southern declivity of the Simplon, and acquiring hydro-electric works on the Ariza. A real wave of activity in promotion is reported to be proceeding, particularly in regard to the electrical, chemical, engineering and shipbuilding industries.

Liquidation.—SIMPLEX INSULATORS (BOURKE'S PATENT), LTD.—This company is winding up voluntarily, with Mr. J. W. F. Grahame, 56, Moorgate Street, E.C., as liquidator.

Catalogues and Lists.—The date under the Order relating to the dispatch of catalogues, price lists, and trade circulars has been extended to April 21st in cases where their production was actually begun before March 3rd.

SILUMINITE INSULATOR CO., LTD., 16, Dowgate Hill, Cannon Street, London, E.C.—Leaflet giving particulars and prices of "Siluminite," a new insulating material.

MESSRS. SIEMENS BROS. DYNAMO WORKS, LTD., Caxton House, London, S.W.—48-page brochure, containing exhaustive particulars of their own rotary converters and information of a general nature concerning this class of machinery. Electrical and mechanical specifications of the Siemens converters are given, and the largest section in the book deals with special characteristics of rotary converters. The brochure is fully illustrated by means of diagrams and excellent half-tone pictures.

LIGHTING AND POWER NOTES.

Aldershot.—The proceeds of a 1d. rate are to be set aside in the ensuing half year to meet the estimated deficiency on the electric light undertaking for the year ending March 31st, 1917.

Australia.—The Railway Department has commenced the erection of a new electric power house at Newcastle East, N.S.W. The present plant supplies power and light to the Walsh Island and Honeysuckle Point workshops, the basin cranes, and wharf, and light to the dyke; in view of the increasing demand for electricity for both power and lighting for present services, and the further supplies which will be necessary when the grain elevator and additional cranes, &c., are erected, it was found necessary to increase the plant. The power house will also supply energy for the tramways when they are electrified. The new building will at first supply light and power for all the services except the tramways, as the electrification of the tramways is not likely to be put in hand for some time.—*Sydney Daily Telegraph.*

The Brunswick (Vic.) Council has decided to borrow £5,000 for the extension of the electric lighting and power system in the municipality.

Bristol.—Price Increase.—At a recent meeting of the Electrical Committee the following additional advances were made:—7½ per cent. on lighting, 15 per cent. on power, and 12½ per cent. on the combined rates, making a total advance on the basis price as follows:—Lighting, 22½ per cent.; power, 45 per cent.; combined rates, 37 per cent.

Chester.—Proposed Loan.—The T.C. has adopted the recommendation of the Electricity Committee to apply to the L.G.B. for sanction to borrow, as a matter of urgency, the sum of £11,500 for cable and the construction of a sub-station.

Chile.—Senores Sougarret Hnos. y Compania has been granted permission to install an electric lighting system, by means of overhead cables, in the town of Ercilla.

Don Luis E. Silva is also authorised to complete the installation of electric lighting in the towns of Llolleo and San Antonio.—*Board of Trade Journal.*

Chippenham.—Price Increase.—The Electric Supply Co. has informed the B. of G. that from April 1st next the price for current supplied to the workhouse will be advanced by ½d. per unit.

Clonakilty.—Price Increase.—The local Electric Lighting Co. has applied to the Council for an increase in the annual payment made to the company for the public lighting of the town, owing to the increased cost of materials and labour. The increase asked for is 15 per cent. on the amount now paid. The Council is at present paying about £109 per annum.

Eastcotts.—The B. of T. has forwarded to the Bedford R.D.C. sanction for the supply of current to new works by the Bedford Corporation.

Finchley.—A discussion took place at the last meeting of the U.D.C. on a motion that no payment be made to the Electricity Committee in respect of arc lighting, which should be discontinued. Eventually an alternative motion was carried to discontinue arc lighting and for the Electricity Committee to allow the Highways Committee 1d. per unit for all current saved owing to the alteration of the lighting arrangements.

Glasgow.—Electricity and Town Planning.—Councillor Denny has given notice that he will move, at the T.C. meeting, the following resolution:—"That the Corporation, being of opinion that, for domestic purposes, electricity should be substituted, wherever possible, for other means of lighting, heating and cooking, direct the attention of those engaged in considering 'the housing problem' to this resolution, especially the architects who have been appointed to town plan the city; and, further, ask the Dean of Guild and his Court to exercise their influence and powers to secure, in new buildings, wiring of sufficient strength to permit, in addition to lighting, the installation of heating and cooking appliances."

Hebden Bridge.—Bulk Supply.—The heavy demand upon the local Council's electrical plant, and the difficulties of installing additional plant at present, have caused the Electricity Committee to take a supply of current in bulk from the Halifax Corporation, subject to a satisfactory agreement being reached, to augment the local supply. The Council did not feel justified in putting down a further oil engine in view of the present price of oil.

Ilford.—The Electricity Committee has revised the tariffs for electric supply as from the readings for the quarter ending June.

Keighley.—In seconding the Electricity Committee's minutes, at the T.C. meeting, last week, Mr. Wardle congratulated the Committee on its enterprise since last month in stopping the waste of coal which had formerly gone on at the electricity works. It was now impossible for the coal to drop down into the cinders. Mr. Sellars, on behalf of the Committee, appreciated Mr. Wardle's remarks, but added, "I should like to say we did look into the matter, but we have not made any alterations for six months."

The T.C. has accepted a recommendation by the War Bonus Committee for the payment of a war bonus of 5s. per week, and 6d. per week for each dependent child under 13, to all employés of the Council over 21 years of age, commencing April 1st, and continuing to three months after the declaration of peace, provided the bonus shall include and be in substitution for any bonus already granted by the Council. The bonus, however, is not to be paid to any official in receipt of a salary exceeding £200 per annum; any clerk or official or female employé who has been appointed since April 1st, 1916; any clerk or official or workman who has received an advance of salary or wages in lieu of war bonus, except to the extent by which the bonus now granted exceeds the amount of such advance. The Council has been paying roughly just over £2,000 a year in bonus and allowances, and the new scale will practically double that amount.

Lancaster.—Price Increase.—On Thursday last week, the T.C. approved the Electricity Committee's decision to increase the charges for lighting and power by 22 per cent. and for tramways and 'buses by 12½ per cent.

London.—L.C.C.—The Finance Committee recommends the sanction of the Council to the borrowing of £1,606 for electricity purposes for the Battersea B.C.

St. Marylebone.—The Electricity Committee reports that certain economisers require renewing, at a cost of £2,000, and recommends that the work should be put in hand as soon as possible.

Londonderry.—Loan Inquiry.—A L.G.B. inquiry will be held on April 13th into the application of the Corporation for sanction to a loan of £35,500 for the electricity undertaking.

Mexborough.—Proposed Loan.—Mr. J. B. Feltham, electrical engineer to the Urban Council, has reported on the proposed extensions of the plant. The Committee has instructed him to proceed with specifications. Sanction is to be asked to a loan of £9,500. The recent electrification of a local factory is largely responsible for the pressure, and the consumption there is rapidly increasing, while the demand for power current generally, apart from this mill, is greatly increasing. The Electricity Committee did not accept a suggestion by the Yorkshire Electric Power Co. of a bulk supply.

Spenborough.—Price Increase.—The Council has decided to advance charges all round as from May 1st. For ordinary power consumption the price will be 2¾d. per unit, with the discount remaining as at present. For lighting the charge is increased to 5½d. per unit, and the discount reduced to 2½ per cent.

TRAMWAY and RAILWAY NOTES.

Australia.—Train Lighting.—The question of lighting the country trains by means of electricity has been under consideration by the Victorian Railway Commissioners for some time. At present on some lines kerosene is used, and it is on these that steps are being taken to use electricity, as the use of Pintsch gas necessitates the transport of the gas cylinders for recharging. A set of Vickers' train-lighting equipment has been obtained, and is to be given a trial in the local service between Heidelberg and Hurstbridge, where the cars are equipped for kerosene lighting.—*Melbourne Age.*

Blackpool.—Electric Vehicle.—The Corporation Finance Committee has decided to purchase an electric motor chassis for the removal of fish offal and household refuse, at a cost of £750. It is stated that the use of the vehicle will effect a saving to the Cleansing Committee of about 1s. 6½d. per ton, as compared with the cost of removal by horse-drawn vehicles. The Corporation already has electric road-sweepers, collection carts, and watering vans.

Bradford.—Year's Traffic.—The aggregate receipts of the Corporation tramway department for the 357 days of the current tramway year are reported to have been £341,772, an increase of £12,006 over the receipts for the corresponding period of last year, which comprised 359 days.

Coventry.—Tramway Expenditure.—At the last meeting of the City Council, Ald. Drinkwater said the Tramways Committee had submitted estimates for an expenditure of £350,000 on the tramways.

Keighley.—Railless Traction.—At the T.C. meeting, last week, a member pointing to a decrease in railless traction receipts of £36 for last month, suggested that, in view of this and the dearness of railway fares and the bad train service, the fares should be increased 25 per cent., which, he held, would convert the £36 decrease into a £25 increase, and with the increased revenue the service could be enlarged. It was explained, in reply, that the Committee had no power to increase the fares, and if they were not already at the maximum they were not far off. In reply to further questions, Mr. Albert Smith, on behalf of the Tramways Committee, said the great obstacle to the proposed through tramway route between Keighley and Bradford, *via* Bingley, was Stock Bridge, which must be widened before a tramway extension there could be thought of.

Leeds.—Year's Traffic.—The tramway returns show that the receipts up to date, for 52 weeks, have been £497,377, an increase of £38,898 on the figures of the same period of the previous year. The total of passengers carried has been 2,129,000.

Manchester.—The City Council, last week, approved increases of salaries to officials in the tramways department, totalling £158; a proposal that salaries should not be increased until the end of the war was defeated.

Mexborough.—The Mexborough and Swinton Tramways Co. has announced that cheap fares will operate only before 7 o'clock in the morning and between 5 and 6 o'clock in the evening, except Saturdays, when the return times will be between noon and 1 o'clock. Miners are the people mostly affected; men who travel less than a mile will have 6d. per week more to pay.

Preston.—At the Council meeting, on Thursday last week, regarding criticisms that it would have been better if the Committee had dealt with the demand for increased wages locally, Ald. Ormrod said the one or two towns who originally backed out had found that it had not been to their advantage. Preston had decided to act in conjunction with other tramway authorities, as it was obviously to the advantage of the town and the men themselves that there should be uniformity in wages and conditions of labour.

U.S.A.—A subway is proposed for St. Louis, Mo., and the city is to be asked to consent to its construction. The cost is estimated at $8,000,000, and it is proposed that the United Railways shall operate it, and repay the city for the improvement from all earnings over 6 per cent. An elevated railway is said to be impossible in St. Louis, but the subway would do much to meet the city's requirements.—*Electric Traction.*

Further reports on the extension of electric traction by the Great Northern Railway, which is proposing to equip a 150,000-H.P. hydro-electric plant on the Chelon River, show that the company is scheming to electrify its coast lines between Vancouver, B.C., and Portland, Ore., a distance of over 500 miles.

TELEGRAPH and TELEPHONE NOTES.

A Lofty Tower.—According to the *Journal Télégraphique*, quoting from *Annales des Postes, &c.*, an American company proposes to erect at Longslang the highest tower in the world—307 metres in height, or 7 metres higher than the Eiffel Tower. This tower will be used for wireless communication with a station at Buenos Ayres, for which the Government of Argentina has already granted a concession. A powerful installation on the improved Poulsen system will be laid down, and the work should be completed within a year.

Glasgow.—The Post Office authorities have made arrangements which will have the effect of considerably accelerating the telephone service between the Glasgow and a few neighbouring telephone areas on the one hand, and the Edinburgh telephone area on the other. The new service was to be inaugurated on April 2nd. Subscribers' calls will be dealt with exactly as in the case of local calls.

Long-Distance Wireless.—A new wireless station has been established at San Diego, a port in the extreme south of California. The apparatus is so powerful that the station will be able to exchange messages with Melbourne. *Melbourne Age.*

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—U.D.C. Electricity Department. Battery of accumulators, complete. See "Official Notices" March 16th.

Australia.—MELBOURNE.—May 23rd. Victorian Railways Department. Twelve months' supply of incandescent electric lamps as ordered.

Aylesbury.—Electricity Department. 200-KW. direct-coupled internal-combustion engine and generator, fuel plant and accessories. See "Official Notices" March 30th.

Hull.—April 12th. Electricity Committee. Cooling towers. See "Official Notices" March 23rd.

London.—ST. PANCRAS.—April 12th. B.C. Arc lamp carbons. See "Official Notices" March 9th.

Salford.—April 9th. Mild-steel trays for coal elevator, for Electricity Department. Borough Electrical Engineer, Frederick Road.

Warrington.—April 11th. Electricity and Tramways Committee. One 3,000-KW. turbo-alternator and surface condensing plant. See "Official Notices" March 16th.

April 11th. Electricity and Tramways Committee. Motors and transformers. See "Official Notices" March 23rd.

CLOSED.

Australia.—Water and Sewerage Board. The following tenders were received for two steam turbines and condensers for Ryde Pymble pumping plant :—

British Westinghouse E. & M. Co., Ltd.	£12,569
Fraser & Chalmers, Ltd.	13,356
Willans & Robinson, Ltd.	13,505
Price, Martyn & Co.	13,952
Australian G.E. Co.	14,700
William Adams & Co.	16,144
,, (alternative)	14,729
A. Harvey & Phillips	17,420

The engineer-in-chief has reduced these tenders to a common basis, f.o.b. England, and recommends the tender of Messrs. Fraser and Chalmers as the most favourable.—*Sydney Sun.*

Ilford.—U.D.C. Annual supplies :—

Incandescent lamps.—Cryselco, Ltd., and Electrical Manufacturing and Supplies, at present prices ; London & Rugby Engineering Co., Ltd., at prices quoted.

Joint boxes and fuse boxes.—W. Lucy & Co., Ltd., on sliding scale, in accordance with prices of copper, iron, and porcelain at time of order.

The tender of Messrs. E. Foster & Co. has been accepted for 10,400 tons of coal at the following prices :—

5,400 tons Ibstock medium peas, 20s. 4d. per ton.
1,500 tons Ibstock D.S. nuts, 22s. 4d. per ton.
2,000 tons West Cannock 2-in. nutty slack, 21s. 4d. per ton.
1,500 tons Ibstock nutty slack, 18s. 8d. per ton ; or, failing this, Ibstock D.S. nuts, 22s. 4d. per ton.

London.—L.C.C.—The Highways Committee recommends that it be authorised during the Easter recess to open any tenders that may be received for transformers, &c., for the Greenwich generating station.

Walthamstow.—U.D.C. Lighting Department. Annual supplies :—

Dussek Bitumen Co.—Jointing material.
Chamberlain & Hookham, Ltd.—Meters.
Electrical Manufacturing & Supplies.—Lamps.
Vacuum Oil Co., Ltd.—Oils.

Tramways Department :—

W. Wood & Co.—Trolley heads.
Anti-Attrition Metal Co.—Trolley wheels.

For the erection of a chimney shaft at the electricity works the tender of Messrs. Custodis, Ltd., at £1,143, is recommended.

FORTHCOMING EVENTS.

Association of Mining Electrical Engineers (West of Scotland Branch).—Saturday, April 7th. At 4.30 p.m. At the Royal Technical College, Glasgow. Annual meeting.

Institution of Electrical Engineers.—Thursday, April 12th. At 8 p.m. At the Institution of Civil Engineers, Gt. George St., S.W. Discussion on "Wayleaves," with introductory paper by Mr. C. Vernier.

Salford Technical and Engineering Association.—Saturday, April 14th. At 7 p.m. At the Royal Technical Institute, Peel Park. Paper on "The Hydraulic Press," by Mr. J. Bacon.

NOTES.

Welfare Study.—We have received from the Special Intelligence Branch of the Ministry of Munitions of War a copy of a brochure on "Welfare Study," written by Mr. Cecil Walton, manager of one of our large National Projectile Factories, from first-hand knowledge. In a prefatory note "V.B.S." explains how the secret of promoting union between all classes, which he had sought before the war without avail, was revealed to him on active service at the Front—it was simply the fact that "the British officer has thoroughly inculcated into him that *his first duty is the care and welfare of his men.*" This is the lesson which we must learn to apply in our industrial life. The author, by way of introduction, declares that welfare work has come to stay ; "apart from all question of general or individual comfort, *it pays*" ; moreover, it will be found a most fascinating study. He proceeds to explain what it is ; that it is not confined to women only, it does not merely mean "canteens, and chairs, and pianos" ; it is the study of mankind, the introduction of the humanising element into manufacture. This is the keynote of the work, and we may point out that it is also the characteristic feature by which British civilisation, as evidenced in the war, is distinguished from the brutal "Kultur" of our chief enemies, the Prussians.

Welfare is essentially the business of the general manager, whose principal function is to choose correctly suitable subordinates and to provide an efficient organisation, pervading the whole factory, so that the head can keep in touch continuously with the trend of feeling amongst the staff and workpeople of every rank. An atmosphere of mutual assistance must be created, and antagonism dispelled. The study of fatigue is the next step ; the appointment of a wholly competent and sympathetic female welfare superintendent is essential ; an ambulance room must be provided ; the question of clothing must be studied, and suitable over-all garments *provided* ; a comfortable, clean, and roomy canteen must be organised ; and adequate facilities for recreation must be arranged for. In the briefest compass, but with convincing earnestness and sincerity, the author thus puts his successful experience at the service of employers, who can obtain further information on application to the "Welfare" Section of the Ministry of Munitions (6, Whitehall Gardens, S.W.), and we strongly urge them to delay not a moment in emulating Mr. Walton's admirable example.

I.M.E.A. Annual Meeting, 1917.—The official programme of the 22nd annual meeting of the Incorporated Municipal Electrical Association, just issued, shows that this year's meeting will be held at the Institution of Civil Engineers, Great George Street, Westminster, on June 21st and 22nd. On the former day, the presidential address of Mr. F. M. Long (Norwich) and a paper on "Individual Interests in Municipal Enterprise," by Mr. J. H. Bowden (Poplar), will occupy the morning, while in the afternoon Mr. J. A. Robertson (Salford) will read a paper on "Fuel Economy." The second day is given up to the annual general (business) meeting, to receive the annual report, elect officers, &c.

A special meeting is to be held to consider the revision of the articles of association relating to the constitution and election of the Council. The programme is subject to revision if found necessary ; all communications to the Secretary, I.M.E.A., 28, Bedford Square, London, W.C.

Electric Vehicles in Germany.—Owing to the scarcity of petrol in the country, a writer in an American motor paper, who has recently returned from a visit to Germany, reports that there has lately been a great increase in the number of electric motor vehicles of the industrial type. The same writer states that, owing to the demand for lead for munition purposes, lead batteries have, in a large number of cases, been supplanted by a new type of accumulator. Describing it in non-technical language, he states that "this novel battery is of the gas type, in which water, with a slight acid percentage, is decomposed by the current on entering, is stored in cathode and anode spaces in the form of oxygen and hydrogen, being compressed therein by suitably-designed mchanism, and, when the battery is drawn upon, the gases issue from their chambers through reduction valves in proper proportions and again combine to water, freeing the amount of current absorbed in the decomposition of the liquid. The poles of this battery are faced with 'Platinmohr,' black amorphous powder of platinum, which is at once a good conductor of electricity and a good catalysing agent, being used to a great extent in the making of sulphuric acid."

Our Mineral Resources.—A new branch of the Ministry of Munitions has been established to deal with the examination and development of such mineral properties (other than coal or iron ore) in the United Kingdom as are considered likely to be of special value for the purposes of the war. The Minister of Munitions has appointed the following gentlemen to act as an Advisory Committee on the development of mineral resources:—Sir Lionel Phillips, Bt. (chairman), Mr. F. J. Allan, Mr. C. W. Fielding, Mr. R. J. Frecheville, Prof. F. W. Harbord, Mr. F. Merricks, Sir Harry Ross Skinner, Dr. A. Strahan (representing the Geological Survey), and Mr. Edgar Taylor, together with a representative to be nominated by the Board of Trade.

Prisoners of War Fund: Football Match.—An interesting event in connection with the effort being made by the Cardiff *Evening Express* to raise funds to send food to starving prisoners of war took place at Cardiff on Saturday, March 31st, when members of the electrical industry in Cardiff and Bristol did their "bit" to further this worthy object. A Local Committee under the presidency of Mr. W. A. Chamen (South Wales Power Distribution Co.), and comprising representatives from every branch of the profession and industry, issued a challenge to similar representatives of Bristol to play an Association football match at Cardiff. The challenge was enthusiastically taken up at Bristol, and a strong side was taken over to Ninian Park, under the captaincy of Mr. W. Wedlock (the Bristol City captain and English International). The "Bristol City Electricals" ran out winners by five goals to love, and 2,000 spectators witnessed the match. Sir John Courtis, J.P. (chairman of the Cardiff Tramways and Electrical Committee) kicked off, and Sergt. Chalmers, D.C.M., performed a similar function at the commencement of the second half. After the match a dinner and smoking concert was held at the Queen's Hotel, at which the president and treasurer of the Cardiff Committee (Mr. W. A. Chamen) gave some interesting details of the results of the effort up to date. He announced that £170 had been cleared so far, and he had every reason to believe that a sum well exceeding £200 would be handed over.

Legal.—Harry Longbottom, electrician, of Risca, was summoned, under the Factories Act, at Blackwood, for failing to take adequate precautions in "earthing" an electric cable at the North Risca Colliery. Mr. Horace Lyne said a man named Phillips, working a mortar mill, received an electric shock when trying to start the motor, which caused his death. The wires were not properly "earthed." Mr. A. Prosser said defendant was much pressed by work, and it was a complete oversight that the wires were not protected. Defendant was ordered to pay £5 5s. costs, there being no conviction. *South Wales Daily News.*

DUNDALK URBAN DISTRICT COUNCIL *v.* THE ATTORNEY-GENERAL.—Before Mr. Justice Barton, at Dublin, this matter was referred to last week. It was a proceeding brought against the Attorney-General, as representing the Crown, for a declaration that, under the Public Health Act and the Electric Lighting Acts, the Local Government Board were entitled, if they thought fit, to grant a loan to provide working capital, or working balance, to enable the electric lighting undertaking in Dundalk to be carried on, wages to be paid, and other expenses to be met, until the revenue could be collected. The Dundalk Urban District Council established an electric lighting scheme under a provisional order dated 1897, made in pursuance of the Electric Lighting Acts, and for that purpose borrowed a sum of £46.000, with the sanction of the Local Government Board. In 1914 the Council entered into a contract with the Great Northern Railway Co. to supply electricity to them for power and lighting at their works at Dundalk, at a minimum price of £1.800 a year. In order to enable them to carry out this contract, which was to commence a year after it was entered into, the Council would have to erect two Diesel engines, so as to ensure a continuous supply of current to the company. Owing to the war, it was found impossible to obtain both the engines, with the result that, instead of commencing their contract with the railway company in September, 1915, they were not able to commence until September, 1916. The Council, accordingly, lost the benefit of the large payment from the railway company. In the meantime, as the contract been had entered into, and a loan had been obtained, the Council had to pay in November, 1916, to the lenders about £1.800 as instalment of the loan and interest. Owing to this state of affairs the estimated revenue was depleted, and the Council applied to the Local Government Board for sanction to a loan of £2,000, one of the grounds being that they were entitled to borrow such sum as would provide them with working capital, or working balance in each year in order to keep them going until such time as the revenue would be collected. The Local Government Board replied that they had been advised that under the Electric Lighting Acts they had no power to sanction such a loan. The question now before the Court was whether they had such power. For the Attorney-General it was argued that it was only for permanent works, and not for working capital, that a loan could be granted.

During the argument Mr. Dickie stated that the case stated did not set out the specific point which he required to have decided—namely, whether the Local Government Board had power to sanction a borrowing within the first six months after the undertaking had commenced. In these circumstances he applied for an adjournment until next sittings, when he would deliver pleadings in an action in the ordinary way.

The adjournment was granted.—*Freeman's Journal.*

Volunteer Notes.—FIRST LONDON ENGINEER VOLUNTEERS.—Headquarters: Balderton Street, Oxford Street, W.

Orders for the Week, by Lieut.-Colonel Clay, V.D., Commanding:—

Monday, April 9th.—Headquarters Closed. Last Day of Easter Training at Esher. Parade Waterloo, opposite No. 5 Platform, 9 a.m.

Wednesday, April 11th.—Instructional Class, 6 15. Platoon Drill, Platoon No. 2

Thursday, April 12th.—Platoon Drill, Platoons, Nos. 5 and 6. Signalling Class. Ambulance Class.

Friday, April 13th.—Technical for Platoon No. 10, Regency Street. Platoon Drill, Platoon No. 9. Recruits' Drill, 6.30.

Saturday, April 14th.—N.C.O.'s Class, 2.30, under Captain Bentley and the Instructor of Musketry. Subjects: Extended Order Drill and Musketry.

Sunday, April 15th.—Orders will be posted at Headquarters.

(By order), MACLEOD YEARSLEY, *Captain and Adjutant.*

The Metric System.—At the Conference of the Association of Chambers of Commerce, last week, it was resolved, by a large majority, that the Executive Council should be requested to arrange for the introduction of a Bill into Parliament to substitute the metric system for the present system of weights and measures, and to urge the Government to pass the measure during the present session.

In the final report of the Dominions Royal Commission, to which we shall refer more fully in our next issue, the Commission states that many of the Dominions have passed resolutions in Parliament, or even permissive legislation, in favour of the decimal and metric systems, and there is clearly in the Dominions a considerable body of opinion in favour of the change. The Commission is of opinion that the termination of the war will bring "an unequalled opportunity for securing this much-needed reform," and recommends the Governments of the United Kingdom and the Oversea Dominions to co-operate in establishing throughout the Empire a uniform coinage based on the decimal system, and uniform weights and measures based on the metric system.

Institution and Lecture Notes.—Institution of Electrical Engineers.—The following have been nominated by the Council for the vacancies which will occur in the offices of president, vice-presidents, honorary treasurer, and ordinary members of Council on September 30th, 1917:—

President: Mr. C. H. Wordingham.

Vice-Presidents: Dr. A. Russell* and Mr. W. B. Woodhouse.

Honorary Treasurer: Mr. J. E. Kingsbury.*

Ordinary Members of Council (six vacancies): Messrs. L. B. Atkinson, W. A. Chamen,* J. S. Highfield, Lieut.-Colonel A. E. Le Rossignol, C.B., Sir W. Slingo,* Lieut.-Colonel H. C. Sparks, D.S.O., M.C., Messrs. A. P. Trotter, and B. Welbourn.*

* At present in office.

Appointment Vacant.—Switchboard attendant, for Lancaster (32s. 6d.). See advertisement pages to-day.

Electrical Trades Benevolent Institution.—The annual general meeting will be held at the Institution of Civil Engineers, Great George Street, Westminster, S.W., on Monday, April 16th, at 2.30 p.m., Mr. A. A. Campbell Swinton presiding.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—Tynemouth T.C. has resolved to advance the salary of Mr. CHARLES TURNBULL, electrical engineer, from £325 to £400 per annum.

The Tramways Committee of the Walthamstow U.D.C. have decided that the salary of Mr. W. MURRAY, the tramways manager, be increased by £25, with a further increase of the same amount at the end of 12 months.

The Lighting Committee of Islington B.C. have conveyed to Mr. A. P. MACALISTER, deputy electrical engineer, their appreciation of the services rendered by him, more particularly during the past year, inasmuch as he has been frequently required to undertake full responsibility for the conduct of the electricity undertaking, owing to the absence through illness of Mr. Gay, the chief electrical engineer. The Committee state that Mr. MacAlister has proved himself to be a most capable engineer, and has dealt with intricate matters affecting the management of the undertaking with conspicuous ability.

The Darwen Corporation proposes to pay a war bonus of £25 per year to the tramways manager, Mr. Hosken.

Mr. T. E. Boothby, charge engineer to the Southwark undertaking, having resigned his appointment owing to ill-health, Mr. E. H. Snook, of Southampton, has been appointed to fill the position temporarily.

Mr. Thos. Roles, the city electrical engineer, Bradford, is recommended for an increase of £100, making his salary £900 per annum; Mr. J. H. Shaw, the deputy engineer, is recommended for an advance of £100, making a total of £450; Mr. J. Fairburn, electrical works superintendent, advance £50, making £350; and Mr. C. F. Allsopp, electrical department commercial assistant, advance £50 (£20 war bonus cancelled), making £300.

General.—Congratulations to Mr. and Mrs. W. Llewellyn Preece on the occasion of their silver wedding.

Mr. W. G. T. Goodman, general manager of the Adelaide Municipal Tramways Trust, who intends to visit Great Britain, Canada, and the United States, has been appointed an honorary commissioner by the Deputy Governor (Hon. G. J. R. Murray) to inquire into and report upon the following questions:—Electrification of railways, mechanical handling of coal, electric power in its relation to the development of industries, equipment and management of engineering workshops, and the briquetting of lignite coal.—*Commonwealth Engineer.*

Mr. W. C. Chappell, the new assistant engineer in the State hydro-electric department, Tasmania, has taken up his duties at Hobart.

Mr. Herbert Willett, who has been in the service of the Edison Swan Co. for the past 25 years, has joined the Colours.

At Preston Police Court, the Mayor presented Mr. Whitehead, an employé of Messrs. Dick, Kerr & Co., with the honorary testimonial and vellum certificate of the Royal Humane Society for gallantry in saving life.

The following appointments to the permanent Royal Australian Naval Radio Service were announced in January:—To be Radio Commander: Engineer Lieutenant Frank Gillespie Creswell, R.A.N. To be Radio Lieutenants: Arthur Frederick Newman, George James Weston.

The Highways Committee of the L.C.C. recommends that Mr. G. H. Hume be appointed chairman of the Committee, and Mr. A. H. Scott vice-chairman.

Captain A. R. Owen, tramways and marine claims superintendent in the L.C.C. tramways department, who has reached the age of 65, has been retired from the service.

Mr. C. Jones, A.M.I.E.E., of Cannock Chase Co., Ltd., and West Cannock Colliery Co., who has been elected M.I.E.E., is nominated as president of the Warwickshire and South Staffordshire Branch of the Association of Mining Electrical Engineers for the 1917/18 session.

Roll of Honour.—Lieutenant F. Raven, R.E., who has died of wounds, was a son of Sir Vincent Raven, chief mechanical engineer of the N.E. Railway.

Lieutenant E. Douglas Coe, R.G.A., has been wounded in action. He has acted as captain since he went to the Front, and was engaged in the electricity department of Blackburn Corporation prior to the war.

Gunner E. G. Crossley, R.F.A., reported in hospital suffering from septic poisoning in the legs, was formerly at the Bradford Corporation electricity works.

Second-Lieutenant H. W. Hutchinson, who was killed on March 13th, aged 19, was the youngest son of Sir Sydney Hutchinson, late Director-General of Telegraphs in India.

Obituary.—Mr. Arthur Brooker.—The unexpected death of Mr. Arthur Brooker, in the prime of life, in the very acme of his vigour, and when one and all anticipated for him a ripe old age after a life of strenuous, fruitful labour, has come as a great shock to his very wide circle of friends, but more especially to those who were associated with him in his earlier days. He joined the Telegraph Department of the Post Office Service in May, 1878, and at the very commencement of his career gave strong indications of a distinct personality which was destined to bring him prominently before his fellows. He came of a long-lived stock—both his parents exceeded the allotted span—he was well to the fore in athletic sports and competitions, he lived a clean, wholesome life; and these facts, which were generally known, made all the more painful his untimely death at the comparatively early age of 53. The Telegraphists' School of Science, which was established at the Central Telegraph Office in 1876 as a pioneer in the cultivation of a sound training in the fundamentals and technical applications of electrical science, soon claimed his attention, and he speedily became an ardent student, securing many successes in physics and mathematics, and in several technical subjects. Among his successes, he gained a bronze medal and £3 prize in the City and Guilds examination in telegraphy, and the first prize in the honours grade of electrical instrument making, consisting of a bronze medal and £5. In 1889 he became an instructor in the School in mathematics and laboratory practice, and the following year he was made chief instructor. He was also on the staff of the People's Palace and the Currie School of Engineering as instructor in electrical engineering. During the remaining years of the existence of the School, which was closed in 1898, he was a most loyal supporter of the principal, an enthusiastic teacher, and a personal friend of the students. His methods were marked by a decided originality which proved eminently successful, and which helped materially in the phenomenal successes attained by the students during their training, but more especially in after life, when those students became the scientific backbone of what is universally regarded as the most advanced and most up-to-date telegraph administration in the world. His scientific attainments procured for him rapid promotion in the Post Office service. He had three promotions in less than two years, and was largely responsible for the development of the present highly specialised testing branch, where the enormous supplies of apparatus and material are tested and proved on scientific bases which are generally acknowledged by manufacturers as affording the best and fairest standards, and have been adopted by very many foreign and colonial administrations. It was, however, his association in the production of Slingo and Brooker's "Electrical Engineering" in 1890 which brought his name more prominently before the public. The genesis of the book dates from a meeting of the would-be authors in the laboratory of the Telegraphists' School of Science after school hours, that is to say, at 10.30 p.m., on February 28th, 1889, when the decision to write the book was arrived at, its general scope and aim were determined, its contents page drawn up, and several chapters divided between the two authors. The zeal with which the two men worked can to some extent be realised when it is stated that the book was on sale at the end of February in the following year, and reviews began to appear on the 7th of the following month. Within a fortnight of its publication (and the first edition consisted of 2,000 copies) the publishers notified that a second edition was in preparation. The book was the first of its kind; it broke quite new ground, it was written from beginning to end to suit the requirements and capacity of a particular individual student, and he must have been fairly typical, for some 40,000 copies of the book have been disposed of, and its circulation has spread to every part of the world where the Anglo-Saxon tongue is understood. The sale was phenomenal, but perhaps the class who took to it most enthusiastically were the marine engineers. Every vessel as it was equipped with the electric light was also provided with its "Slingo and Brooker." The general style of the book, its language, the analytical diagrams, and the simple illustrative calculations were all points which appealed to the practical engineer, cut adrift as he was from every chance of appeal or assistance. Many a time has Brooker, when in quiet converse with old-time friends, referred to the meetings for proof-reading and for discussing debateable points of fact, theory, and phraseology, for these meetings often began at 11 p.m., after a full day's work in the office, the laboratory, and the class-room. Severe as the work was, the reward was great in comparison, for a firm position in engineering had been established, innumerable good and sincere friendships had been made, and an *entrée* gained into any assembly of men who valued hard work and good fellowship. After the publication of the book the authors entered into journalism, and contributed largely to the pages of the Electrical Review, one of the most important contributions being a series of articles on "Storms and Telegrams," which appeared in the beginning of 1891, and which were translated and reproduced in the *Journal Télégraphique of Berne*. These articles brought the authors into an interesting tussle with the late Sir W. H. Preece, but they had their effect, and resulted in more substantial methods of construction and a better system of maintenance. In 1898 Arthur Brooker severed his connection with the Post Office, and became works manager of the Peel Works of the General Electric Co., Ltd., where he spent seven years in organising the factory and devoting himself to the wholesale manufacture of telegraph and telephone apparatus, of which he was able to bring down the cost very materially, and thereby to extend the operations of the firm. In 1906 he joined the British Insulated Co. as assistant to Mr. Dane Sinclair, and on the formation of the Automatic Telephone Manufacturing Co. in 1912 he became its general manager, a position he retained until shortly before his untimely death as the result of a nervous breakdown. During these years he gathered round him a staff of truly loyal assistants, who soon recognised his many good qualities, his readiness to take responsibility, and to give them the benefit of his long and varied experience, and his sympathy with them in their difficulties and troubles. Since the commencement of the war he had devoted the energies of his company to meeting the requirements of the Munitions Department, and his organising abilities in this direction were so outstanding, and his output of munitions so considerable and so good in quality, that he had already taken up an important position under the Ministry when his first and last illness overtook him. He leaves a widow who, since his marriage in 1905, has been a real helpmate and companion, to mourn his loss.

Mrs. J. S. Raworth and family desire to express their thanks to those who have so kindly sympathised with them in their great bereavement. The number of letters received is so great that they cannot at the moment be acknowledged individually; it is hoped that they will be in the future.

Mr. W. Baily.—The *Times* records the death of Mr. Walter Baily, for many years secretary and vice-president of the Physical Society, and inventor of two-phase electric motors, at the age of 80 years.

CITY NOTES.

City of London Electric Lighting Co., Ltd. Mr. J. B. Braithwaite, presiding at the annual meeting, said that they had reduced the loan from the bankers from £66,000 to £34,000 by the end of 1916, and it now stood at nothing. The gross revenue had increased by £21,116, due to the increase in price of which they had had nine months' benefit. This year they would have it for the whole twelve months, which should enable them to maintain their revenue, and possibly show a further increase. The increase in cost of generation was £20,817. Rents, rates, taxes, management expenses, and special charges increased by £38,000. Including the balance brought forward, the total available revenue showed a decrease of £22,284. They had reduced the allocation to depreciation from £50,000 to £40,000 this year, as they had debited £12,181 for war bonus to employés and allowances to employés on service straightaway to revenue instead of carrying those items to a suspense account for writing off over a period of years. In 1915 coal cost £49,858, but in 1916 it was £18,428 more, which was almost exactly the amount of the reduced net revenue. This increase in coal cost was chiefly due to the exceptional freights on sea-borne coal. Their works were put on the water to secure cheap coal, but they were now temporarily suffering from the fact that at present railway-borne coal was cheaper than sea-borne coal, because railway freights had not increased to the same extent as sea freights. When they got back to normal times they would again reap the advantage of water-borne coal. Sir Albert Stanley had stated that they would have to burn less coal. He (the speaker) knew from past experience that it was a popular idea that the electric supply authorities of the country were the great offenders in that respect. As a matter of fact, all electric supply companies were great economisers of coal. To illustrate this he gave figures drawn up on a very conservative basis which might easily have been made to appear more favourable to the electric supply industry than they did. During 1916 there were used in electric supply, not including electric traction or electric railways, 2,000 million units. Taking a very low rate of production, say, only 500 units per ton of coal (whereas, as a matter of fact, in power houses like their own the figure was very much nearer 1,000 units than 500), that consumed 4,000,000 tons of coal during the year. Now, if there had been no electric supply the same needs would have been supplied with less convenience, less value, and less efficiency, and would have required at least 9,000,000 tons to do it. The saving had, therefore, been by the use of electric, instead of other forms of energy, 5,000,000 tons of coal, so that in seeking to reduce the consumption of coal by electric supply companies the authorities would be, so to speak, "killing the goose that lays the golden eggs." They would be hitting the very people who were economising coal. Supposing the authorities said that they would restrict the supply of light by electric companies, with a view to economising coal, the effect would be either that they would increase the consumption of coal or that the people would have to go without light altogether, which was hardly possible indoors. This was very much more true in respect of electric power. In the case of this company, 55 per cent. of its supply was used for power and heating and 45 per cent. for lighting. In regard to the future, they were extremely anxious not to increase the price further if it was possible to avoid it. Output had increased about 13 per cent. this quarter.

Brompton and Kensington Electricity Supply Co., Ltd. At the annual meeting the Chairman said that the year had been one of exceptional difficulty, and the result had obliged them to recommend a reduction in the annual dividend which had been regularly distributed for the last 13 years. This had occurred in the year in which the Summer Time Act first came into operation. Whatever might be the effect of daylight-saving upon society at large—and he was inclined to regard it as decidedly beneficial—there could be no doubt that to the purveyor of artificial illumination it was an unmitigated evil. It amounted, in fact, to an impairment of the statutory basis of the electric lighting industry, for which it was very difficult to find adequate reparation in an increase of price. But the diminution in output from that cause was by no means the sole cause of the loss of profit. The war had compelled restrictions and economies in the consumption of light, and it had increased the cost of its production in consequence of a phenomenal rise in the price of coal, and a general increase in working charges. It had reduced income and increased expenditure. In spite of a steady growth in lamps connected, and of a 10 per cent. increase in price, and in spite also of the development of electric cooking, which now amounted to over 10 per cent. of their total output, the falling-off in receipts was about £600. They burned less coal, but paid much more for the reduced quantity, and the account benefited by an allowance of £1,250 which they were able to obtain for faulty delivery under contracts in the previous year. Thus the increased coal cost amounted to £500, and it would have been less but for a delay in the delivery of the new 1,500-kw. turbo-alternator owing to the difficult manufacturing conditions prevailing. The new generating plant was now working most satisfactorily, and was largely reducing their coal consumption. This economy would result in a considerable saving. The coal position continued to be an anxious one, but they had a larger stock than at this time last year. The burden of administration devolving upon the reduced staff had been borne with cheerfulness and devotion. Although, on account of the war, the progress of the Accessories Co. had been slower than anticipated, the manufacturing side of the business especially having been curtailed owing to the difficulty in obtaining material and the prohibition of imports, the undertaking was to-day working without loss, and the prospect, on a return to normal conditions, was satisfactory.

Charing Cross, West End and City Electricity Supply Co., Ltd. Mr. W. F. Fladgate, addressing the recent annual meeting, first referred to the death of Mr. R. Chadwick, who had been a director for 22 years. In these times of extreme difficulty, it had taxed the ingenuity and the work of all the members of the staff, and particularly of the engineer-in-chief, Mr. Kingston, and of the secretary, Mr. Stanesby; he could not speak too highly of their services, and of those of the staff under their control. Without careful co-ordinated work between the two important branches of the company—the secretarial and the engineering—they could not possibly have arrived at the satisfactory position shown in the accounts. The net revenue in the West End had increased by £2,700, and the total available net revenue was £71,640. That was arrived at after spending £10,000 on repairs and maintenance of the stations and mains in the West End during the year. In regard to the expenditure of £4,900 on capital account, that was a very productive item, as it was on the erection of buildings in Short's Gardens which were already let at remunerative rentals. In the case of the City undertaking, the results were equally satisfactory, the net revenue having increased by £1,788. In addition to carrying forward £18,000, and transferring a large sum to reserve, they had spent £15,000 in keeping the plant and mains in an efficient state of repair. Comment was usually made as to there being no depreciation fund in connection with the City undertaking. It was, perhaps, better therefore to explain that, having regard to the form of the Provisional Order, they were advised that no depreciation fund was necessary, and as they did not divide their profits, but simply paid the dividend on the preference shares, and carried the rest to general reserve, it seemed immaterial whether there was a depreciation fund or not. The balance of general reserve was £104,562. In regard to the general state of the company, they did not feel any great nervousness for the future. They quite appreciated that the task before them and the staff was still a heavy one, but they honestly believed that there would not be any danger of the company doing otherwise than passing safely through this very trying period and emerging from it stronger than ever. Their position had never been stronger than it was at the present moment. Under war conditions nothing in the way of an amalgamation or a working together of the companies was possible. They had, however, through the committee of the companies, of which he was chairman, been able to secure an increase in the excess profits standard from 6½ to 7½ per cent. The company was not materially interested, as he was afraid there would be no excess profits during war-time, but it was a matter of principle. It appeared to them unfair that the taxation of a company which had only a provisional order for a limited period should be put in the same position as a company with a perpetual existence. The application was made practically on the part of the whole of the London companies. He hoped that all those companies would see their way to work together in the future.

Coalite, Ltd. Presiding at the recent meeting, in London, Mr. H. Willmott said that there could not be any marked change in the finances of the company until the works at Barnsley were in full operation and proved the process to have the value that they attached to it. They hoped the plant would start working soon; the delay in its completion had been due chiefly to labour difficulties and war conditions. Now that every civilised nation had become alive to the vital importance, not only of conserving its coal energy, but of providing cheap power for every form of industrial enterprise, as well as to the enormous value attaching to the recovery of the many valuable by-products from coal distillation, it was manifest that low temperature carbonisation must progress by leaps and bounds. They had the priceless advantage of being the first in the field to prove both the practicability and economical advantages attaching to low temperature distillation as carried out by this process. The Government was carefully watching the development, and a very important committee had been appointed by the Board of Trade to deal with the economical supply of electric power for all classes of consumers in the United Kingdom. They were perfectly satisfied that their process would give the country cheap electric power, which was the greatest economical factor we had to face from now onwards, and, in addition, all the many by-products obtained from low temperature distillation, such as motor spirit and the heavier oils, that the country was importing at the present time at an enormous cost, in addition to which there were the other valuable by-products, for which there was practically an unlimited demand. The British Coalite Co., with which they were naturally closely allied in interest, appeared to be on the eve of reaping some advantage from the seed it had plentifully sown. That company, which owned the British rights for the processes in respect of which the company controlled the foreign patents, was arranging to grant a licence for the use of the process for the United Kingdom to a development company which was about to be formed, with which very powerful interests were connected, with an issue capital of a least £50,000, part of a nominal capital of £100,000, on terms that should be mutually satisfactory.

German Electrical Companies.

The Aluminium und Magnesium Fabrik of Hemelingen, Bremen, records net profits of £19,000 for 1916, as compared with £16,000 in 1915. The dividend recommended is at the rate of 18 per cent., as compared with 15 per cent. in the preciding year.

The Deutsche Kabelwerke A.G., of Berlin-Lichtenberg, realised gross profits amounting to £67,000 in 1916, as against £74,000 in the previous year, the works having been well occupied during the year. As the plant has already been entirely written off the books to the nominal sum of 1s., the only provision made for depreciation last year is £1,500 for buildings. The net profits are £31,000, as compared with £35,000, and the dividend is at the rate of 8 per cent., this contrasting with 6 per cent. in 1915.

The directors of the *Kabelwerk Duisburg A.G.* report gross profits on manufacturing of £119,000 in 1916, as compared with £114,000 in the preceding year. After making various appropriations and setting aside £5,400 for depreciation, as against £5,600 in 1915, the accounts show net profits of £74,000, as contrasted with £81,000. It is proposed to pay a dividend of 16 per cent. and a bonus of 9 per cent., making 25 per cent., as against 18 and 12 per cent. respectively in 1915, or 30 per cent. together.

The Elektro-Osmose Gesellschaft, of Berlin, which was formed in 1913, reports that notwithstanding difficulties in working, it was possible for the company to carry out much scientific work and many experiments in 1915-16, and to bring them in part to a final conclusion. The Kaolin Elektro-Osmose Co. made further progress, whilst the plant of the Westerwald Elektro-Osmose Ton Gewerkschaft is shortly to be put into operation. The accounts of the Berlin company show a small profit for the year, this comparing with a loss of £14,000 in 1914-15.

The Brandenburg Carbid und Elektrizitats Werke, of Berlin, report that the production of carbide in the year ended on March 31st, 1916, was less than in the preceding twelve months, owing to the unfavourable water conditions, particularly in Norway. Nevertheless, good results were obtained in Germany as a consequence of the higher sale prices. A further large increase took place in the supply of electrical energy despite the difficulties of extending the overhead network on account of the war. The net profits amount to £14,000, as compared with £15,000 in 1914-15, and a dividend at the rate of 7 per cent. has been declared, as in the previous year.

The Grosse Berliner Strassenbahn A.G. intimates that, despite the considerable augmentation in the car mileage run in 1915, and the expansion in the receipts by nearly £300,000, the company is compelled to reduce the rate of dividend from 6 per cent. in 1915 to 4 per cent. for last year owing to the growth in the cost of materials and wages, and the excessive provision necessary for depreciation due to the extraordinary wear and tear of the tracks and cars. A deficit has only been avoided by the suspension of legal restrictions so as to permit of the overcrowding of cars, the greater use of trailers, and the stoppage of working in the case of unprofitable lines.

The Ges. fur Elektrische Hoch und Untergrund Bahnen, of Berlin, announces a dividend of 3 per cent. for 1916, as compared with 4 per cent. in the previous year. It has been necessary partly to draw upon the balance brought forward from 1915 in order to pay the dividend owing to higher working expenses, and notwithstanding the fact that the traffic receipts on this underground and high-level railway increased from £458,000 in 1915 to £526,000 last year. The traffic has further increased in the present year, but this has not equalised the further rise in wages and the prices of raw materials, and unless the fares are advanced a further decline in the net revenue is held in prospect for the current year.

The Sachsenwerk, Licht und Kraft A.G., of Niedersedlitz, Dresden (the former Kummer concern), reports an increase in the turnover in 1916 to £2,000,000 as a result of extensions of the works and the greater degree of activity. After allocating £72,000 to depreciation, as against £24,000 in 1915, the accounts exhibit net profits of £53,000, as compared with £47,000, and the directors recommend a dividend of 20 per cent. on the share capital of £225,000, as contrasted with 18 per cent. in 1915. It is now proposed to increase the share capital by £150,000, and the board suggest that part of this sum should be provided by the acceptance by shareholders of the dividend in the form of new shares.

The directors of the *Norddeutsche Kabel Werke A.G., of Neu-Kolln, Berlin,* which was formed in 1914 with the cooperation of the Mix & Genest Co., the Town Council of Neu-Kolln, and the Mansfeld Copper Co., state that the working results in the year ended on September 30th, 1916, were satisfactory, having regard to the disturbance caused by the removal of the works from Schoneberg to Neu-Kolln, which was completed at the beginning of last summer. As net profits, the accounts show the sum of £11,000, as contrasted with £6,500 in 1914-15, and a dividend at the rate of 10 per cent. has been declared on share capital of £52,000, and 2½ per cent. on £22,000, as against 8 per cent. It is proposed to increase the share capital by £50,000, so as to be able to execute larger Government orders.

Llanelly and District Electric Lighting & Traction Co., Ltd.—Mr. A. R. Holland, at the annual meeting, said there was a more satisfactory showing than for 1915, owing to an all-round improvement in electricity supply and tramway sections. Coal cost approximately 60 per cent. more than in pre-war times, and nearly 30 per cent. more than in 1915. Labour conditions were extremely difficult. Women conductors had been employed on the cars with some success, and the directors were watching the labour question very carefully. New power consumers were being secured at satisfactory rates under long-term contracts, which showed that the business was of a permanent nature. Extensions to the power station plant would be in service toward the end of April, and this should have a favourable effect on the current year's results.

Salisbury Electric Light & Supply Co., Ltd.—Mr. C. J. Woodrow, addressing the annual meeting, referred to the difficulties of the year. They looked forward to a great improvement after the war. They had reluctantly come to the conclusion that the price of current must be raised, but the increased price did not cover the cost of production. Mr. Gripper said that they sold exactly the same number of units last year as in 1913, and they received £9,630, against £9,040 in 1913. Their expenses, however, increased by £1,500. Though the income was larger by nearly £600, the profit was nearly £900 less; that was why they must increase the charge, but only for the period of the war, he thought.

Dublin and Lucan Electric Railway Co.—The company held its annual meeting on March 29th. The traffic receipts during 1916 increased by £104, and the expenditure by £482 owing to enhanced price of coal and other materials. Coal, which averaged £752 for twelve years prior to the war, rose to £2,572 for 1916. After paying debenture interest, £313 is to be carried forward, the payment of the cum. pref. dividend being postponed for the present. The mileage had been somewhat reduced, and that had to some extent reduced the expenses without reducing the receipts. Passenger fares and goods rates had been slightly increased. It was observed that the company's line was the only one in Dublin that maintained a continuous service during Easter week last year.

Slough and Datchet Electric Supply Co., Ltd.—During 1916 the connections increased by 3,275 lamp equivalents (30 watts). The units sold increased from 1,070,927 to 1,367,557, and the revenue from £9,625 to £12,012. The increase of £2,387 in revenue is due to the large sale of current for power, and to the bulk supply to the Windsor Co. Receipts from lighting supply were reduced by £600. The increased revenue has been more than neutralised by the high prices of coal and fuel oil, &c. The net profit available is £3,487, out of which £1,500 is put to depreciation and reserve, 3 per cent., less tax, is paid on the shares, and £192 is to be carried forward. Mr. Prior resigned the chairmanship, and Mr. Jackaman has taken his place.

Windsor Electrical Installation Co., Ltd.—The profit for 1916, including £779 brought forward, was £4,516. After paying debenture and other interest £560, preference dividend £912, putting £1,500 to depreciation, renewal and reserve, paying £250 directors' fees, and 2 per cent., less tax, on the ordinary shares, £519 is to be carried forward. Lighting restrictions and the Summer Time Act reduced receipts from the more remunerative class of consumer. Owing to a large increase, however, in the sale of cheap power units, the net receipts show only a small reduction in revenue. Cost of fuel and other materials considerably increased the working expenses and seriously affected the profit.

Urban Electric Supply Co., Ltd.—The gross profit for 1916 was £61,983, as against £68,513 for 1915. After deducting expenses, the balance is £61,772. Interest and debenture stock redemption absorb £43,748; £10,000 to reserve for depreciation; 2½ per cent. is to be paid on the preference shares (£6,250), and £1,774 carried forward. The directors regret that under existing conditions they do not feel justified in paying the preference dividend in full. We shall publish the usual table of results of the various undertakings next week.

Australia: Electric Light & Power Supply Corpn., Ltd.—The directors have been authorised to issue 60,000 £1 shares.

Commonwealth Edison Co.—The accounts for 1916 show a total income of \$6,498,806, as compared with \$6,519,462, and after providing for dividends amounting to 8 per cent., the same as for each of the two preceding years, there remained a surplus of \$732,301, increasing the total surplus brought forward to \$5,175,264.—*Financial Times.*

Russia.—The Industrial and Electrical Constructions Co., Ltd., Petrograd, began business in January.

The Tabreer Electrical Stations "Otes" Co. is being formed; capital, 2,000,000 roubles.

The Russo-French Electro-Mechanical Co., Petrograd, began operations in January.

Tramways & Light Railways Estates Co., Ltd.—The total revenue for the year was £804. The surplus is £619, plus £558 brought forward. A dividend of 3 per cent. is to be paid, and £626 carried forward.

Vickers, Ltd.—Final dividend for 1916, 1s. 6d. per share (free of tax) on the ordinary, making 12½ per cent. for the year.

S. Smith & Sons (Motor Accessories), Ltd.—Interim dividend, 9d. per share, free of tax, for half-year ended January 31st.

Anglo-American Telegraph Co., Ltd.—Interim dividend for the March quarter, 15s. per cent. on the ordinary stock and £1 10s. per cent. on the preferred stock, less income tax.

STOCKS AND SHARES.

Saturday Afternoon.

War Stock naturally monopolises most of the attention in the investment markets for the time being. The quotation, after giving way, recovered to within ⅛ of its issue price; and the effect upon other high-class securities may now be written off as virtually nil. People who sold good stocks in order to invest their money in the War Loan are beginning to ask whether they were not a little hasty, and the demand now runs on debenture and preference shares that were pressed for sale what time the War Loan lists were open. The tone throughout the market is good, the excellent news from the Western Front and from Syria being a stimulus to investment of the large amounts of money which are available—more particularly in the Northern provinces.

Home Railway Stocks are slightly disturbed by the announcement of the Board of Trade that it is desirable there should be no extra travelling at Easter, and that no relaxation of the higher fares must be expected during the summer months. Why this should have affected prices it is difficult to say, because it makes little difference to the companies themselves, so far as dividends are concerned. Underground Electric incomes weakened because of the withdrawal of some of the 'bus services, and the probability of yet other routes being re-arranged in consequence of the necessity for conserving petrol. National Steam Cars, by the way, have improved for this reason.

The market for electricity supply shares is very firm, and buyers are beginning to put in an appearance, only to find that holders are anything but willing to sell at the current levels. This is as good evidence as could be desired of the faith which investors have in the market, because there are several influences at work—*e.g.*, the Daylight Saving, the calling-up of more men, the difficulties connected with coal—which are scarcely bull points for the industry at present. They are purely temporary influences, of course, though it may be assumed that Daylight Saving will continue long after the war is over. The earnings of the various supply companies are greatly helped by the demand for power; and this should prove the mainstay of profits while the lighting receipts suffer from war conditions.

In view of the difficulty that there is of obtaining good stock, we hope it may be of use to set out a few investments which are actually on offer in the market at the moment. Securities are so quickly snapped up nowadays that before these lines appear some of the instances noted may have been taken; but as we write, the following can be obtained:—

Stock or share.	Price.	Yield.	Dividends payable.
Bournemouth & Poole 2nd Preference	9⅝	£6 5 0	March, Sept.
British Electric Traction 4½ % 2nd Debenture ...	70	6 8 6	May, Nov.
British Westinghouse 4 % Debenture	68½	5 16 9	Jan., July.
Chelsea 6 % Preference ...	4⅞	6 3 0	Jan., July.
Electric Construction 4 % 1st Debenture	68	5 17 9	Jan., July.
London & Suburban Traction 4½ % 1st Debenture ...	65½	6 17 6	Jan., July.
Metropolitan Electric Trams 5 % Debenture	81	6 3 6	Jan., July.
Winnipeg Electric 4½ % Debenture	71	6 7 0	April, Oct.

We have confined ourselves to fixed-interest stocks and shares, but in the Ordinary list there are attractive purchases, though it is more difficult to set out a selection of these for the simple reason that there are comparatively few actually on offer.

The price movements this week in our tables are trifling. With Easter so near at hand, the ordinary reason for quietude would be to ascribe it to reluctance on the part of the buyer to be bothered with stocks and shares on the eve of the holiday. This, however, can scarcely be advanced at the present time as acting upon the stock markets, for volunteering and allotment-digging will take the place of seaside holidays this year, and these call for less interruption than the latter do.

However, the fact remains that business is quiet, except in the rubber share market. The activity here continues apace. Prices gave way on a shrinkage of orders, but as soon as the demand was resumed, they started to recover. Although not so buoyant as it was a fortnight ago, there is plenty of resiliency in the market. Tin shares are mostly better, thanks to the big rise in the price of the metal: and the recent improvement in copper shares is yet more than maintained.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1915.	Dividend 1916	Price Mar. 31, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	9	6⅝	—	£7 11 0
Charing Cross Ordinary ..	5	5	3¼ xd	—	7 13 10
do. do. do. 4½ Pref..	4½	4½	$3\frac{3}{16}$	—	7 1 2
Chelsea	4	3	3	—	6 18 4
City of London	8	8	11⅜ xd	+ ¾	7 0 8
do. do. 6 per cent. Pref.	6	6	9¾ xd	—	6 3 1
County of London	7	7	10⅛	— ⅛	6 18 3
do. 6 per cent. Pref.	6	6	9⅜	+	6 8 1
Kensington Ordinary	7	10	5¼	—	5 11 7
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	3¾	—	5 6 8
Metropolitan	8	8	$2\frac{5}{16}$	—	6 9 9
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 4 0
St. James' and Pall Mall ..	8	8	6⅛	—	6 10 8
South London	5	5	2¼ xd	—	7 5 6
South Metropolitan Pref. ..	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	5⅝	—	6 5 9

Telegraphs and Telephones.

	Dividend 1915.	Dividend 1916	Price Mar. 31, 1917.	Rise or fall this week.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	94	—	6 7 8
do. Def.	33/6	1½	22	—	6 16 4
Chile Telephone	8	8	$6\frac{15}{16}$	—	*5 15 3
Cuba Sub. Ord.	5	5	7⅛	—	6 13 4
Eastern Extension	8	8	13¾	—	*5 16 4
Eastern Tel. Ord.	8	8	139	—	*5 15 1
Globe Tel. and T. Ord.	7	7	11⅝	+ ⅛	*6 0 5
do. Pref. ..	6	6	9¼	—	6 6 4
Great Northern Tel.	22	24	39½	—	6 1 0
Indo-European	13	13	46½	—	6 19 9
Marconi	10	10	$2\frac{13}{16}$	—	3 11 0
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord. ..	10	10	2⅛	—	4 14 1
United R. Plate Tel.	8	8	$6\frac{9}{16}$	—	*6 2 0
West India and Pan.	6d.	6d.	⅞	—	2 12 6
Western Telegraph	8	8	13¾ xd	+ ⅛	*5 16 4

Home Rails.

	Dividend 1915.	Dividend 1916	Price Mar. 31, 1917.	Rise or fall this week.	Yield p.c.
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	24¼	+ ¼	4 3 0
do. District	Nil	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A" ..	Nil	Nil	5/-	—	Nil
do. do. Income	6	5	78½	— ½	*6 7 0

Foreign Trams, &c.

	Dividend 1914.	Dividend 1915.	Price	Rise or fall	Yield
Adelaide Sup. 6 per cent. Pref.	6	6	5	+ $\frac{1}{16}$	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	2⅞	—	9 11 4
do. 2nd Pref. ..	5½	5½	2⅝	—	—
do. 5 Deb. ..	5	5	64½	—	7 15 0
Brazil Tractions	4	4	46⅛	—	8 12 0
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	63	—	8 1 4
do. do. Preferred	—	Nil	45	—1	Nil
do. do. Deferred	—	Nil	39½	—	Nil
do. do. Deb.	4½	4½	62½	—	6 16 0
Mexico Trams 5 per cent. Bonds	—	Nil	27½	—	Nil
do. 6 per cent. Bonds	—	Nil	25	—	Nil
Mexican Light Common ..	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	14½	—	Nil
do. 1st Bonds ..	Nil	Nil	27½	—	—

Manufacturing Companies.

	Dividend 1915.	Dividend 1916	Price Mar. 31, 1917.	Rise or fall this week.	Yield p.c.
Babcock & Wilcox	14	15	$2\frac{13}{16}$	+ $\frac{1}{32}$	5 6 0
British Aluminium Ord. ..	5	7	28/6	—	7 0 4
British Insulated Ord.	15	17½	12¾	—	6 17 3
British Westinghouse Pref. ..	7½	7½	2½ xd	—	6 0 0
Callenders	15	20	12⅝	—	7 18 6
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	$3\frac{5}{16}$	—	6 13 0
Edison & Swan, £3 paid ..	Nil	—	⅞	—	Nil
do. do. fully paid ..	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	66	—	6 1 3
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9½	—	6 6 4
do. Ord.	10	10	14½	—	6 18 0
Henley	20	25	15½	—	8 1 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11⅞	—	*8 8 4
Telegraph Con	20	20	86	—	*6 13 4

* Dividends paid free of income-tax.

Summer Time.—Summer time is to be re-introduced on Sunday next, April 8th. The clock will be put forward one hour at 2 a.m. Normal time will be resumed on the morning of Monday, September 17th. In Germany a similar change will be made on April 15th.

SOME NOTES ON BONDING AND EARTHING THE LEAD SHEATHING OF UNDERGROUND CABLES, WITH SPECIAL REFERENCE TO SOLID SYSTEMS.

By G. W. S.

The practice of bonding the lead sheathing of underground cables across joint boxes is now commonly adopted, and the need for doing this is largely recognised. The days when it was considered sufficient that the lead of a ·75 concentric cable should be made continuous by a bond consisting of a single strand of 18 s.w.g. copper wire tacked on to the lead of the cable with hard solder are now over, it having been found by bitter experience that such bonding, so far from being of any service, is a positive danger to the cable system. It might, indeed, be said that the bonding and earthing of cable leads has become an article of faith with many mains engineers, inasmuch as it is seldom considered what is the reason for bonding and earthing, whether there is any necessary connection between the two, and whether these practices should be universally applied.

The reason or object of bonding electric cables may be briefly stated to be to enable all parts of the lead sheathing of a cable system to be maintained at approximately the same potential, and in good condition, notwithstanding that a heavy fault current may be flowing. If the cable leads are earthed in addition, such potential will be approximately that of earth. To fulfil this condition, obviously bonds of ample cross-section are necessary, and, more important still, the connection of the bond to the lead of the cable must be efficiently made. Many a bond of ample size has failed on the passage of a considerable fault current, through being simply tacked on to the lead, the joint of bond to lead having become heated and the bond isolated, with, of course, serious damage to the lead, and the creation of another fault, maturing either at the time or some months later. Bonds should, therefore, be secured to the lead of a cable by being made to embrace the whole circumference, the joint then being plumbed, and an ample amount of metal being used.

Earthing the lead of cables that are armoured and laid direct in the ground, and of those drawn into conduits, can be well understood. In these cases the lead is uninsulated, and it is essential, in order to avoid stray currents getting on to or leaving the lead, to maintain the same at earth potential. In the case of cables laid on the solid system, the reason is not so apparent. The whole object of the care taken in laying cables on the solid system seems to be to insulate the lead efficiently. The numerous precautions requisite to be taken in filling the channels, and the use of asphalt or stoneware bridges that now characterises the best practice, all suggest the question why, having been at such pains efficiently to insulate the lead of the cables, we should be so careful to earth it.

The earthing of the lead of a solid system of cables occurs at each service, or other buried box, if, as is the usual custom, these boxes are bonded to lead, and through the lead of the feeders to the earth plate at the works. It is readily seen that, by insulating the lead of the cable from the various boxes, and by removing the earth connection to the lead of the feeders at the works, the metallic sheathing of the whole of the cables of a well-laid solid system would be insulated from earth.

The question immediately arises as to what degree of insulation could readily be maintained. By the use of boxes with the compound pocket type of gland, it should not be difficult to design an insulating bush of suitable shape and material to maintain good insulation between the lead of the cable and the iron of the box. To make a sound job, and to obtain additional security, 6 in. of the channel on each side of the box could be filled with box compound instead of pitch. It would, of course, be inadmissible to connect the lead of any branch cable with the lead of the main, unless the branch were laid solid. This would present no difficulty where iron service boxes were used. If, however, service joints of three or four-core distributors were covered by lead T-sleeves it would be quite possible, by removing a narrow strip of lead from the branch cable near the sleeve, to maintain the insulation of the distributor lead. The break of the lead of the service cable would be covered by an insulating sealing fitting, such as is used for isolating the lead of traction feeders into short lengths. This fitting, being pitched in with the T-sleeve, would make quite a sound job. The lead of the armoured cable service would, of course, have to be earthed, and this would be done by bonding it to the service box, and also, if thought desirable, to the water main inside the building. It would not be possible to maintain such effective insulation of the lead of the distributor if the boxes used were of the brass gland type. Although the brass gland could be insulated from the box, to do so would really sacrifice all the advantages of this type. Experience has proved however that, given a careful jointer, a box of the compound pocket gland type will make as sound a job as one of the brass gland type, without calling for so high a degree of skill, the plumbing of the brass glands, especially when these are large, being an operation requiring a first-rate plumber.

With a system of cables arranged as described above, breakdown of the insulation of the conductor at any point would not, normally, result in any leakage current; and consequently could go for a long time undetected. Should, however, the insulation of the lead fail at this or at any other point on that particular length the conditions of a system with earthed but unbonded leads would be partly reproduced with the attendant evils. It therefore becomes essential to have some means of checking the insulation of both the conductor and the lead. Regarding any particular length of cable, it is quite apparent that if the conductor insulation be faulty, and that of the lead be good, the lead will become alive. By testing the lead, first for potential then for insulation, an excellent knowledge is obtained of the state of the particular length. With the lead of the cables isolated at each box, it is impossible to apply such a test. If, however, the lead of the cable be bonded at each box, but with an insulated bond, and, furthermore, if in each disconnecting box the lead of each way be connected to an insulated terminal, it is possible for a box inspector to test with test lamps, or, more accurately, with a voltmeter, the insulation of conductor and lead of each length of cable on the system. Should the lead be found alive a conductor fault would be indicated, and this would be tested for in the usual way, the lead being meanwhile earthed at one disconnecting box. In case of an earth on the lead being indicated, this would point either to a neutral fault or to damage to the channel at some point, which would be found by locating the fault on the lead, one of the outers being used as a return wire, the neutral conductor meanwhile being connected.

The provision of an insulated bond at each box should be a comparatively easy matter. The bond would be wiped on to the lead of the cable at a point that would come inside the box close to the gland, and would be of ordinary insulated cable. The attachment of the bond should be done before the lead of the cable is removed for sweating of fittings. This method of bonding would necessitate the use of a box slightly longer than would otherwise be required, and on completion of the job the bond would be in the box surrounded by compound.

The system can easily be extended by connecting together the leads of the cables in the disconnecting box in the same way as are the conductors, and, in the feeder pillars, by connecting the leads of the various distributor ways to the lead of the feeder. The lead of each way from the feeder pillar should be isolated from all other ways of the same or of other feeders in the various boxes, as this will considerably expedite testing operations. The feeder leads at the works can then be connected to a terminal board, so arranged that daily tests of the potential and insulation of each feeder lead can rapidly and conveniently be made. As in the case of services, it is essential to break the continuity of the feeder lead before it leaves the channel to enter the cable subway, the lead in the cable subway being earthed in the usual manner. The earthing of feeder pillars and disconnecting boxes would have to be efficiently carried out. This could best be done by bonding to the nearest water main.

As an alternative to the above method of connecting up the lead of the feeder cables in the works, a system could be arranged by which they were connected, each through a switch, to a bus-bar, which bus-bar would be put to earth, through a resistance, in a similar way to the neutral of a three-wire system. With this method, the lead of the cables would be maintained normally at earth potential, and by connecting an ammeter between the bus-bar and earth, faults on the conductor would be at once indicated by the passage of a current through the ammeter. By opening the various switches, this fault would at once be localised to a particular feeder, and by testing the various ways at the feeder pillar, to the particular section. The further localisation to the shortest length would be a simple matter. Faults of the insulation of the lead would be tested for, at the works, by opening the various switches and testing with lamps. In case of a fault being indicated, it would be followed up as before. As each way in the feeder pillar is entirely isolated, the tracing of a faulty length will be a very simple matter, and will take little time, especially if the feeder pillars are provided with an ample number of ways.

A difficulty arises in connection with a system as outlined above when any work, such as connecting a service, which requires the lead of the cable to be exposed, has to be carried out. As there is always a possibility of the lead becoming alive through a conductor fault, special precautions would have to be taken before working. The most thorough method would be to disconnect the length of lead in the nearest disconnecting boxes, and to earth it to the frame of one box. If disconnecting boxes with diving-bell covers were used, this would be quite a simple matter, and would take up little time. The jointer would, of course, test the lead for insulation and potential before and after his work, and report any defect.

Such a cable system as has been described would, if properly maintained, make a bad fault or burn-out a very remote possibility. By maintaining efficient insulation of the lead, a conductor fault, while being immediately detected, is comparatively harmless, and a good insulation of the lead, indicating, as it does, that the channeling of the cables is in perfect order, makes conductor faults the more unlikely. The system would fail in the case of simultaneous faults in the conductor and the lead, and an earth would be put on the conductor network. By manipulation of the switches connecting each feeder lead to the earth bus-bar, the lead of the section containing the conductor fault could be isolated from earth and the neutral of the conductor system restored to earth potential. If the faults on the conductor and lead were both on the same feeder section the earth could not, of course, be removed so easily, but by disconnecting each way at the feeder pillar in turn, the lead of the faulty way could be isolated, unless again the two faults were on the same sub-section, when the conductor fault would have to be followed up and removed. The possibility of the simultaneous occurrence of two faults is not great, especially on the same feeder section, certainly not greater than the simultaneous occurrence of two faults on each outer, or on an outer and neutral of an ordinary three-wire system with bonded and earthed cable leads. The system, of course, affords no protection against mechanical damage. It should be noted that the method of locating conductor faults to the shortest length by testing the lead for potential, not only can be carried out with the utmost ease without interruption of supply, but, by reason of the isolation of each feeder way, with very much greater speed than by direct tests on the distributor conductors, as the sections will all be very small, and a test at the feeder pillar will leave little to be done.

The writer is not aware that a system such as has been described has ever been carried out. The method of insulating and isolating each length of lead is well known, but with such a system it is impossible to form any accurate idea of the state of the insulation of the conductors. The insulation of the network to earth may be high, while the insulation of the conductor to lead may be low in many places, and, moreover, conductor faults can develop and accumulate in number without detection, till, in course of time, the insulation of the lead begins to deteriorate generally, when the penalty has to be paid for the false security that has for a time been enjoyed. With an insulated and bonded system, double insulation is fully maintained and utilised, but easy means are adopted frequently to determine the insulation of both conductor and lead. A fault on either causes no inconvenience or interruption of supply, but can be located and repaired in comfort. The method of isolating feeder sub-sections enables faults to be found very quickly and easily, while finally, the great bugbear of the conscientious mains engineer, neutral faults, which with an ordinary system are so difficult to locate, are indicated with the system described as an earth on the lead, and are located with the same ease and expedition as faults on the outers.

EQUIPMENT OF KING GEORGE DOCK, HULL.

(Concluded from page 342.)

The hydraulic pumping station is situated at the east end of the estate, adjacent to the coal hoists.

The installation consists of four sets of three-throw horizontal pumps, each capable of delivering 250 gallons of water per minute, against a pressure of 850 lb. per square inch.

Each pump is driven through a single reduction, machine cut, double helical gear by a 200 B.H.P. open type motor, the pumps, motor and bearings for the gearing, being mounted on a cast-iron bedplate of substantial design. The motors run at 500 R.P.M., and the pump crankshaft at 55 R.P.M.

The rams are of hard manganese bronze 5½ in. diameter, and have a stroke of 18 in. The cylinders are of cast iron with gunmetal neck rings, and have single delivery and double suction valves, the valve boxes, which are of cast steel with hard bronze valves and seats, are bolted direct to branches provided on the cylinders.

Three accumulators are provided; the return water from the system is led into four cast-iron tanks; any leakage in the return water pipe lines is automatically made up in the tanks from the fresh water mains. In the event of the return water supply being interrupted, the tanks can be filled from the dock by four emergency centrifugal pumps, direct driven by 7½ B.H.P. motors.

The starting or stopping of the motors is carried out automatically by the accumulators, when they are at the top and bottom of their stroke.

A square steel tappet rod arranged vertically is partially rotated by tappets fixed on the accumulator. An eccentric at the lower end of the tappet rod controls a hydraulic slide valve, which is connected to the pressure mains. When the accumulator is nearing the bottom of its stroke and the pumps are to be started, the slide valve, moved by the eccentric, admits pressure to a small hydraulic ram, which moves forward against a ram of smaller diameter, which is always connected to the pressure mains. In moving forward, the ram operates an electric tramway type controller, through a simple system of links, levers and gearing. During this movement, the pumps are simply circulating water through a bye-pass connecting the suction and discharge. When the controller is in the "on" position and all the resistance is out of the motor circuit, the operating ram, still moving forward, strikes the tappet of a small hydraulic slide valve, which closes the bye-pass by admitting pressure to the ram of a hydraulically operated valve. The pump is then working under load.

When the accumulator is nearing the top of its stroke and the pumps are to be stopped, the slide valve moved by the eccentric opens the starting ram to exhaust and the above operations are reversed, the starter being brought to the "off" position by the constant pressure ram. This arrangement, by starting and stopping the motors under no load, prevents any excessive rush of current, and has been found to work exceedingly well in practice.

The main feeder cables are connected directly to the bus-bars of the switchboard, which consists of a separate panel for each set of pumps, equipped with double-pole circuit-breakers and ammeter. A watt-meter is fitted, which, together with a Venturi meter in the delivery pipe line, enables the cost of pumping to be accurately kept. At the trials the overall efficiency of the motors and pumps varied from 81 per cent. to 85 per cent.

The coal shipping appliances at present consist of two conveyors situated at Nos. 2 and 3 berths, and one fixed and one movable coal hoist at No. 6 berth, so arranged that both hoists can, if required, deliver into the same ship. These appliances will be added to in the future by probably three additional conveyors or, alternatively, two conveyors and one hoist.

The hoists are operated by hydraulic power, and each is capable of dealing with wagons having a maximum gross weight of 35 tons. The coal conveyor belts are of mild steel plate, supported on link chains.

All the working operations are controlled from a conveniently placed cabin on the main gantry framing, all the spout adjustments being made by means of electrically-driven winches and wire ropes.

The main conveyor is driven by a 220-B.H.P. motor and two sets of steel wheel and chain gearing, a differential gear being fitted to equalise the load on the conveyor chains. The speed of the belts is 120 ft. per minute. The spouts are driven by helical spur gearing and electric motors mounted at the back end of the spout girders.

The capacity of the conveyors is nominally 800 tons per hour, though on the trials this was considerably exceeded.

The dock entrance gates are of the composite type with straight sills and fixed flotation.

The rope barrels are driven by means of machine-cut gears and reversible, three-throw, single acting, oscillating, hydraulic engines, developing 25 B.H.P.

The pumping installation at the graving docks consists of two main centrifugal pumps, a centrifugal drainage pump, and a charging pump.

The pump house is formed between the walls of the two docks, and is covered in by a central skylight and reinforced concrete slabs covered with asphalte and supported by steel joists.

The main pumps each have a mean capacity of 36,000 gallons of water per minute against a head of 40 ft. The two pumps working together are capable of emptying the 72-ft. dock in 90 minutes, or the 66-ft. dock in 70 minutes.

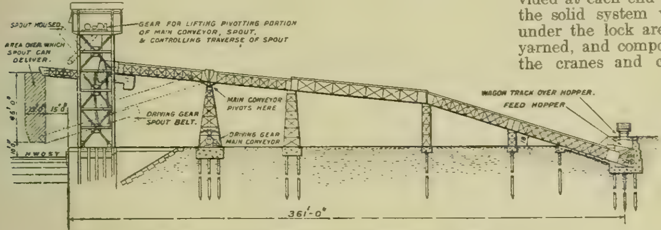

SPOUT HOUSED.
GEAR FOR LIFTING PIVOTTING PORTION OF MAIN CONVEYOR, SPOUT, & CONTROLLING TRAVERSE OF SPOUT
AREA OVER WHICH SPOUT CAN DELIVER.
15'8"
45'0"
10'0"
H.W.O.S.T.
MAIN CONVEYOR PIVOTS HERE
DRIVING GEAR SPOUT BELT.
DRIVING GEAR MAIN CONVEYOR
WAGON TRACK OVER HOPPER.
FEED HOPPER.
361'-0"

Fig. 4.—Electrically-driven Coal Conveyor, King George Dock.

The pumps run at 575-416 R.P.M., and absorb a maximum H.P. of 390. They are driven direct by shunt-wound open-type motors of 420 B.H.P., drip shields being fitted over the commutators.

The feeder cables are led to a switch pillar, each pair of cables having two single-pole knife switches, a voltmeter, and watt-hour meter being provided in the pillar.

The bus-bars of the switch pillar are connected to a distribution board, from which the various services to the motors are taken, each service being fitted with pull-out switches.

The starting gear for the main motors consists of an iron-clad pillar, containing an ammeter, shunt field regulator, and a multiple-lever starter. Step-by-step operation is effected by means of a slow motion ratchet type handle; a double-pole circuit breaker is actuated by this handle and is interlocked with the starter, so that the breaker can only be put on when the starter is "off," and the breaker is tripped and cannot be put on again until the starter is returned to the "off" position, in the event of the operator failing to complete the operation of starting.

The drainage pump delivers 3,000 gallons of water per minute when pumping against a total head of 54 ft.

The pump is driven by a 75-B.H.P. semi-enclosed motor at a speed of 1,100 R.P.M. The charging pump is driven through gearing by a semi-enclosed motor of 4 B.H.P.

A 25-ton electric travelling crane running on rails laid on the pier between the two docks, and capable of serving both docks, is now being installed.

The electrical energy for power and lighting is distributed by means of 10 main feeder circuits, arranged as follows:—

Circuit.	*Description of Machines on Circuit.*
A.	Two coal conveyors.
B.	Cranes and capstans north quay, north-west arm
C.	Cranes and capstans south quay, north-west arm
D.	Grain silo.
E.	Hydraulic pumping plant.
F.	Graving dock pumping plant.
G.	Cranes and capstans at south quays of main basin and north-east arm.
H, K. & L.	Electric light feeders.

The main switchboard consists of a separate panel for each of the above circuits. Each of the power circuit panels are equipped with an ammeter, two single-pole circuit breakers, and single-pole knife switches to each cable where the feeders consist of more than two cables. The lighting circuit panels are each equipped with two ammeters, two single-pole circuit breakers, and knife switches.

An earthing panel is provided equipped with a circuit-breaker, ammeter, limiting resistance and alarm signals. Watt-hour meters are provided on the lighting and power circuits.

The main bus-bars are fitted with isolating switches, so that the panels controlling circuits B, C, D, and G, or circuits A, E, and F, or circuits H, K, and L can be cut out in case of any fault.

The feeders consist of single conductor cables which, in the case of circuits A, B, C, G, H, K, and L, are led to feeder pillars, from which distributing cables to serve the various machines or lighting circuits are led.

In view of the importance of maintaining an uninterrupted supply to the hydraulic pumps, feeders E and F are connected to the bus-bars of a sub-switchboard, situated near the hydraulic pumping station, from which service cables are taken to the two pumping installations. Each incoming and outgoing cable is fitted with a single-pole switch, so that any pair of the centrifugal pump feeder cables may be used to supply the hydraulic pumps in case of necessity.

The power circuit feeder pillars are equipped with two single-pole switches for each pair of incoming and outgoing pair of cables. The lighting circuit feeder pillars have removable porcelain handle fuses for each sub-feeder.

All the main feeder cables for the power and lighting circuits and distributing cables for power are of the single conductor type, paper insulated and lead sheathed, laid generally on the solid system in earthenware troughing, with tile covers.

In special cases where the ground was soft the cables were laid solid in cast-iron troughs with cast-iron covers. Where the cables were laid under railway tracks they were drawn into cast-iron pipes, brick pits roofed with flags being provided at each end of the pipes, up to which the troughing of the solid system was laid. The cables laid in the subway under the lock are insulated as above and double armoured, yarned, and compounded overall. The distributing cables to the cranes and capstans on the various quays are single armoured, yarned, and compounded overall, and are supported by cast-iron racks, fixed in the tunnels formed in the quay walls.

The services to the capstans and to the plug boxes for the cranes, are taken from the distributor cables through branch boxes, which are of the solid type where the distributors are supported on racks in the wall tunnels, and of the mushroom type, in brick pits, fitted with roadway frame and cover where the distributors are laid in the ground. The services are connected through links in both types of box.

The lighting sub-feeders and distributors are two or three-core, paper insulated, lead sheathed double-steel tape armoured cables, laid direct in the ground, and protected by creosoted planks. The cables are looped into switchboxes attached to the lamp standards.

The whole of the estate is lighted by electric incandescent and seven-ampere flame arc lamps. The arc lamps, of which there are 132, are supported at a height of 30 ft. above the ground by steel standards. Arc lamps are used exclusively for lighting the railway sidings, the service consisting of bare overhead wires run on insulators carried by cross arms on the lamp standards or intermediate timber posts.

NEW ASH AND CLINKER EQUIPMENT FOR CENTRAL STATIONS.

The advantages of automatic mechanical equipment for removing ash and clinker must be obvious to everyone who has had anything to do with the operation of large or medium sized boilers. Manual labour is too slow and costly to be satisfactory in this connection. The task is more than can reasonably be expected from flesh and blood, in view of the great quantities of material concerned, and the heat and dust accompanying its removal by other than mechanical means. Also, if the grate and ashpit are kept clean by manual labour, a certain loss of efficiency by admission of cold air is almost certain to occur. On economic, technical, and hygienic grounds alike, it is highly desirable to employ some automatic means of removing hot ash and clinker continuously, and without raising dust.

In the Schwabach system, illustrated in the accompanying figures (from *E.T.Z.*), hot ashes and clinkers fall through chutes straight into a water trough, where they are quenched, and whence they are removed continuously. The chutes dip into the water, so that there is no possibility of dust escaping into the surrounding atmosphere. The ash and clinker ducts, A, B, C (fig. 1), for each grate are grouped together, so that a single waterway serves a whole row of boilers for quenching purposes (fig. 2). The waterway is formed in a concrete plinth which carries a light iron framework for the support of the conveyor chain. The rim of the trough is provided with rails for the chain rollers, and a third rail is provided at the bottom of the trough, so that the conveyor is kept from rubbing on the concrete. Ashes and small pieces of clinker collect to a depth equal to the height of the third rail, and thus furnish further protection against abrasion. The conveyor scoops are so constructed and so set on the chain that no pieces larger than, say, 1¼ inches are allowed to fall through or between them, hence there is no risk of scraping the bottom by large pieces caught under the conveyor chain. The latter moves quite slowly, so that the ash and clinker is thoroughly quenched by the time it reaches the inclined portion of the trough up which it is dragged, prior to being discharged into a tip wagon or on to a removal conveyor, as may be more convenient. The boiler crew is relieved entirely of the duty of opening and closing ash ducts and quenching hot, dry ashes; the action is automatic and continuous.

At the two ends of the trough, the conveyor chain is taken over a driving wheel and over a tension device respectively, return tracks being laid along the top of the ironwork already mentioned. The conveyor is driven by an electric motor through double-reduction worm and spur gearing; attendance and maintenance charges on the equipment are exceptionally low owing to the arrangement of the moving parts and the slow speed at which they are operated. For the same reason, the power requirement is low, say, 1.5 to 2.2 kw.'s for an equipment 80 ft. in length.

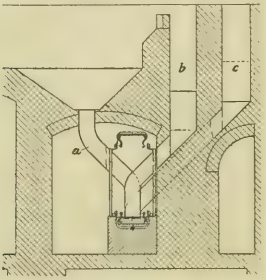


Fig. 1.

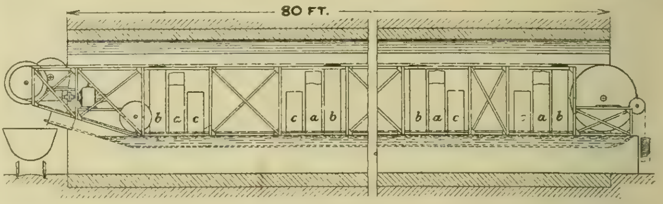


Fig. 2.

New Automatic Ash-handling Equipment.

Fig. 3 shows, in section, an automatic ash-ejector which may conveniently be employed in conjunction with the above main equipment, to quench and remove dust and ashes from collecting-pockets in flues or other places where this material is collected intentionally or otherwise. An outfall pipe (*a*, fig. 3) of cast or wrought iron is provided at the bottom of the ash receptacle, and the open mouth of this pipe is below the surface of water in a cast-iron box *b*. The water level is kept constant by a ball valve or other means, and thus ensures a dust and gas-tight seal between the dry ashes and the outer atmosphere. Ash and similar material falling into *b* is at once quenched and sinks to the bottom of the box, whence it is removed by wings on a cast-iron wheel *c*, which is set with its spindle perpendicular to the inclined bottom of the box *b* and rotated slowly, through worm gearing *h*, by an electric motor. Quenched ashes carried round by *c* are delivered at *g* into a tip-wagon or other convenient receptacle. A light line shafting may be used, if convenient, to drive a number of such devices. The power required by each amounts only to a few tenths of a kilowatt

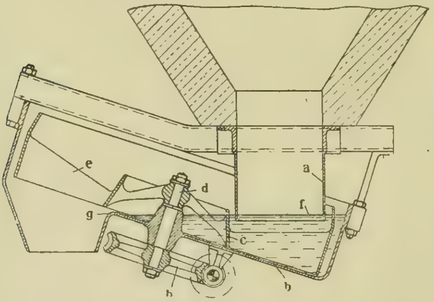


Fig. 3.—Device for Removing Ashes from Flue-Pockets.

Special advantages of this apparatus are that no cold air can gain admission to the flue *viâ* the ash-box or outfall, and that there is no accumulation of dust or ash necessitating periodical special cleaning. It is only necessary to remove filled trucks from time to time and, even this can be avoided if there is a sufficient quantity of material to justify the provision of a belt or other conveyor for its removal. No dust is raised by the removal of the ashes, nor are there any injurious gases such as rise from hot ash of clinker. The freedom from dust results in a minimum expenditure on the bearings of machinery in the neighbourhood of the boiler house, and the conditions of labour for the boiler crew are improved by better hygienic conditions and the elimination of much manual labour. Any system of ash removal which involves handling dry ashes and quenching them more or less in the open wastes much time and labour and leads to conditions which are unpleasant and injurious both to men and machines. The heat, dust and fumes in such a case are, indeed, so objectionable that the workman spends a good deal of time in evading the effects as far as possible. For this he can hardly be blamed, but it is obviously more economical and in every way more efficient to utilise an entirely automatic and unobjectionable mechanical system.

REVIEWS.

Discovery: Or the Spirit and Service of Science. By R. A. Gregory. London: Macmillan & Co. Price 5s. net.

In this work the author seeks to promote a more sympathetic attitude on the part of the public towards those who are engaged in the pursuit of scientific truth, and to remove the widespread misconception which prevails as to the meaning and influence of science. The book could hardly have appeared at a more opportune time, for the fierce trial through which the country is passing has directed attention to the imperative necessity of encouraging scientific progress as an essential element in the regeneration of the nation and in the maintenance of its economic position amongst the peoples of the world. Prof. Gregory points out that, to the popular mind, a "man of science" is a person who has developed his intellect at the expense of his spiritual nature, and has thus "lost the throbbing and compassionate heart of a full life," and, indeed, this view is not without some excuse, in view of the base purposes to which scientific knowledge has been turned by our enemies; but even as Cæsar's clay might be employed to stop a hole, so the most noble scientific gifts may be prostituted to the service of the devil, and no greater error could be committed than to suppose that science should be blamed for its misapplication. The author, discussing the methods and aims of science from numerous points of view, traverses an immense field, and displays an extraordinarily wide familiarity with the history of scientific progress in all its branches. The book reminds us somewhat of Lubbock's "The Use of Life," in that it draws upon innumerable sources for apt quotations bearing upon the subjects of which it treats. The general method of the author is to select a subject, such as "Belief and Evidence," or the "Conquest of Disease," and to discuss it in the light of scientific methods and aspirations, with numerous illustrations derived from the lives and achievements of researchers of all ages, showing bow these men, the salt of the earth, have by slow degrees, and with infinite pains and self-sacrifice, built up the magnificent structure which forms the framework of modern civilisation as we know it. The record is one of surpassing interest, and drives home with irresistible force the claim that scientific discovery has contributed more than any other factor of modern life to human welfare. "Every addition to knowledge is a stepping-stone by which the human race can pass to new regions of discovery. Science asks not for words, but work; for the patient study of the things before us rather than for dreams and vague speculations." Nothing in the book, perhaps, leaves a more enduring impression than the fact, exemplified in scores of cases, that the scientist's is a labour of love; the value of his work is rarely recognised during his lifetime, and hardly ever rewarded in proportion to its merits. But the thirst for knowledge is insatiable, and volunteers are never lacking to devote their lives to the task which, at the time, seems to be useless—to have no "practical application," as the man in the street would say, unconscious of the fact that he enjoys countless privileges and comforts only made possible by those researches which possessed no obvious utility. But the author clearly recognises the necessity of both industrial research and pure scientific investigation, which have their own respective fields to till. We have read the book with the keenest interest and appreciation, and trust that it will gain the widest possible circulation, for the principles which it inculcates are of the highest importance to the future of our race.

The Engineer's Year-Book of Formulæ, Rules, Tables, Data, &c., for 1917. Edited by H. R. Kempe, M.Inst.C.E. London: Crosby Lockwood & Son. Price 20s. net.

We always look forward to the arrival of the new yearbook, revised and brought up-to-date, and enriched with new sections; this year nearly 200 pages of new matter have been inserted, but excisions have been made reducing the increase to a net 150 pages. To our mind, this process of excision is as important as that of extension; many a once well-known hand-book has gradually declined into obscurity and neglect owing to its pages having become overladen with obsolete and useless matter, to the accumulation of independent formulæ giving widely divergent values for the same quantity, and to other defects symptomatic of senility—may this fate never overtake our old friend in the red cover!

Thumb notches giving direct access to the index and to the buyers' guide are external innovations for which we are grateful; ease and rapidity of reference are essential factors of convenience and utility in such a work. New sections deal with water-power development (by A. Surveyer), navigable waterways (by Dr. B. Cunningham), and the metric system (by A. H. Allen), and the section on gasworks has been rewritten (by A. Meade); all these are subjects of vital interest at this time. As for the contents as a whole, to review them *seriatim* would be a colossal undertaking in peace time, and is unthinkable during the war; in any event, it would be a superfluous task, for this is the 24th year of publication of the work, a fact which speaks for itself. We hope the book will not grow much bigger; it already contains 1,946 pages of editorial matter (without the index), and we suggest that the editor should sternly decline to pass the 2,000 mark.

Principles of the Telephone. Part I. Subscribers' Apparatus. By Cyril M. Jansky, B.S., B.A., and Daniel C. Faber, E.E. London: Hill Publishing Co., Ltd. Price 6s. 3d. net.

In their preface to the above volume, which is the first part of a course extending over three volumes, the authors state that in preparing the work every advantage was taken of contact with men engaged in the industry, particularly the engineers of the Wisconsin Telephone Co.; and, although details of construction are not given to any great extent, the principles underlying good construction are aimed at.

In the introductory chapter is described in simple language the method of operating a telephone instrument. The functions of the several pieces of apparatus are explained, and illustrations are given of the assembled parts.

Chapters II and III deal with the elementary facts of electricity and magnetism; and, at the end of each, questions are appended for the purpose of testing the student's knowledge of what he has read.

Chapter IV deals in a simple manner with sound and the transmission of speech telephonically.

Chapter V and VI discuss the various types of modern transmitters and receivers. Self-induction, mutual induction, and impedance are briefly touched upon; and in this connection it is observed that, although the names of the units of resistance, current, pressure, and capacity are duly assigned to these quantities, yet, with becoming trans-Atlantic modesty, the authors suppress the name of their illustrious compatriot in the case of the unit of inductance!

The remaining four chapters are devoted to descriptions of signalling apparatus and circuits, subscribers' set, local battery systems, C.B. telephones, and sub-station apparatus. Lines, methods of leading in, party lines, and intercommunication systems are likewise briefly dealt with. A useful list of faults is also given, and the methods of localising them.

In describing the Leclanché cell, the unusual form "Le Clanche" is employed throughout—a form for which there is no justification, and which is at variance with every French technical work which the writer has consulted.

On page 98, referring to fig. 75, it is stated that the *primary* of the induction coil, transmitter, and receiver are in the line circuit, while the *secondary*, the transmitter, and the condenser form a local circuit. To be in accordance with the diagram, the words primary and secondary should be interchanged.

On pages 18 and 118 references to Ohm's law are made without any formal statement of the law being given to assist the student in its comprehension. The reader must also attend to the definition of a circular mil as given on page 11, otherwise his calculations of the *true* area of circular wires will differ considerably from those in the text and subjoined tables.

Although at times the authors are not so explicit as they might be (*e.g.*, page 121, dealing with the storage of energy in the space surrounding a wire), yet, on the whole, the book is one that may safely be recommended to students taking up the subject of telephony for the first time. The explanations and descriptions given are clearly and simply stated, and the illustrative numerical examples neatly worked out. The many illustrations interspersed throughout, combined with excellent printing, add materially to the merits of this introductory volume.—A. F.

Electrical Engineering: Advanced Course. By Prof. Ernst. Julius Berg, Sc.D. London: Hill Publishing Co. Price 15s. net.

The author, in his preface, explains that this volume contains abstracts of a series of lectures given to graduate students in electrical engineering at the Union College, Schenectady, and that it is primarily intended to prepare the student who uses it to understand and to deal mathematically with phenomena which are incidental to abnormal or transient conditions in electric circuits. While admitting that the subject-matter of the book has been thoroughly treated by other writers, Dr. Berg hopes that justification for his treatise will be found in the fact that his treatment is not beyond the comprehension of a student who has completed only the ordinary undergraduate course in electrical engineering, and he further hopes that it may serve a useful purpose in calling the student's attention to a field of mathematics of extreme importance, but one which is too little known.

The problems dealt with are divided into two parts, of which the first contains the mathematical investigation of transient phenomena in an electrical circuit; while the second part is devoted to problems in electrostatics.

In the part dealing with transient phenomena, the author begins with the simple case of the rise or fall of the current in a simple inductive circuit when an E.M.F. is applied to it, or when a source of E.M.F. is removed. The differential equation for this case is obtained, and its solution discussed and illustrated by several examples in a very clear manner.

Next, the application of an alternating E.M.F. to a circuit containing concentrated inductance and resistances in series is discussed, and again illustrative examples and curves are introduced.

In the following chapter, the influence of a mutual inductance is considered. The treatment is clear and consistent, but it might have been helpful to add some explanation of the connection between circuits which are linked by induction by the diagrammatic method of the "equivalent circuit," which is so useful in many problems. In the "equivalent circuit," windings which are linked by the same flux appear as inductances connected in parallel, while windings which link separate portions of a flux are represented as inductances connected in séries.

The next chapter is devoted to a circuit having a variable inductance, *i.e.*, for example, circuits with an iron core. This is followed by a chapter dealing with the effects of a condenser (*i.e.*, a concentrated capacity) in the circuit.

The remaining seven chapters of Part I trace the application of the principles previously given to circuits in which the various constants of the circuit (resistance, inductance, and capacity) are distributed along the conductor, and thus form a mathematical discussion of the conditions existing in long cables and transmission lines. The treatment is entirely mathematical, but follows gradually from the simpler cases already given, so that the student is not confronted suddenly with complex expressions without gradual preparation for realising their meaning and entering upon their solution.

The second part of the book is devoted to problems in electrostatics, and is on lines more in accordance with those found in theoretical treatises on the subject. A graduated mathematical sequence is not possible in this case, and the several parts of the subject are treated in a more isolated fashion.

After a discussion of the fundamental laws, such as Coulomb's Law and Gauss's Theorem, the method of images is applied to point charges. Legendre's Function has a chapter to itself. Then follow chapters dealing with concentric conductors and two-wire and three-wire lines, while the last chapter gives an excellent summary of the principles of electromagnetic radiation in its application to wireless transmission of waves.

The brief analysis which has been given of the contents of the volume will indicate the scope which it covers, and it only remains to say that the author has accomplished his task excellently; his methods are clear and concise, and the result is a very helpful introduction to the study of problems in electrical engineering which demand an advanced mathematical treatment and which, for that reason, are sometimes considered to be beyond the range of students who have not specialised in the higher mathematics. The author has made it possible for any serious student of electrical engineering who is familiar with only that amount of mathematics which is included in an ordinary university course to attack with confidence many complex problems which have an important place in practical engineering design as applied to electrical transmission. For this we owe him our thanks.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

FRANCE.—Some recent decisions of the French Customs Department with regard to the tariff classification of certain articles not specified in the Customs Tariff have been published in the *Journal Officiel*. Among these are:—

Apparatus for transmitting written or spoken messages, which is dutiable under paragraph 524 *bis*—electro-technical apparatus. (The transmitter and registering apparatus are considered as one apparatus and the telephone attachment as another. If the parts are imported separately, each part is regarded as one apparatus.)

Cuprovanadium containing over 5 per cent. of vanadium is dutiable under 205 *bis*—ferro-vanadium.

DENMARK.—Under a Royal Decree, dated January 15th, the warehouse rent for the storing of goods in the State warehouses or in Custom houses has been increased by 25 per cent. as from February 1st.

AUSTRALIA.—Under a recent Customs by-law, the following articles, when imported for use in the manufacture within the Commonwealth of dry electric cells, are admitted as "minor articles," and are accordingly free of duty under the Preferential Tariff, and pay 5 per cent. *ad val.* under the General Tariff. The articles in question are brass caps, with nuts; caps for carbons; carbons; zinc cups; and terminals (including binding posts) of brass and nuts and washers therefor, but not including terminals having metal strips or other metal attachments soldered thereto.

ECUADOR.—A new Customs Tariff came into force on January 1st, 1917, under a Law dated October 13th last, which consolidates the duties and surtaxes previously in force. For the purpose of levying import duty, goods are grouped into classes, each class being subject to duty at a prescribed rate. The free list has been added to, and now includes, *inter alia*, electric accumulators and insulators, telegraph and telephone posts and fittings, and industrial machinery. The special local surtaxes on the import duties which are leviable at various ports for specific local purposes remain unchanged, as are also in the main the various charges levied on imported goods, *e.g.*, unloading charges, wharfage charges, &c. Particulars as to the rates of duty leviable on particular goods can be obtained from the Department of Commercial Intelligence, 73, Basinghall Street, E.C. 2.

GAMBIA.—Under the "Customs (Amendment) Ordinance, 1916," invoices for goods to be exported to Gambia may now be authenticated by *any person authorised to administer oaths* in the United Kingdom, as well as by Collectors of Customs. No attestation of invoices is required for imports not exceeding £10 in value.

BRAZIL.—The Brazilian Budget Law for 1917, which came into force on January 1st, authorises the Government to levy import duties on all goods in the proportion of 55 per cent. in gold and 45 per cent. in paper—the proportions fixed by the Bill, as noted in the Review of December 22nd. Among the changes made in the Tariff is the duty on plain, uncovered wire, in cables or cords, for electrical purposes, which is now at the rate of 800 reis per kilog., representing a duty of 30 per cent. Electrodes will continue to pay 8 per cent. *ad val.* The *expediente* (registration) tax on duty-free goods (which is payable on the same basis as the ordinary import duties), and the surtax of 10 per cent. (paper) on that tax, are continued in force. Former provisions are also continued in force whereby the Government is authorised (1) to levy, for the benefit of a port improvement fund, a tax not exceeding 2 per cent. (gold) upon the official values of imports at Rio de Janeiro, Recife, Bahia, Rio Grande do Sul, Maranhao, Ceara, Rio Grande do Norte, Parahyba, Espirito Santo, Parana, Santa Catharina, Matto Grosso, Alagoas, Parnahyba, Aracaju, and Para; and (2) to levy a tax of from 1 to 5 reis per kilog. (according to the value of the goods) on merchandise loaded or discharged at Brazilian ports and destined for or proceeding from other ports.

Consular Invoices. A new form of Consular Invoice is prescribed by the Law. The complete specification of each class of merchandise is to be declared, the commercial description, application, or material being clearly stated. In addition to the country of origin of the goods, the country in which goods were purchased for export to Brazil must be given. Invoices are to be presented for legalisation before the sailing of the vessel carrying the goods; if not, the importer is liable to a penalty equal to double duties for the non-production of the invoices within the period specified for their presentation. The fee for the legalisation of invoices is raised from 3 milreis to 4 milreis (gold).

[Milreis (1,000 reis), gold = 2s. 3d.; milreis paper = 1s. (about).]

FEDERATED MALAY STATES.—Under the "War Taxation Enactment, 1916," a new export duty on cultivated rubber is levied for one year from January 1st, 1917. When the price of cultivated rubber does not exceed 2s. 6d. per lb. the duty is 2½ per cent. *ad val.*; when the price exceeds 2s. 6d. per lb. the duty is 5 per cent. *ad val.*

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents 285, High Holborn, London, W.C., and at Liverpool and Bradford.

3,937. "Power traverses in electrically-driven lathes, boring mills, &c." E. Stirk, G. Stirk, J. G. Stirk, R. Stirk. March 19th.

3,954. "Ignition devices for internal-combustion engines." R. Taylor. March 19th.

3,956. "Magnetic separators." A. F. Wenger, A. H. C. Wenger and Wengers, Ltd. March 19th.

3,958. "Magneto-electric generators." G. F. Cooke. March 19th.

3,976. "Sparking plug for internal-combustion engines." W. C. Matthews. March 19th.

4,001. "Self-contained electric lighting apparatus." F. D. M. Gordon. March 19th.

4,002. "Medical induction coils." F. D. M. Gordon. March 19th.

4,003. "Electrical heating apparatus." F. D. M. Gordon. March 19th.

4,005. "Galvanometer for use on board ship, &c." Rymer-Jones. March 19th.

4,014. "Telephone, &c., diaphragms." B. A. Pilkington. March 20th.

4,036. "Fusible cut-outs." E. S. Conradi & J. F. Conradi. March 20th.

4,047. "Ozone generators." E. L. Joseph & Ozonair, Ltd. March 20th.

4,074. "Supporting indirect or semi-indirect inverted shades for electric lamps." A. Hardie & H. R. Hardie. March 20th.

4,082. "Magnetic compasses." L. E. Cowey. March 20th.

4,083. "Processes of producing metallised brushes for electric machines." Compagnie Generale Electrique. (France, May 22nd, 1916.) March 20th.

4,097. "Permanent electric flashlamp." R. J. W. Ogilvie. March 21st.

4,116. "Means for coupling magneto-generator with internal-combustion engine." D. Y. Wheatley. March 21st.

4,118. "Electric welding machines." G. Gandolfo. March 21st.

4,131. "Apparatus for regulating by hand the time of ignition in internal-combustion engines." Soc. Anon. des Etablissements L. Bleriot.

4,142. "Imitation electric candle lamps." C. Ammentorp & G. Gandolfo. (Denmark, May 20th, 1916.)

4,144. "Magneto-electric machines." O. Pfetscher. March 21st.

4,146, 4,147, 4,148. "Oil-insulated electrical apparatus." S. E. Bowrey and Duckham & Co. March 21st.

4,162. "Electrical cables, flexible cords, &c." M. H. Goldstone & J. H Ward. March 22nd.

4,167. "Sparking plug." J. Dorn. March 22nd.

4,174. "Continuous-current electric generators." R. Boin. March 22nd.

4,177. "Glands for electric cables, &c." G. H. Brough. March 22nd.

4,188. "Electric circuit controllers." Cutler-Hammer Manufacturing Co. and Igranic Electric Co. March 22nd.

4,196. "Electrical transmitting apparatus." H. K. Harris. March 23rd.

4,202. "Globes for enclosing electric glow lamps." T Tons & Veritys, Ltd. March 23rd.

4,223. "Searchlights." H. Remington. March 23rd.

4,228. "Electric generating and battery-charging installations for railways, &c." A. H. Darker and J. Stone & Co. March 23rd.

4,237. "Electrical condensers and process of making same." Philips-Briston & Co. (U.S.A., March 23rd, 1916.) March 23rd.

4,256. "Means for cooling body of sparking plugs for internal-combustion engines." J. Knight. March 24th.

4,260. "Overhead trolley-guide for electric tramcars." G. R. Goll. March 24th.

4,288. "Apparatus for electric driving of submarines, &c." Volta Soc Anon. March 24th.

PUBLISHED SPECIFICATIONS.

1915.

13,886. Dynamo-electric Power Transmission Apparatus. F. A. Heys (Neuland Patents, Ltd.). September 30th.

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1,418. Arc Incandescent Lamp for Therapeutic and other purposes. E. A. Gimingham. (July 20th, 1916.) (104,350.)

1,436. Device for Controlling Electric Ignition in Internal-combustion Engines. M. Pensuti. February 3rd, 1915. (100,053.)

2,290. Means of Control for Electro-mechanical Transmissions for Motor Vehicles. W. A. Stevens. February 28th, 1916. (Cognate application, 3,331/16.) (104,370.)

3,036. Polyphase Alternating Electric Current Commutator Machines. British Thomson-Houston Co. & N. Shuttleworth. February 29th, 1916. (104,378.)

3,087. Electric Motor Controllers. J. A. Hurst & F S. Brook. March 1st, 1916. (104,381.)

3,165. Studs or Electrodes of Electric Discharges. Marconi's Wireless Telegraph Co. & H. M. Dowsett. March 2nd, 1916. (104,385.)

3,166. Aeroplanes fitted with Wireless Telegraph Apparatus. Marconi's Wireless Telegraph Co. & H. M. Dowsett. March 2nd, 1916. (104,386.)

3,230. Electric Motor Driving Mechanism for Machines. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 3rd, 1916. (104,390.)

3,254. Electric Potentiometers. F. Wunsch. March 4th, 1915. (100,139.)

3,255. Voltage Regulating Systems for Electrical Circuits. R. E. Gillmor (Sperry Gyroscope Co., U.S.A.). March 3rd, 1916. (104,391.)

3,726. Manufacture of Electrically-welded Link Chains and Cables. R. Green. March 13th, 1916. (104,397.)

3,739. Coil Supports for Electric Apparatus, such as Transformers. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 13th, 1916. (104,398.)

3,976. Electric Cables. British Insulated & Helsby Cables, Ltd., and E. A. Bayles. March 17th, 1916. (104,401.)

4,247. Electric Transformers. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 22nd, 1916. (104,404.)

4,399. Controlling Mechanism for Electric Motors operating Cranes, Lifts, and the like. British Thomson-Houston Co. & W. L. Wise. March 24th, 1916. (104,407.)

4,620. Spark Plugs. J. W. Baird. March 29th, 1916. (104,410.)

6,379. Magnetos for Ignition Purposes. C. Messerschmidt. June 29th, 1915. (100,782.)

7,178. Electrical Rotary Switches. Armstrong, Whitworth & Co., Sir W. G. Widdingham, W. H. & J. H. Thain. May 19th, 1916. (104,426.)

7,848. Devices for Stripping Insulated Wire. S. G. Wood. June 22nd, 1915. (100,736.)

8,360. Control Systems for Electric Motors. British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.) June 13th, 1916. (104,439.)

8,436. Ammeters and Voltmeters. Walsall Electrical Co. & V. Delebecque. June 15th, 1916. (104,441.)

9,062. Shadeholders for Gas or Electric Light Fittings. R. W. MacLachlan. June 27th, 1916. (104,443.)

10,561. Electric Circuit Controllers. Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.) July 26th, 1916. (104,457.)

11,548. Spark Plugs. J. G. Knutson. August 15th, 1916. (104,463.)

11,924. Lacquering Machines. Sterling Telephone & Electric Co. and A. W. James. August 22nd, 1916. (104,464.)

12,162. Automatic and Semi-automatic Telephone Systems. Relay Automatic Telephone Co. & A. Grahn. August 28th, 1916. (104,467.)

12,737. Electric Sparking Plug. P. H. Sands, A. E. Coney & H. L. Constable. September 8th, 1916. (104,468.)

12,950. Manufacture of Electrically-welded Link Chains and Cables. R. Green. March 13th, 1916. (Divided application on 3,726/16.) (104,469.)

15,443. Battery Cells. W. L. Walker. March 17th, 1915. (Divided application on 3,161/16.) (102,056.)

16,077. Electric Portable High-speed Grinding Attachments for Lathes, Shaping, or like Machines. Canadian-American Machinery Co. (Toronto Type Foundry Co.) November 9th, 1916. (104,480.)

THE

ELECTRICAL REVIEW.

VOL. LXXX. APRIL 13, 1917. No. 2,055.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: April 13, 1917. [No. 2,055.

Page

Empire Development 393
Lumen *versus* Candle-Power 394
The Greaves-Etchells Electric Furnace (*illus.*) 395
Electricity Supply: a Retrospect 397
Machine-Switching Telephone Gear, by F. R. McBerty (*illus.*) 398
The Lumen as a Measure of Illuminating Power (*illus.*) ... 401
Legal 404
Business Notes 404
Notes 408
City Notes 411
Stocks and Shares 413
Market Quotations 414
Electric Tramway and Railway Traffic Returns 414
Municipal Electrical Publicity, by E. P. Hollis 415
Registration of Business Names 416
The Future of the British X-Ray Industry 418
Correspondence—
Insulating the Lead Sheathing of Cables 418
Fault Localisation 419
Combination Plug and Adapter 419
War Items 419
New Patents Applied for, 1917 420
Abstracts of Published Specifications 420
Contractors' Column ... ... Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. *Established 1872.*

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE :—4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson, & Co., Gresham Street.

AUCKLAND N.Z: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.

BRISBANE: Gordon & Gotch, Queen St.

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MELBOURNE: The Mining & Engineering Review, 90, William Street; Gordon & Gotch, Queen Street.

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NEW YORK: D. Van Nostrand, 25, Park Place.

PARIS: Boyveau & Chevillet, 22, Rue de la Banque.

PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Loescher & Co., Corso Umberto 1° 307.

SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.

TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE "ELECTRICAL REVIEW'S"

ELECTRICAL & ALLIED TRADES DIRECTORY

(THE RED BOOK),

1917 EDITION

IN THE PRESS.

H. ALABASTER, GATEHOUSE & KEMPE,

4, Ludgate Hill, London, E.C. 4.

EMPIRE DEVELOPMENT.

WAR has brought to millions of our own people, as well as to the enemy, a new and truer conception of the British Empire and of the spirit of Imperial Unity. All parts of the Empire have contributed their share in life, in blood, and in treasure to bring about the downfall of those who hoped to see an end of the Empire upon which, as we sometimes glory, the sun never sets. What will be the future of that Empire? Will our kith and kin, when the last of the fighting is done, return to their colonial cities and dwellings, and settle down to the daily round and common task as of former days, the self-same men as they went away when the call of Motherland flashed forth? The experiences through which we all have passed during these two or three years surely provide the answer. There will remain a new comradeship between us all, and having laboured and fought and died side by side to break a tyrant power, Mother Country, Colonies, and Dependencies alike will continue the spirit that has characterised their unity of action in war-time, in the rich and peaceful development that the coming years will bring. *Now*, the one thing that really matters is the complete defeat of the enemy; *then* we shall have great work to do to secure the utilisation of the great resources of the Empire for the good of all who are her children, and not for the enrichment of those with whose penetrative designs we have become all too familiar. In the past we have been blind to the vastness of the resources and the greatness of the opportunities of the Empire, though we have had our prophets and our orators, too, who have sought to impress us. But we cannot repeat those old past errors, and there is certainly no desire to do so among the millions in these islands to-day. Two things have been, and are, needed: investigation affording necessary information, and organisation. In regard to the first, there was appointed, as a result of the Imperial Conference in 1911, a Dominions Royal Commission to report on the natural resources, trade, and legislation of certain portions of His Majesty's Dominions. Through peace-time and in war the Commission has carried on its labours, and now, as good fortune would have it, the final report of the Commission (Blue Book Cd. 8462) appears while another Imperial Conference, called by the present Government, is in session in London. This final report is an impressive and imposing document, and its contents cover a very wide field indeed. It contains a mine of valuable material concerning the natural resources of the Empire, and emphasises the need for an Imperial trade policy in order that both the British manufacturer and the Colonies may utilise these for their mutual good, the former both meeting the actual requirements of the Colonies in pursuing their manufacturing operations and using the raw materials of the Dominions in so doing. It does not consider that any short cut can be found to the formulation of such an Imperial policy—it must include much that is not fiscal—but it holds that what is needed is detailed examination of existing conditions, and practical and definite proposals for the removal of difficulties and for securing co-operation. It gives an imposing statement of resources and deals fully with the application of scientific research in relation to their development. In one of its many sections it discusses three important questions bearing on the future of inter-Imperial trade, namely, Trade Intelligence arrangements now in force, the statistical systems of the Empire, and the value of various types of exhibitions in the promotion of trade. The work of the Board of Trade Commercial Intelligence Department, of Trade Commissioners, and of our Consuls, is discussed, and in a later Section the proposed unification of legislation bearing upon trade is examined. We regret that in the space at our disposal at the moment it is not possible to deal with the report at the length which its interest and importance merit. We must be content to summarise its main conclusions and recommendations. After all that has occurred, or been disclosed, during the past three years, we believe it will be generally agreed that it is vital that the Empire should, as far as possible, be in future able to resist any pressure which a foreign Power or group of Powers can exercise in virtue of a control of raw materials and commodities essential to its well being. Therefore, it is most essential that a complete survey should be made of the relation between Empire production and Empire requirements of such materials and commodities. Many of the points which such a survey should comprise are outlined by the Commission, and the whole of the work, in its opinion, should be entrusted to a proposed Imperial Development Board, which should carry out its research work and investigations (1) in respect of the United Kingdom, through the recently-formed Department for Scientific and Industrial Research, the National Physical Laboratory, &c.; (2) in respect of the Self-governing Dominions, through the now existing scientific departments, and the Committees for Research which are being set up in the Dominions; and (3) in respect of India, the Crown Colonies, and the Protectorates, through the local scientific departments and the Imperial Institute. The main functions proposed for the new Imperial Development Board are set forth fully. In addition to conducting the survey of resources, keeping a general watch out for changing requirements, and investigating many matters in collaboration with existing institutions and committees for scientific research, it will have regard to, and, we suppose, certain advisory powers respecting, the direction of Empire capital towards the development of Empire resources, the question of migration of population, harbour adequacy and improvements, shipping, cable and railway matters, trade legislation, and so on.

No study of an Empire—some of whose several parts are separated by such vast distances—can be complete without a very thorough examination of the whole subject of communications. The Commission therefore made an exhaustive study of the existing facilities for cable and wireless communication, and it makes some very definite recommendations. It describes further reduction of cable rates between the Mother Country and the Colonies as an urgent necessity, both for the encouragement of trade development and for the promotion of social intercourse. It does not consider the present control over the private cable companies effective for this purpose, and it declares that public opinion in all the Dominions is in favour of a policy which will secure State control of telegraphic communication between the United Kingdom and Australia and New Zealand through Canada. "In our judgment, such control is essential if adequate reduction of rates is to be secured." State acquisition as soon as possible (either by lease or otherwise) of a cable across the Atlantic is, therefore, recommended, with the necessary land line connection between Nova Scotia and Montreal, there to connect with the existing services administered by the Pacific Cable Board. As soon as through communication has been obtained, it is advised that there should be cheaper rates to and from Australia and New Zealand, lower business rates between Canada, Newfoundland, and Home, also to and from South Africa, and a considerable reduction in the Press rates. The objective that the Commission has in mind in its study of this important part of the entire subject is—plain language messages between the most distant parts of the Empire at sixpence per word, and the lowest possible Press rates in view of the vital need of the dissemination of Imperial news as fully, widely, and cheaply as possible. To our mind there are few things which are of greater urgency for the good of the whole Empire family than a cheapening of cable communication. The possibilities of Empire development along the lines of utmost efficiency are very deeply involved. We may assist or retard progress according to the manner in which so vital a question is handled. Every handicap under which we labour in this connection should be removed as the result of a large policy of real statesmanship.

The public mind, with its larger conception of what the British Empire is; with its imagination kindled as never before by the vastness of its resources and its potentialities; with the knowledge of the responsibility that rests upon itself and its kith and kin to develop and utilise those resources and potentialities; and with the unbounded admiration that possesses it for the million who have fought side by side with us, will readily grasp what it must mean to ourselves and to the Dominions to possess the amplest and cheapest means for keeping in expeditious touch with all the constituent parts of the Empire. We trust that the Imperial War Conference will see its way clear to ensure, as far as lies in its power, the adoption as early as may be of the progressive policy indicated by the Commission concerning this and the other essential matters covered in its very valuable and comprehensive report.

Lumen versus Candle-power.

Changes in nomenclature or in the magnitudes of units used in commercial practice always call for careful consideration before they are accepted as worthy of adoption, especially when they relate to matters which affect the general public as well as the trades or industries concerned. They should never be made unless they tend in the direction of uniformity, convenience, and scientific accuracy. All these advantages unquestionably attach to the proposal to adopt the "lumen" as a new unit for measuring the luminous output of light sources of every description, which was recently discussed exhaustively at a meeting of the Illuminating Engineering Society. Elsewhere in this issue we give a fairly full abstract of the discussion, the subject being one of material importance to electrical engineers; it will be found on reading this that a very strong case was made out for the lumen as compared with the candle-power, which is inherently defective as a measure of light production, giving no better guidance as to the output of a lamp than the voltage would give as to the output of a dynamo. The lumen is not strictly new, seeing that it has been known for some 20 years; but it has not come into general use until comparatively recently.

It should be obvious that to rate a lamp in terms of the total flux of light which it produces is much more scientific and practical than to state the intensity of its lighting value in a particular direction, or a more or less imaginary mean value. The lumen has already acquired considerable vogue abroad, and has now been adopted, in addition to the watt rating, by the leading British lamp makers; it is to be hoped, therefore, that it will speedily become a household word in the electrical world.

THE GREAVES-ETCHELLS ELECTRIC FURNACE.

THE rapidly growing utilisation of the electric furnace in the Sheffield steel industries was a noteworthy feature before the war, and has been greatly stimulated by the existing conditions. In connection with the recovery of scrap, it has the great advantage that it can readily melt the whole of its charge in the shape of shell turnings, &c., whereas all other furnaces can use only a very limited proportion of turnings, and the remainder of the charge must be new raw materials, pig iron, &c. ; the electric furnace can make sound steel or castings directly from the melted turnings, and should be installed in all works where there is an accumulation of turnings or other steel scrap and a supply of electrical energy. Moreover, the quality of the finished product is much superior to that of any other type of furnace.

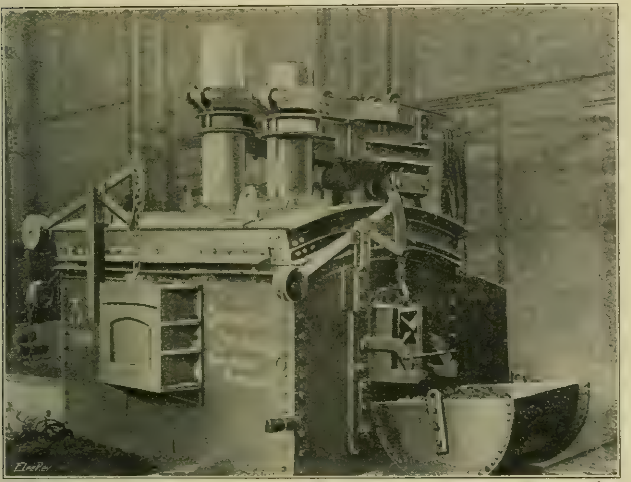

Fig. 1.—Greaves-Etchells 3-ton Furnace at the Works of Sheffield Alloys, Ltd., Rotherham.

An electric furnace of new design has recently been introduced in the Sheffield district by Messrs. T. H. Watson and Co. (of Sheffield), Ltd., and is illustrated herewith ; it is the joint invention of Mr. H. A. Greaves, a member of the electrical engineering staff of the Sheffield Corporation, and Mr. H. Etchells, who has for some time specialised in electric furnace work. The furnace is of the three-phase type, two of the phases being introduced through the roof with vertical electrodes, while the whole of the hearth acts as the third electrode. The hearth is a solid basic lining, 20 in. thick, composed of dolomite, tar, magnesite, &c. Energy is supplied by three single-phase transformers with the primaries in delta connection ; the secondaries are connected in star, with unequal legs, the proportions being so calculated as to give a balanced load on the primary mains when the upper electrodes are in equal adjustment. An advantage of this arrangement is that if one of the arcs is broken the others are not affected, and an overload on one arc is limited owing to the current having to pass through two transformers in series and in different phase, producing a considerable buffer effect, and tending towards a reduction of shock. Hence it is found possible to maintain a continuous load, with little variation, and thus to utilise the full capacity of the transformers. Owing to electromagnetic effects the molten steel is kept in motion, so that it becomes uniformly heated and homogeneous in composition. Tappings in the primary windings of the transformers enable the secondary voltages to be varied, in such a way that the currents passing through the bottom of the furnace and between the top electrodes can be adjusted between wide limits, in order to distribute the heat in any desired proportion between the top and bottom of the charge, to superheat the slag floating on the steel, if desired, and so on.

The furnace is made in standard sizes ranging from 10 cwt. to 10 tons ; the smallest size is designed to produce small ingots of high-speed steel, magnet steel, rustless steel, and similar alloys, and is provided with transformers of 260 K.V.A. ; the 3-ton furnace requires 800 K.V.A., and the 6-ton size 1,560 K.V.A. The smaller furnaces have two carbon electrodes each ; above 3 tons, four electrodes are used. The electrodes are carried by substantial brackets at the side of the furnace. The 6-ton and larger furnaces have the four electrodes evenly spaced, with a charging opening, 3 ft. wide, at each side of the furnace, which is sealed up with a patented type of door : the electrode arms can be swung outwards, allowing the roof to be bodily removed, or the electrodes to be changed without climbing on the roof. The electrodes are raised and lowered by a screw shaft, which can be operated by hand or by a motor, with or without automatic regulation, as desired. The casing of the furnace is constructed of heavy boiler-plate, suitably stayed to prevent distortion, and the arched roof consists of silica brick, so supported as to allow of free expansion. The doors are opened by levers, and when closed are locked by a steel wedge ; under the makers' patent system, a plug of refractory material completely seals up the door opening.

The smaller furnaces are rectangular, the larger circular, in plan ; they are all balanced, and are mounted on an ingenious arrangement of compensating rollers, as shown in fig. 3, which has the effect that when the furnace is tilted for pouring, the teeming spout travels downwards in a vertical line, so that the ladle can be put in the right

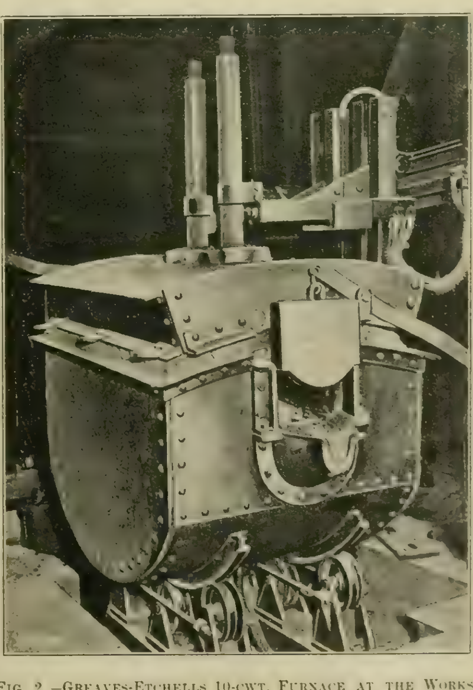

Fig. 2.—Greaves-Etchells 10-cwt. Furnace at the Works of the Apex Steel Co., Ltd., Sheffield.

position, and need not be moved whilst tapping the furnace. A slagging spout is provided at the rear charging door, and in the smaller sizes another charging door is placed at one side.

The transformers are of the British Electric Transformer Co.'s manufacture, and the switchgear is made by Messrs. Reyrolles, Ltd., with a rotary selector switch for controlling the voltage.

In all except the smallest size of furnace two working voltages are provided. Electric motors are used for hoisting and for tilting the furnaces, except in the case of the 10-cwt. furnace, which is operated by hand.

The tilting gear consists of a steel screwed shaft operated by a steel bevel wheel mounted on trunnions, with a threaded steel nut in the centre; the bevel wheel is driven through gearing by a motor of 3½ H.P. in the case of a 3-ton furnace. Motors of the same size drive the electrode carriers, through worm gear, and all the motors are controlled from the attendant's platform with controllers of the tramway type.

The first furnace made was designed to melt 5 or 6 cwt. of high-speed steel, and consumed 700 units per ton; the time occupied from charging with cold raw material to casting the finished ingot ranged from 75 to 100 minutes. A small furnace erected at the works of Messrs. Spear and Jackson, Ltd., Sheffield, has already made 1,080 heats of high-speed steel, and the lining has only once been renewed. The furnaces already in operation or on order number more than 20, including one of 10 tons capacity for Messrs. Kayser, Ellison & Co., Ltd., Sheffield, and one of 3 tons capacity for Messrs. J. H. Andrew & Co., Ltd., Sheffield. We illustrate in fig. 1 a 3-ton furnace at a Rotherham works; it occupies a space 9 ft. square, and the casting pit, which provides for casting two groups of four ingots each, together with the ladle pit measures 24 ft. × 7 ft. In this furnace a charge of two tons of steel turnings can be melted in two hours and twenty minutes, and the refining process for the production of nickel-chrome vanadium steel occupies two hours. The load on the three phases is well balanced, and the power factor is 0·90.

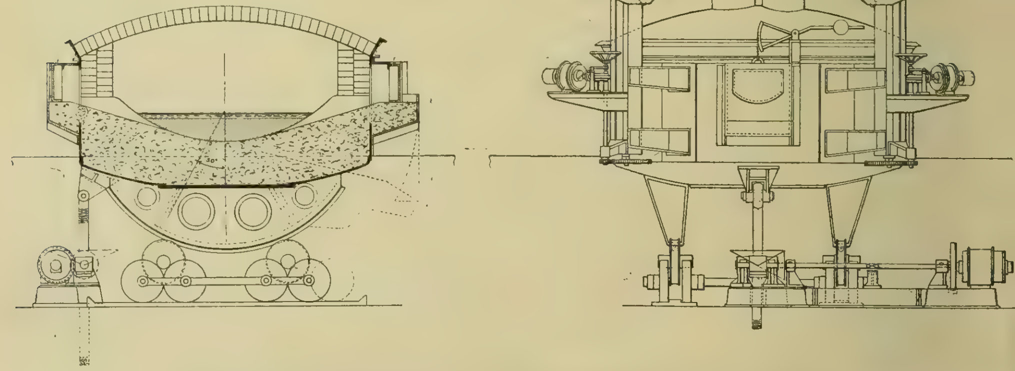

Fig. 3.—Section and Elevation of Standard 10-ton Greaves-Etchells Furnace.

It is significant and interesting to note that old-established firms in the Sheffield steel trade are adopting the electric furnace without hesitation, and are building shops specially for its accommodation. Energy is derived from the Corporation mains at 11,200 volts, and is transformed to 80 volts for melting and 65 volts for refining.

According to the *Sheffield Daily Telegraph*, the past year has witnessed the beginning of a new era in the local steel industry, created by the introduction of the electric furnace. A number of such furnaces have been at work for some years, but during the war the innovation has received attention from the trade as a whole, and much prejudice against it has disappeared. Nearly 40 such furnaces are at work or contracted for, and additions to the number are certain to be made in the near future. The Greaves-Etchells type, which was designed and is being constructed in Sheffield, has won general favour, and the small sizes are proving quite satisfactory for the manufacture of high-speed steel. In a number of cases, electric steel has proved a reliable substitute for Swedish steel, and the extension of electric melting should lessen the city's dependence upon Swedish iron and steel products, which are extremely scarce and terribly dear. The electricity department of the Sheffield Corporation realises that electric melting has a great future, and is arranging for a large increase in the supply of current. It states that it is already supplying current to 20 furnaces, and expects shortly to couple up a further 16, the output of the whole being estimated at 100,000 tons per annum of expensive steel.

Bauxite in Hungary.—A company, with a share capital of £333,000, has been formed at Budapest, under the title of the Aluminium Ore Mining and Industry Co., and under the presidency of the general director of the Hungarian General Credit Bank, to take over the bauxite mines of the Count Karl Kornis group in the districts of Bihar and Klausenburg. The object of the company, in which the German banking firm of S. Bleichroder, the Disconto Gesellschaft, and the metal firm of Aron Hirsch & Co. are also interested, is chiefly to work the mines in question, the large present output from which is mainly forwarded to Germany. The new company, however, proposes to establish plant for the treatment of the ores and the production of aluminium.

Water Power in Ireland.—A recent issue of the *Times Engineering Supplement* contains an article on the possible power development of the Shannon for supplying Dublin and Limerick, and the Erne for supply to Belfast and Derry. The longest transmission would be about 120 miles, and each river is estimated to give 50,000 H.P. during eight months of the year, and from 20,000 to 40,000 H.P. during the remainder. The possibilities of Lough Neagh, which has an area about equal to that of the Isle of Man, are apparently discounted by the drop of only 40 ft. over a distance of 60 miles to the sea; there is, however, an opportunity for some small local developments, such as for electric supply to the town of Coleraine.

Proposals have been made to utilise the tides in Strangford Lough, which is convenient to Belfast, and is fed from the sea through a narrow channel, about 4 miles long and from ¼ to ½ mile wide.

The tides run about six hours each way, with two hours of slack water, when no head would be available. To overcome this it has been suggested to provide internal storage reservoirs by means of a barrage across the Quoile River estuary and a bay behind Mahee Island; also, as an alternative, to provide battery storage. Power would be generated by both the incoming and outflowing tides, and it is estimated that the power at the turbines would vary from 60,000 to 10,000 H.P., averaging with suitable storage 32,000 H.P. the year round. The capital expenditure on the scheme is estimated at £1,120,000, and the annual saving over a steam plant of similar capacity at about £120,000.

ELECTRICITY SUPPLY: A RETROSPECT.

Those who have watched for a considerable period of years the gradual fruition of an enterprise, the perfection of a process, or the development of an ideal, will know how to appreciate the old saying that "everything comes to him who knows how to wait." History, perhaps, affords the best illustration of the fact that sooner or later, but almost certainly in course of time, sustained effort with a legitimate object in view will succeed. At the moment such reflections are not inappropriate to those who have striven for the official recognition of the merits of cheap electric supply as an essential factor in that sphere of human activity which really dominates modern history, viz., modern industry; nor is the present time an inappropriate one for briefly reviewing some of the steps which have been taken during the past year with a view to realising such an ideal, and which have, in fact, culminated in a measure of official recognition beyond the expectations of all but the most hopeful supporters of the idea.

It is a year ago, to-day, that, at the Institution of Electrical Engineers, Mr. E. T. Williams, by his able introduction to a discussion on the position of electricity supply in the United Kingdom, and the steps to be taken to improve and strengthen it, helped to focus attention on the question of electricity supply from the national standpoint.

As mentioned in our leading article at the time,* his proposals represented the logical sequel to the insistent demands for the conservation of our national fuel resources, and the no less pressing necessity of improving our industrial equipment with a view to securing the maximum efficiency in industry after the war.

The basic idea underlying the carefully thought-out scheme enunciated by Mr. Williams was, of course, by no means a novel one, and only the previous week we had had occasion to refer editorially to the views of Sir R. A. S. Redmayne in regard to the vital necessity of centralising production—a doctrine which was most forcibly propounded some years previously by Dr. Ferranti,† and subsequently gained the support of many other leaders in the electrical world.

The discussion on Mr. Williams's scheme for reorganising electricity supply on national lines was followed by a similar one in Manchester, in which Mr. J. A. Robertson introduced the subject,‡ and in commenting editorially on this in the following week§ we were able to announce the issue of the Board of Trade circular (under date May 25th), urging the interconnection and joint working of electric supply undertakings of all kinds, and offering to facilitate the carrying out of such schemes. This was a great step in advance, to the importance of which, as regards the electrical industry, as well as in attaining the expressed purpose of the Board, viz., economy in fuel consumption, we drew attention at the time, even urging that a measure of compulsion would not be unwarranted in view of the national importance of the question.

However, events have shown that those most concerned fully appreciated the situation, and that the electric supply authorities in Lancashire and Cheshire had even anticipated the Board of Trade circular, to the extent that on May 9th they had formed a committee to prepare a scheme of interconnection where feasible in those counties. We referred editorially to this matter, and to the I.M.E.A. meeting, where the paper by Mr. Ellis echoed the demand for organisation of electricity supply in this country, in our June issues; subsequently it was announced that the Council of the Institution of Electrical Engineers had, in fact, appointed a committee to consider the present and future of electricity supply in this country, on June 8th, and almost simultaneously came the announcement that on June 21st a joint committee of the Municipal Electrical Association and electric power companies had been formed to investigate the same matter.

In a subsequent issue* we discussed the respective spheres of activity of these two committees, some of the members of which are common to both, pointing out that "apparently the duties of the former (I.E.E. Committee) will be to consider the principles and methods, to confer with the Board of Trade on questions of policy, and to solve engineering problems, while the latter will be a committee of ways and means, and will investigate local conditions in the various areas concerned, with a view to expediting the accomplishment of the work of linking-up."

The next public references to the matter were at the meeting of the British Association† in September, where, in discussing the question of fuel economy, Mr. C. H. Merz again emphasised the necessity of centralising production and interconnecting electric supply systems under the guidance of some central authority, pointing out that such an ideal may be achieved in this country, on account of its compact nature, to an extent which is not possible in other countries.

At this meeting, too, Mr. R. P. Sloan read a paper on fuel economy on the North-East Coast, such economy being, of course, due to the splendid efforts of the large interconnected electric power companies in that area.

In the early days of October‡ came the issue of the memorandum which the Joint Committee, appointed by the Incorporated Municipal Electrical Association and the Incorporated Association of Electrical Power Companies, addressed to electricity supply undertakers throughout the country, and, almost coincident with it the publication of the interim report of the Committee for the Interconnection of Lancashire and Cheshire supply systems (dated September, 1916), which detailed the proceedings of the Committee since its inception in the previous May. During the same month, Mr. R. A. Chattock (who is the chairman of the I.E.E. Committee on Electricity Supply) addressed the Birmingham Association of Mechanical Engineers on the subject of industrial economics,§ and referred at some length to the question of centralised power generation, fuel economy, &c.

The close of October saw the formation of a joint committee of municipal and company representatives with a view to considering a scheme for interconnecting the West Yorkshire electrical undertakings,|| and a committee of a similar kind was formed on November 3rd, to deal with electric supply in the West of Scotland.**

In our issue of November 10th, we published an important article on the question of wayleaves—we refer to it here because the author, who is intimately acquainted with the subject, outlined the possible procedure for dealing with this matter, which is of vital interest to those contemplating extended distribution of electricity; moreover, the whole matter was to be discussed at the Institution of Electrical Engineers last night. On November 21st a joint committee, representing municipal and company interests, was formed to deal with the interconnection

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*Elec. Rev., April 21st, 1916; † *ibid.*, November 18th, 1910, Presidential Address to the I.E.E.; ‡ *ibid.*, May 19th, 1916; § *ibid.*, May 26th, 1916.

* Elec. Rev., August 4th, 1916; † *ibid.*, September 15th, 1916; ‡ *ibid.*, October 13th, 1916; § *ibid.*, October 20th, 1916; || *ibid.*, November 3rd, 1916; ** *ibid.*, November 10th, 1916.

question in South Wales[*]; on December 18th a similar committee was formed for the West of England area[†]; and two days later the same procedure was adopted by the supply authorities on the North-East Coast.[‡]

The next landmark is one to the importance of which we drew attention at the time,[§] viz., the Manchester conference of the Lancashire and Cheshire supply authorities, which was convened by the Board of Trade and presided over by its Parliamentary Secretary, Mr. G. H. Roberts, M.P.; it is not too much to say that the impression conveyed by that gentleman as to his grip of the subject generally, caused the deepest satisfaction in electrical circles, and, in fact, gave rise to what have turned out to be well-founded anticipations that a completer measure of recognition of the national interests involved in electricity supply might be accorded by the Government.

In point of fact, we were able to announce editorially on March 23rd, that the President of the Board of Trade was appointing a Departmental Committee to report on the steps, legislative or otherwise, necessary to ensure an economical supply of electric power for all classes of consumer in the United Kingdom, and the names of those constituting the Committee were announced in the following issue,[‖] as also the formation of a Provincial Electric Supply Committee representing some 60 provincial supply companies who are working between 200 and 300 Provisional Orders.

In the meantime, it may be noted that steps had been taken to form a committee to study the question of interconnecting supply areas in Devon and Cornwall[**]; a conference of West London supply authorities took place with a view to establishing a co-operative bulk supply station; and simultaneously with our announcement regarding the Board of Trade Committee, we were able to state that the Incorporated Municipal Electrical Association had formed a committee on the development of electricity in agricultural areas—this being a matter which has too long remained in obscurity, but is obviously brought much nearer to the stage of realisation by the various proposals for interconnecting existing electric supply areas.

Our review of the matter is necessarily brief and, in some respects, incomplete, our object being, as far as possible, to direct attention to the essential history of the year as it affects the administrative reorganisation of electricity supply on a broader and, we hope, national basis; the technical problems involved in this reorganisation have been by no means overlooked during the year, and one need only instance the papers on "Parallel Operation of Power Stations" (Peck), "Frequency Changers" (Townend), "Voltage Regulation of Rotary Converters" (Juhlin), and the discussion on "Wayleaves" (already mentioned) at the Institution of Electrical Engineers, while the recent paper on power-house design, by Mr. E. M. Lacey, before the Institution of Civil Engineers raises a technical side issue of some interest. While the year has been so prolific in the formation of committees, &c., most of which are fortunately correlated, and imbued with more or less common aspirations, the future of electricity supply depends more particularly on the result of their labours, and in one case at least, viz., that of the Committee formed by the Institution of Electrical Engineers, some indication of its work during the past year seems rather overdue, seeing that its formation followed closely on the discussion initiated by Mr. Williams. Possibly it regards its labours as superfluous in view of the active interest which is being taken in the matter by other bodies which are more closely in touch with the subject, and especially in view of its representation on such bodies.

A feature of the greatest interest in the events of the past year, which must strike all close observers, is the community of electric supply interests which has been established as a result of the common object in view, which dominates all other considerations. At the moment these interests, though working in unison, are of a semi-independent nature, and it should be our common object to permanently weld them, as far as possible, so that after the war one representative body—possibly a National Electric Supply Association of Great Britain—may exist for the benefit of the electric supply industry as a whole.

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[*] Elec. Rev., December 1st, 1916; [†] *ibid.*, December 29th, 1916; [‡] *ibid.*, January 12th, 1917; [§] *ibid.*, March 9th and 16th, 1917; [‖] *ibid.*, March 30th, 1917; [**] *ibid.*, March 9th, 1917.

MACHINE-SWITCHING TELEPHONE GEAR.

By F. R. McBERTY, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

The operations now necessary in a telephone exchange are, to place a conducting link between a terminal of a calling party's line and the terminal of any party wanted within the telephonic area, to signal the wanted party, and to return the apparatus to normal condition after conversation.

Within 40 years the extension of the circuits to be interconnected has increased from a maximum of a few hundred feet to a maximum of 5,000 miles; the number of telephones to be interconnected has increased from a dozen or so to 10 millions; the time required for the switching operations in local service has diminished from an hour or more to a maximum measurable in seconds. The training of the operator and the development of apparatus and methods suited to her have permitted these changes; but the physical and mental characteristics of the operator have dominated the nature and cost of the apparatus and the arrangement of the plant. The operator has been needed primarily to perform the physical work of connecting one terminal with, and disconnecting it from, the other. In addition, she has been loaded with the supervision and inspection of the connections, with various discriminatory functions in respect of classes of service, choice of route and rates, and with various sorts of clerical work. In the present consideration, we are concerned mainly with the physical work of switching.

In performing switching, the operator observes the signal of the calling party, connects her telephone with the calling line, tests the wanted line, connects the calling line with the wanted line, rings the bell at the wanted station, observes the call for disconnection, and removes the connecting means.

Merely to observe a call signal and prepare to act upon it she requires an appreciable time—one or two seconds; to take a plug and insert it into a near-by jack consumes 1½ seconds; to receive an average number at an average rate of speaking consumes two or more seconds; to repeat it for the sake of accuracy, 2 seconds; to carry a plug from the key shelf to a jack in the multiple field requires 1½ seconds or more; to withdraw two plugs, 2 or more seconds. In addition to these times of activity, it is necessary to allow her a resting time amounting to 30 or 40 per cent. of an hour. The operator has also a limited reach. While sitting, she can reach over a semi-circle of about 30 in. radius above knee height; if she is compelled to rise to make a connection, the time consumed, the fatigue, and consequent reduction of load are largely increased.

In each of these acts she exhibits inherent and controlling limitations, to which the character of service and of telephonic switching plant have been adjusted. In each of them she is at a distinct disadvantage as compared with a switching machine.

The construction and capabilities of the apparatus which she manipulates are dominated likewise by her physical characteristics. The dimensions and the material of the jacks, plugs and cords, keys and keyboard, are determined by the character of her grasp, and of the forces she exerts in pushing in and pulling out the plugs and working keys; the number of jacks and of junction terminals which can be assembled in a given area is fixed by the dimensions of plugs and keys; and a certain orderly numbered arrangement, which permits easy observation and a minimum of mental effort, must be preserved.

These facts limit the multiple switchboard to about 10,000 lines capacity, thus fixing the largest switching unit which can be operated by a single operator. The time required for noting signals, speaking, and making movements is so large that a second operator is interposed in a series of connecting operations only of actual necessity, while a third operator can be resorted to only for a limited amount of special service. The average time of switching through a single operator may be 8 seconds; in switching through two operators, it is increased to 15 or even 20 seconds. The large city exchange areas therefore have been organised into central offices of about 10,000 lines each, with a maximum switching unit of about 10,000 lines, with junction switching between offices which, regardless of the economics of plant construction, is never permitted to involve more than two operators.

The wages of operators, together with those of reserve forces, supervisors, and trainers paid for the times thus expended in switching and rest, form a large and increasingly important feature of telephonic economics. Take, for a rough comparison of costs, the work of the switching or incoming junction operator, which is practically confined to acting upon instructions given as briefly and rapidly as possible to plug up and remove connections. Such an operator can switch about 500 connections per hour, with a resulting wage cost of £5 for 100,000 connections. On the simplest showing, an equal expenditure would pay each year for a machine capable of switching an equal number of connections for an indefinite period; in other words, a switching machine would cost about as much per 1,000,000 connections or more as manual switching per 100,000 connections. In a closer analysis, the comparison is less simple; the switching machine is expected to retire the cost of the displaced manual apparatus, to pay interest and upkeep on itself, and to retire its initial expense during its life. Thus there are brought into the comparison a number of variable factors that, in comparative estimates, are still based largely upon assumptions, which can be adjusted by partisans to demonstrate the case for either manual or machine switching.

The underlying problem of switching lines together in desired combinations, substantially the same whether by manual or by mechanical means, is to move the terminal of one line calling by chance to the terminal of another particular chosen line amongst a large number, and to hold the two in electrical contact for a short period. There is a limit to the time which the switching operation may consume and to the cost of the machine for effecting it. The human motor of the manual switching system has a mechanical advantage over the machine of a controlling nature—the operator can use vision and can plan to determine the course which her hands shall follow in applying the movable to the fixed terminal, and in removing it at the end of connection—and thereby is enabled to move the terminal in three co-ordinate directions, as no machine so far designed is capable of doing. In all switching machines the movable terminal is provided with a free and clear path to and from all fixed terminals, and moves in one direction or in two co-ordinate directions in a plane. The human motor, therefore, has been used to operate a number of movable terminals (plugs) over the same field of fixed terminals (jacks) for making a considerable number of simultaneous connections; while the mechanical motor is confined to moving a single movable terminal (brush) over its allotted field of fixed terminals, which must be multiplied together before movable terminals in sufficient number to provide for connections occurring simultaneously.

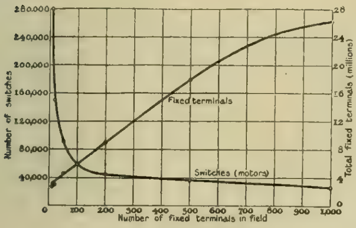

Fig. 1.

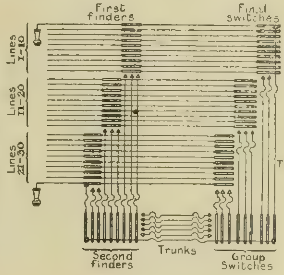

Fig. 2.

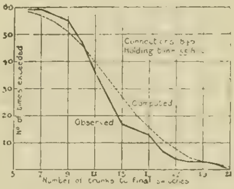

Fig. 3.

The three limitations suggested—time of switching, cost, and number of machines—have determined the nature of mechanical line switches, and each has given rise to a series of inventions and developments. Of these the time limit within which the switching operation must be completed has imposed the most rigid restrictions, and has resulted in the most various and striking characteristics of switching mechanism.

The obvious method of arranging the terminals in a single row, whether straight, curved, or circular, is immediately open to the objection that the speed at which the movable terminal can be driven is limited by the necessity of stopping accurately upon the required terminal and without a destructive blow. The mass of the moving member cannot be brought below certain limits without sacrificing durability and rigidity; the speed of motion and the accuracy of stopping at the point required is determined by the quickness of action of magnets of which the power diminishes as the quickness is increased. Because of these physical conditions, it has not been found feasible for commercial service to propel the movable terminal over more than about 50 or 60 terminals per second—a number which is not satisfactorily large. A number of inventors have solved the problem of driving a movable member over a sufficiently long row of fixed terminals by means of two motors of different speeds, the member being driven at high speed nearly to the desired point, say to the preceding decimal, by the first motor after which it is connected with the low-speed motor which moves it at a rate suitable for accurate stopping to the particular terminal. By this means, a straight row of terminals up to 500 can be covered within the available period.

A type of quick-acting switch better represented in the art is that having terminals in several rows in a compact rectangular field, the wanted terminal being reached in the field by choosing first the desired row, and then the desired point in the row—commonly known as the "co-ordinate" switch. In one form, the switch is furnished with a single movable terminal which is propelled over the field along co-ordinate axes, thus arriving at the most remote terminal by passing crosswise over all the rows and along one of the rows. Of this type are the Strowger switch and the Clement switch, both in extensive and successful use. In another form (the "multiple brush" switch) the movable member carries a number of terminals equal to the number of rows, of which one moving terminal is chosen and put into condition for making contact in the desired row, while the entire group of movable members is propelled over the rows to the desired point in the row. This form of switch is able to connect with the desired point in the field with a minimum of motion, and thus with the same speed permits a relatively massive construction. The form is represented in commercial equipments by two different switching machines, in one of which (the Western Electric system) the desired brush or movable terminal is chosen by moving the brush member bodily into position for contact, whereas in the other (the Lorimer system) all brushes are in contact, and one is electrically chosen by an auxiliary switch.

All the co-ordinate switches require two motor elements. Moving at the same rate of speed as a single-row switch, they can cover much larger fields of terminals—it is practicable to reach the most remote of 200 terminal points in one second.

The single row of terminals has been arranged in a straight line, in an arc, and in a complete circle. The straight line is best suited to large switches, for the reason that many rows can be placed side by side in a compact arrangement; the single curved row is suitable only for small switches; the complete circular row is far too bulky for switches of considerable capacity, and presents serious difficulties in attaching wires. The rectangular fields take the form of plane surfaces, arcs of cylinders, complete cylinders, and segments of spheres.

It will be apparent that the motor elements required for producing the motion of movable terminals so diverse in extent, rate, and direction, must be correspondingly various; but development has favoured two general types, of which one is the ratchet or "step-by-step" motor, and the other the power-driven motor, each with a different characteristic method of control.

Possibly the ratchet motor has the advantage of the longer history; the earliest automatic switching mechanisms were of the same nature as the early Wheatstone telegraphs, electric clocks, and like mechanism. Switches which contained only a small number of terminals were intended for location in lieu of operators, in remote places lacking sources of adequate electric power. For such circumstances it is extremely well suited. With the demand for massive construction, high speeds, and large switch capacity, the limitations of ratchet motors have been found serious, and recourse has been had to constantly driven motors to which the moving-switch member is clutched as required. The ratchet motor has the advantage of being quiet, except at the moments of propelling the switch member, which may amount to no more than one or two minutes per day. Aside from the presence of a constantly moving part, simplicity of construction and easy maintenance would seem to be in favour of the power-driven clutch. For such work as is required of a telephone switch, it is a surprising fact that the annual cost of a piece of shafting maintained in constant motion is very little more than that of the same piece of metal still, and much less than the cost of maintaining a more complex form of motor device.

Size of Machines and Number of Multiples.

The accommodation of the traffic requires a sufficient number of multiple fields each with its movable terminal and motor to make and maintain the maximum number of connections simultaneously required in the particular numerical group represented in the field of terminals.

The maximum requirement deviates considerably from the average of the traffic requirements, and the deviation increases very greatly as the group of lines diminishes. This fact under present conditions of manufacture has an important influence upon the number of terminals which may be brought together in a single multiple field, and on the consequent dimensions of the individual machine switch. The machine for maximum economy in first cost must represent a choice between a large number of terminals very inefficiently employed, with a minimum number of motors and movable members very efficiently employed, on the one hand, and on the other a small number of terminals efficiently employed and a large number of motor and moving members inefficiently employed. Fig. 1 shows the computed total of movable terminals and motors, and of fixed terminals, required for performing the switching in a 100,000-line exchange furnished with machines of different dimensions—from 10 points each to 1,000 points each.

The subsequent cost of maintenance is, however, of weight, since this cost is affected in a more important way by the multiplication of moving parts than it is by the multiplication of fixed parts.

The motion of the switching machine may be controlled primarily in either of two ways, for functions which may be described as "seeking" and "choosing" respectively, corresponding to the operator's connecting with a calling line (which she does by seeking out the particular line displaying a signal) and connecting with a wanted line (which she does under the direction of the subscriber by the process of numerical choice). The switching functions are not essentially different; the moving terminal of a seeker or finder is driven to the required points and stopped there by the different conditions of the point itself; whereas in the choosing-switch or selector, the moving terminal is propelled through a measured distance which is controlled from a distant point; both functions are sometimes combined in the same switch. Nevertheless, the finders commonly require a smaller field of terminals for efficient operation than selectors, and each of the developed machine switching systems contains two forms of switching machine based on this difference of function.

Trunking Through Switches.

The switching machine in itself is quite inadequate for interconnecting the lines of even a small telephone exchange. The manual switchboard is, as noted, limited to about 10,000 lines within reach of the operator with a plug. The largest machine switch so far constructed is limited to about 500 lines within reach of the movable terminal. Recourse is therefore had to combinations of machine switches operating in series, the seekers connecting the calling lines into diminishing groups of trunks finally to the first series of choosers, whence they are distributed under direction of the calling subscriber through continually ramifying groups to the wanted lines. The mechanism for distributing the incoming calls to their destinations in the field of called lines is exactly like that resorted to in the manual system when the single multiple-jack field was outgrown, namely, trunking the call to a multiple jack of a free-testing junction line in a chosen group of junctions, which ends in the moving member of a switch at a distant point before another field of jacks containing the wanted line. As pointed out at the beginning of this paper, the manual trunking method is practically limited to two switching operations in sequence, because of the time taken by operators to communicate and to perform their functions. The switching machine is free from this limitation, and permits the switching of connections through successive junction lines and machine switches to an unlimited extent.

The function of the seeking switch is to concentrate the connections originating in a large group of lines upon a limited number of the more complex and costly elements involved in the connection, namely, the group-choosing switches and the speech-transmitting and controlling gear. The function of the choosing-switch or group-switches is the reverse—to distribute the traffic from those general and relatively costly appliances to a large number of call-receiving lines—and this purpose likewise is served by one or more choosing switches in series, which choose free paths through ramifying groups of trunks. In this case, however, since the purpose of the selection is to reach a particular line, the connection into the next group cannot be made at random, but a free trunk in a particular group of trunks must be chosen (fig. 2). The choice of group can be made by a separate choosing-switch which connects through to a seeking-switch having access to the desired group of trunks; or by setting in motion one of a number of seeking-switches connected in multiple with the chosen trunk, each of which has access to a different group of trunk lines; or by concentrating terminals of all the groups in a single switching machine and performing in the same machine the double choice of a particular group and an idle trunk in the group. As so far developed the two first-described methods of choosing the group require for each trunk a separate movable terminal and motor for each group to be chosen; while in the latter plan—making the double choice in a single machine—one, or at most two motors are required (one for choosing the group and one for choosing the idle trunk in the group), but fixed terminals for all trunks of all groups must be assembled in a single machine. The former plan thus calls for a large number of moving elements very inefficiently used, while the latter plan requires a large number of fixed terminals inefficiently used by a small number of movable terminals. In this case also, the choice of a commercial switching plan is determined by the relative cost of movable and fixed terminals. It is unnecessary to emphasise the desirability of thus concentrating the traffic of the telephone system in the minimum number of machine switches; the extent to which it can be carried determines both the dimensions and number of the switching machines, and thus the cost of the equipment This concentration has been one of the main causes of the reduction in cost of machine-switching equipments to a point at which such systems can compete with manual-switching systems. The extent of the concentration, or, in other words, the relative number of paths through the switching equipment for simultaneous connections, determines not only the cost of the equipment, but also the quality of service it is capable of rendering to the users. Such a number of paths could be furnished as certainly would carry the maximum traffic in the busiest hour ever experienced—but only at high cost. At the other extreme, the switching equipment may be reduced to a point at which, during busy periods, such a large percentage of connections are prevented or delayed by the occupation of all trunks, or of trunks at some place of maximum congestion, that service is seriously impaired. In planning the switching equipment, the constructor, as well as the purchaser, must make a choice between first cost and quality of service.

For the inventor, the engineer, and the purchaser of machine-switching equipments, the computation of the number of paths from calling to called lines, and the number of machines and trunk links necessary for producing the paths, becomes essential.

A subscriber calling, either gets through and speaks with his wanted subscriber, or he fails to get the wanted party; the result of failure will be the definite loss of revenue for the owner of the equipment coupled with dissatisfaction on the part of the users, or a large increase in calling rate resulting from repeated futile calls. Each such repeated call may involve the use of the plant to almost the same extent as a successful and revenue-producing connection.

In the manual-switching system the calculation in advance of the elements for use in common has not been essential; but in the planning of machine-switching equipments the accurate adjustment of the switching capacity to traffic in advance of construction is important. The number of trunks or junctions linked together to form a through circuit is larger than in manual equipments; the switching mechanisms for connecting the successive links form a large part of the total cost of the switching equipment; the addition of link circuits when later required is more difficult and relatively more costly; the necessity for the addition cannot be observed with equal facility; the required switching capacity largely affects the nature of the mechanism.

A large number of calls originating under defined conditions can be treated as though they were initiated and distributed purely by chance through given periods of time, and as originating and terminating at random in the different numerical or geographical groups of lines. The switching equipment must have a carrying capacity or number of paths for the maximum number of connections required in the busiest moment, and for accommodating the maximum requirements from any group of call-originating lines to any group of call-receiving lines. It would be a simple matter to plan an equipment for distribution in time and in groups of numbers on a basis of averages, but the system so planned would be deficient to the point of practical inoperativeness. Studies of chance are employed to determine the probable deviation from the average. It is not expedient to provide for an absolute maximum of paths, but it is necessary to compute and make such provision that the switching capacity of any portion of the exchange probably shall not be exceeded more than a certain small number of times which will appear negligible.

The correspondence between the number of switches required by traffic of given amount and character, as observed and as computed from observed duration of conversation, is shown in fig. 3. The observations were made in a semi-automatic machine-switching equipment known hereafter as "I." The total number of connections during the period of observation was 846, the average holding time per connection being 55.9 seconds. The selectors observed contained 22 trunks in a group; the 22nd trunk was not required during the period of observations, though 21 trunks were required. As computed for one call lost in the period, 22 trunks might have been once exceeded. The correspondence between observed and computed results is noticeably close.

(To be continued.)

Discussion.

The paper was read and discussed at a meeting of the Birmingham Local Section of the Institution on March 25th, 1917.

Mr. T. Plummer said that the Post Office, in order to test the rival claims of various systems, had had machine switching telephone gears installed by different contractors at some 16 towns. The small installation at Dudley was opened in September last. Most of the other installations had been working for some time under service conditions, and careful records were being kept of the costs of capital and maintenance, as well as of the defects of the different systems and the faults to which they gave rise. In the course, therefore, of the next year or two full information on these most important matters would have been secured by the Telephone Administration. Apart from the question of economy in regard to the employment of operators, the great improvement in machine switching was, in his opinion, the substitution of rigid electrical and mechanical contacts and gears for the flexible switching cords ordinarily used on manual boards. A very large percentage of complaints of unsatisfactory working were due solely to defective cords, which remained the essentially weak feature in the manual switchboard. The reduction in the employment of operators brought about by the installation of machine switching meant a very large saving in exchange buildings, not only on account of the comparatively small floor space occupied by the machine-switching gear, but also because of the saving in retiring rooms, dining rooms, &c., for the operators. The automatic system had a further advantage in relieving the telephone service from the imputation, rarely deserved, of delay in completing calls on the part of the operators. The subscriber made his own call, and knew that any following delay was entirely due to the person called not attending promptly to the telephone. The arrangements for machine switching had been worked out to give practically an identical service with the manual board, the only difference being in relation to the need for the handling of traffic by operators on the manual board in connection with certain differential rates for the use of junctions, and the trunk service. Self-contained towns seemed to him to give the best results in the economy of operating staff which was brought about by the absence of junction circuits to other exchanges, unlike an area served by multi-exchanges. The case of Dudley from this point of view was not entirely satisfactory, as it was a single exchange in a large multi-exchange area with an exceedingly large number of junction circuits in comparison with the number of direct exchange lines connected, and this called for the employment of a comparatively large number of operators on the manual switchboard fitted in addition to the machine-switching gear. Of course, this was working the automatic system under the greatest disadvantage from an economic aspect, and if the results proved satisfactory at Dudley they would be much better under more normal conditions. His experience was that the type of skilled men employed in dealing with the maintenance of ordinary common-battery exchanges of the larger type were fully capable of handling automatic exchanges; and there was no need for the special training of such men. The figures relating to the maintenance man-hours seemed rather low; Mr. McBerty had explained that they referred to the moving switches only. Locally, such low figures had not been reached. When odd automatic exchanges were installed, relatively high maintenance costs must be expected, as a certain number of men had to be trained in excess of the actual requirements so as to be available in case of emergency through sickness, &c. This factor would disappear as the type of exchange became more general, and a margin of trained staff became available for emergencies.

Mr. R. G. Masaroon (Post Office Engineering Department) pointed out that in working an automatic telephone exchange the subscriber was given something to do in getting his call through. Inventors in the past had been too leniently disposed towards the subscriber by relieving him of the necessity of doing anything except the lifting of the telephone from its rest and speaking. After a change-over from the magneto system to central-battery working, subscribers frequently complained of the delay in answering calls, although the service under the new conditions was superior to what it had been under the old, *i.e.*, the answering time was less. This had proved to be due to the subscriber having nothing to do but wait after putting the telephone to his ear, whereas in a magneto system there was a handle to turn, and the time passed more quickly. He looked forward to the time when all exchanges would be automatic, and the subscriber in making a call from, say, Exeter to Dundee would operate dials controlling the mechanism at intermediate points, and thus set up the circuit for himself. He asked whether any means had been devised for redistributing the lines for outgoing traffic. Any redistribution which necessitated changing subscribers' numbers was out of the question, and the rigidity of the automatic system in this respect appeared likely to be the cause of difficulties in adjusting traffic to meet abnormal conditions.

Mr. W. C. Burbridge referred to the reaction which the extension of the automatic telephone system was expected to have on the design of external plant. He emphasised the saving in the comparatively heavy conduit and cable cost which would ensue from the placing of small automatic units, requiring only occasional attention, in suburban areas, and the connecting of such to the central automatic exchange by a limited number of "trunks."

THE LUMEN AS A MEASURE OF ILLUMINATING POWER.

At a meeting of the Illuminating Engineering Society on January 16th, a discussion took place on the use of the "lumen" as a measure of illuminating power, in place of "mean spherical candle-power." The total flux of light from a source of lumens is obtained by multiplying the mean spherical candle-power by 4 , and the scientific arguments in favour of the lumen have been summarised by Mr. Leon Gaster in the *Illuminating Engineer* as follows:—

1. Mean spherical candle-power is an imaginary quantity. Few, if any, existing sources approach a "point-source" in dimensions, or radiate uniformly in space. But the flux of light in lumens is a real quantity, independent of the area of the source or its distribution.

2. In every calculation in which mean spherical candle-power is obtained, we must first obtain the total flux of light; the latter, therefore, and not the former, is the fundamental quantity expressing the total illuminating power of a source.

3. Determination of mean spherical candle-power from polar curves is tedious, and, in the case of sources whose distribution about a vertical axis is not symmetrical (such as lamps with parabolic mirrors, many flames, &c.), very difficult. It is therefore advisable to develop alternative methods of direct measurement, such as the Ulbricht sphere, and these methods essentially measure flux.

4. Mean spherical candle-power is of no practical utility in calculations. The flux in lumens is useful, and a knowledge of the flux of light of any beam leads at once to a rapid estimate of the average illumination on any surface on which it impinges. In studying the path of beams of light, and in expressing brightness, the use of lumens leads to great simplification and avoids the anomaly of two distinct methods of specifying the latter quantity (candle-power per square inch and equivalent foot-candles).

5. The word lumen is understood in all the chief countries of Europe and in America. The words used to indicate mean spherical candle-power differ according to the language.

The discussion was opened with a paper by Prof. J. T. Morris, who emphasised the inadequacy of the "horizontal candle-power" of a lamp under modern conditions of use, as a guide to its performance. It was essential to take into consideration the effect of the shade or reflector used with the lamp, and to treat the combination as a complete unit. While the polar curve of light distribution was indispensable to the expert, the information contained in such curves could not be summarised for rating purposes. Moreover, such lamps as the half watt lamp presented difficulties in the measurement of horizontal candle-power, and were not comparable on this basis with other lamps. The only proper basis of comparison of such lamps must be in terms of the total amount of light emitted in *all* directions. The mean spherical candle-power would be lower in numerical value than the old rating, which would be objectionable on commercial grounds, and it was also an imaginary quantity; in most cases the light emitted in different directions varied enormously.

Recently, however, the suggestion had been brought forward that lamps should be rated in terms of the total flux of light, the unit of which was the lumen, *i.e.*, the flux of light received by a surface 1 sq. ft. in area, and having an illumination over its area of 1 ft.-candle. The above definition was also equivalent to stating that the lumen was the flux of light emitted by a source of unit candle-power in unit solid angle. The solid angle subtended at its centre by a spherical surface was 4π, and the flux in lumens from any source was therefore obtained by multiplying the mean spherical candle-power by this figure.

On the lumen rating, therefore, a 40-c.p. lamp would be sold as a 350- or 400-lumen lamp in future.

In the report of the Committee of the American Illuminating Engineering Society on Nomenclature and Standards presented at the Convention last September, it was definitely specified that illuminants should be rated in terms of lumens in the future.

In this country, also, it seemed that the makers of electric lamps contemplated adopting the lumen, though it might be necessary also to state candle-power values and to show their relation to lumen values during the transition period. Once the lamp makers had adopted the necessary photometric apparatus, the ease of measurement and certainty of the result would recommend methods based on the measurement of total flux of light.

Apart from the loss of light involved by the use of a globe or reflector with a lamp, the output of the combined unit in lumens should not be affected by any measures that were taken to alter the distribution of light. If the lumens in each zone from such a unit were tabulated the summation of these values gave at once the total flux of light, and by comparing this with the output in lumens of the lamp used, the efficiency of the globe or reflector could be readily ascertained.

It was convenient to work with lumens in the usual formulæ for determining the average illumination in a room resulting from a given arrangement of lamps, and particularly when the approximate average illumination over an area needed to be quickly determined. It also facilitated calculation of the illumination derived from extensive illuminated surfaces, such as occurred in the case of indirect lighting. Again, we were almost compelled to utilise the conception of flux of light when dealing with concentrated beams such as occurred in the searchlight and the optical lantern.

Mr. F. W. Willcox read a paper, in which he said that the fundamental requirement was a definite unit which would always clearly and invariably express one thing. This condition the lumen complied with, and the candle-power unit did not. When the lumen was employed either as a measure of luminous value or to express the efficiency of the illuminant, its terms were precise. For example, when we expressed the efficiency of an electric lamp in the usual terms "watts per candle," a query arose as to what variety of candle was meant —whether the mean spherical or the mean horizontal or the tip end value, &c.—whereas "watts per lumen" or "lumens per watt" was wholly definite.

Again, the filament of an electric lamp could be re-shaped and concentrated so as to give its maximum value in any given direction, and by simply frosting or silvering the upper part of the glass bulb, a lamp might be made to give apparently very much increased candle-power value for the same energy from the same length and section of filament, and the variations in candle-power values obtainable in different directions with different kinds and shapes of reflectors were well known to all. The same amount of light flux (lumens) was made to give—now 50, now 100, now 500, or more candle-power value.

The exceeding difficulty of trying to assign candle-power values to many of these shapes of filaments was apparent when they considered the light distributions as shown in figs. 1, 2, 3, and 4. The luminous output of a lamp as expressed in lumens remained the same, whatever the shape of the filament, and no matter what variations of external arrangements or what accessories (reflectors, &c.) were employed with the lamp (always, of course, allowing for any absorption losses there might be in the accessories).

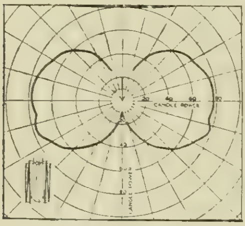

Fig. 1.—100-watt Standard Metal-filament Lamp.

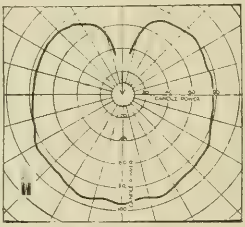

Fig. 2.—100-watt Focusing Lamp.

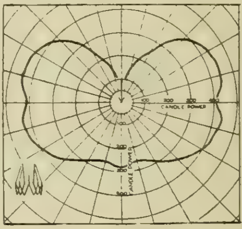

Fig. 3.—300-watt Half-watt Lamp.

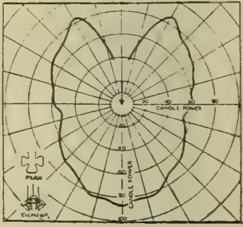

Fig. 4.—100-watt Spiralised Filament Lamp.

Light Distribution Curves.

A serious defect of candle-power was that the value materially altered (as in the case of light distribution curves), according to the direction in which it was measured. Practically a unit of candle-power should have the same value whether measured horizontally, vertically, or at any angle. Actually it did not, as was shown by a consideration of the spherical surface surrounding a lamp.

The diagrams in figs. 5, 6, and 7 clearly illustrated the difficulties. It was hopeless to expect people to understand the apparent inconsistency of these different curves containing very unequal areas, and yet representing the same volume of light.

The case was no longer that of the early days—the simple light value given by a lamp in a given direction. The modern case must provide for expressing luminous values given by lamps in combination with reflectors or glassware, distributed directly or indirectly *viâ* the ceiling, or part directly and part indirectly as in semi-direct lighting. The diagrams in figs. 8 and 9 illustrated this point, and showed two characteristic cases of light distribution from modern lighting equipment. The idea of flux of light suited these complex conditions admirably, and the lumen correctly expressed luminous values for all cases and conditions.

The value established for the lumen was the amount of light from a unit source falling upon a unit surface, all points of which were at unit distance from the source.

A lumen would give an intensity of one foot-candle over an area of one square foot. The average illumination at all points of the unit sphere mentioned above would be one foot-candle.

We thus had the total light output of the lamp definitely measured by the lumens, instead of light intensity in some one direction by candle-power. We had the illumination values measured by lumens per square foot. As each lumen corresponded to one foot-candle per square foot, the term "foot-candles per square foot per watt" (the expression for efficiency of illumination) became more simply "lumens per watt." We also had the efficiency of the lamp clearly and fully measured by lumens per watt, instead of watts per candle. The brightness of a surface, either "self-luminous" and radiating light, or made luminous by reflected light, might be preferably expressed in terms of lumens per sq. ft. or per sq. cm. instead of candles per sq. ft. or per sq. in., or in "equivalent foot-candles." Thus the lumen was an allround term of general application in lighting work.

In fig. 10 was given a graphical representation of the lumen shown by means of the unit sphere.

The lumen was essentially a quantity denoting rate of flow of energy in the form of light, and therefore analogous to, and of the same dimensions as, watts. In order to obtain the total light-output during a given interval of time, analogous to energy, we must multiply the flux of light by the period during which it operated. The output of light from a source in a given time was, therefore, conveniently expressed in lumen-seconds or lumen-hours.

It was certainly much better, in adopting the flux idea for expressing luminous output, entirely to drop the term "candle-power" in any expression for this unit, and substitute an entirely new term, such as the lumen. In this way, we cut loose from all the previous deficiencies and misconceptions associated with the term "candle-power."

The merits of the lumen would ultimately force its adoption, and a number of the leading electric lamp manufacturers in Great Britain, as well as the Holophane Co., were adopting the plan of expressing their luminous ratings in lumens.

In employing lumens in practical illuminating problems, engineers have recourse to the utilisation efficiency factor, which is the percentage of the total amount of lumens given by a luminous source which is made available upon the working plane or illumination area considered.

In lighting a room, the area of the room in square feet is multiplied by the intensity desired in foot-candles. This at once gives the net lumens required. To find the total lumens required from the lamps, we divide the net lumens by the utilisation efficiency or factor decimally expressed. We then have the total lumens which the lamps must give, and by reference to a table of lumen values for the various sizes of lamps, we can select the most suitable size to accord with the desired number of points to be fixed, or we modify the number of points to accord with the lumen value of some desired size of lamp. The simple equation for such work is:—

$$\frac{\text{Floor area in sq. ft.} \times \text{intensity in foot-candles}}{\text{Utilisation efficiency as a decimal} \times \text{lumens per lamp}} = \text{No. of lamps.}$$

TABLE I.—Lumen Data for Metal-Filament (Tungsten) Lamps, of Sizes and Efficiency Standards in Great Britain, January, 1917. Voltage Class, 100–130.

	Size of lamp in total watts.	Efficiency.		Initial lumen values at various utilisation efficiencies.				
		Watts per mean horiz. C.P.	Lumens per watt.	Total 1·00.	0·60.	0·50.	0·40.	0·30.
Vacuum type	20	1·20	8·1	163	97·8	81·5	65·2	48·9
	30	1·15	8·5	255	153	127·5	102	76·5
	40	1·15	8·4	341	204·6	170·5	136·4	102 3
	60	1·10	8·9	535	321	267·5	214	160 5
	100	1·05	9·3	930	558	465	372	279
	150	1·0	9·8	1,470	882	735	588	441
Half-watt type	100	—	12·5	1,250	750	625	500	375
	150	—	13·4	2,010	1,206	1,005	804	603
	200	—	14·0	2.795	1,677	1,397·5	1,118	838·5
	300	—	15·3	4,600	2,760	2,300	1,840	1,380
	500	—	16·12	8,060	4,836	4,030	3,224	2,418
	1,000	—	18·0	18,000	10,800	9,000	7,200	5,400
	1,500	—	18·0	27,000	16,200	13,500	10,800	8,100

Table I presents a list of standard vacuum type and half-watt type metal-filament lamps, and gives the efficiencies at present supplied in Great Britain. This table also gives full lumen values for each size of lamp, and the corresponding lumen values at various utilisation efficiencies.

The use of the sphere photometer is rapidly growing, and simplifies the problem of measuring the total flux of light from an illuminant. The lamp is inserted in the centre of an enclosing sphere, and the total light flux given out by the lamp is measured in one reading. This reading can be directly measured in lumens without having recourse to candle-power values.

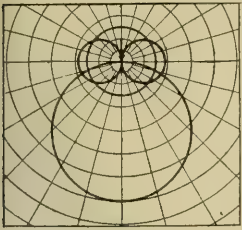

Fig. 5.—Ideal curves, showing same Total Light Flux. Each Curve Expresses Equal Illuminating Value (the same total Lumens) but apparently very different Candle-power Values.

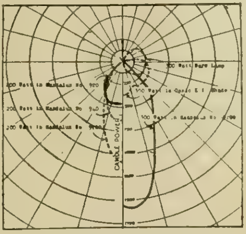

Fig. 6.—Apparent Variation in Candle-power from a 300-watt Lamp, through use of Various Reflectors.

It is, however, convenient and natural to convert candle-power values into lumen values as results are at present almost invariably available in terms of candle-power. The ordinary metal-filament (vacuum type) lamp gives a lumen value about 10 times its candle-power (mean horizontal).*

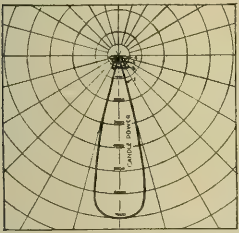

Fig. 7.—Diagram showing how, in an Extreme Case, the same Total Light Flux may be Distributed so as to Show Very Misleading Apparent Values of Candle-power.

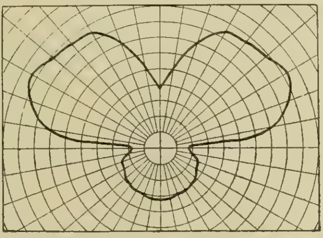

Fig. 8.—Light Distribution from Veluria Hemisphere, showing the Complex Character of Light Distribution with Modern Lighting Equipment.

The lumen has received the endorsement of the American Illuminating Engineering Society, of the Association of the Edison Illuminating Companies, and of the National Electric Light Association, and is being employed in regular practice in the rating of electric lamps.

Discussion.

In the discussion which ensued, Mr. S. H. Callow said that the old method of rating illuminants by horizontal candle-power was inadequate to meet present-day conditions, and lent itself to deception. Mr. J. G. Clark admitted the usefulness of the lumen, but said that information as to the distribution of the light was indispensable, and therefore the distribution curve must be retained. Mr. A. Blok urged that the Society should take steps to make the term intelligible to the average contractor. Dr. L. Rabinovitch feared that the larger values would confuse the public, and that the determination and guarantee by the lamp maker of a definite number of lumens would be complicated. The m.h.c.p. could be converted into m.s.c.p. by the use of the coefficients explained by Prof. Fleming, which might be mentioned by makers in their catalogues. Mr. G. Campbell said that if the Tungsten Lamp Association would agree to mark their lamps in lumens and watts, a great step forward would result. Mr. E. Stroud pointed out that for comparative purposes the quantity of light emitted by a lamp must be known, irrespective of its distribution. As the lumens were about 10 times the m.h.c.p., by the use of a "deka-lumen" the new ratings would be made practically identical with the old. It was useful to remember that

Lumens = foot-candles × sq. ft.

Mr. A. Wise thought the public would have difficulty in appreciating the significance of the new rating in lumens; if the m.s.c.p. were stated, anyone who wished to work in lumens could easily make the conversion. Mr. C. H. Pitman suggested that lamp lists should give total lumens and lumens per zone, and fittings lists should give conversion figures for particular reflectors. Lamps might be rated in lumens per watt. Mr. J. S. Dow agreed as to the disleading character of the candle-power rating, and referred to the utility of the lumen rating in dealing with beams of light from projection apparatus. Mr. L. Gaster said that the leading manufacturers of lamps and reflectors in this country were favourably considering the proposal, and the Illuminating Engineering Society would gladly assist in the educational work that would be necessary.

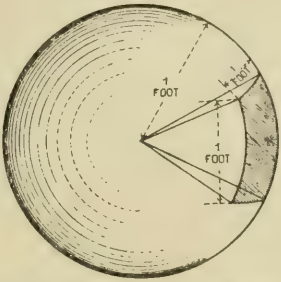

Fig. 10.—Graphical Representation of the Lumen.

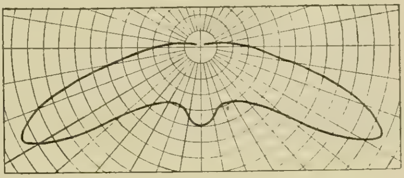

Fig. 9.—Light Distribution from "Strela" Fitting, with Holophane Refractor, showing Special Character of Light Distribution desirable for Street Lighting.

Mr. A. P. Trotter (chairman) expressed a wish for a definition of the lumen that would meet the case of the man in the street.

In reply, Mr. Willcox pointed out that the large numerical values in the lumen rating permitted a more accurate expression of efficiencies than with candle-power ratings, "candles per watt" being less than unity, whereas "lumens per watt" would be convenient numbers. Prof. J. T. Morris commended the proposal that the Society should issue an explanatory pamphlet, and pointed out that with half-watt spiralised filaments and other innovations, the Fleming coefficients were rendered useless.

In later communications to the *Illuminating Engineer*, Mr. A. P. Trotter and Prof. A. Blondel dealt further with the subject, the latter reviewing the history of the lumen as a unit since he introduced it in 1895, while the former, after discussing the factors involved, suggested that one might say that "one lumen is 0.08 of the whole light emitted from a source giving one candle in every direction."

Electroculture in the Greenhouse.—A recent paragraph in the *Star* mentions an interview with Mr. Thomas Clark, an electrical man whose apparatus for the intensification of growth in plants, &c., is, we gather, working in several large market gardens. At the Highfield Nurseries, at Billericay, it has been found that tomatoes and cucumbers, and other produce, are on the market a fortnight before those of other nurseries; strawberries are 20 days earlier. To work four large greenhouses, 200 ft. by 28 ft., an apparatus costing £100 is required, with an oil engine costing £35; the weekly running cost is given at 2s. 6d. The discharge wires are suspended 6 ft. above the floor, from insulators.

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* The mean spherical candle-power of the ordinary vacuum metal-filament lamp is 78 per cent. to 79 per cent. of the mean horizontal candle-power. Therefore the flux in lumens is 12.57×0.79=9.94, or practically 10 times the mean horizontal candle-power.

LEGAL.

Electrical Engineer Sentenced.

At Otley Police Court, last week, Sydney Harold Bill, late electrical engineer and manager to the Ilkley District Council, was charged with having stolen a quantity of three-core armoured electric cable, valued at £110, the property of the Ilkley Council. The prisoner appeared in khaki, having joined the Army. It was stated that he was originally employed as clerk of works in connection with the installation of the Council's electric lighting undertaking, and was subsequently appointed manager. He joined the Forces last June, since when Mr. John Senior had been acting as his substitute. The shortage of cable was not discovered until January, when the Western Electric Co., from whom the cable had been purchased, requested the return of two empty drums. The drums could not be found. Inquiries elicited the information that two drums of cable had been sent by the accused from Ilkley to the Workington Iron and Steel Co., but that concern stated that they had purchased them through a gentleman in Glasgow. That gentleman, on being communicated with, refused to give any information beyond that he had made the purchase through an advertisement. The pages of the electrical journals were searched, and it was found that the cable had been advertised for sale and that the advertiser was the accused. The cable had been dispatched in the name of the Western Electric Co., Ltd., but that firm denied all knowledge of the transaction. The Council had had no wish to sell the cable, as it was of use to them and the price was continually advancing.

Mr. F. S. Eckersley, the Council's clerk, said it was painful to him to have to prosecute, as the defendant had been a fellow official and they had been on quite cordial relations.

In defence, it was pointed out that the accused, who is 33 years of age, and has a wife and three children, had had an honourable career. He was a member of the Institution of Electrical Engineers. He had offered himself for service in August, 1914, but was rejected because of a bullet wound in the leg, received during manœuvres. In 1915 he was offered a commission in the Royal Engineers, but the Council did not want him to leave, as they valued his services. Later, on undertaking to provide a substitute, he was allowed to join the Naval Volunteers, being appointed an electrical engineer on a boat. Afterwards, his commanding officer advised him to join the Flying Corps, but he was too old, and therefore, under promise of a commission, he joined the Royal Field Artillery as a private. He had always had a good character and had held many good appointments, including that of assistant electrical engineer to the Mersey Docks and Harbour Board. He had sold the cable because he was pressed by creditors, and had hoped to be able to replace it before anybody should know that it had been sold.

The Bench held that the offence was far too serious to be dealt with lightly. But for the fact that the defendant had done his best to serve his country, the maximum sentence of six months' imprisonment would have been passed, but he would have to go to prison for two months. They hoped that afterwards he would do his best to restore his lost character.

The Ilkley District Council, last week, formally discharged Bill from the position of electrical engineer, and appointed Mr. John Senior, the acting engineer, in his place, at the same salary of £250 per year.

Workmen's Compensation.

At Preston County Court, last week, Judge Sturges declined, on account of the inadequacy of the sum, to approve a settlement under the Workmen's Compensation Act awarding Margaret Casson, aged 18, £25 for the loss of the end of the index finger of the right hand while cleaning a machine at Messrs. Dick, Kerr and Co.'s works.

Munitions Court Case.

Before the Munitions Tribunal at Edinburgh, last week, an apprentice electrical engineer, George Barrett, of Leith, was charged, in absence, with having engaged and signed on as a member of the crew of a steamer owned by a Glasgow firm, without consent and without a clearance certificate. It was stated that when Barrett, who is now at sea, engaged himself to the shipowners, he was on sick leave, and that the only intimation the firm of electrical engineers received from him was contained in a note to the effect that he was going to sea, and that he did not know when he would be back. A fine of £1 was imposed.

BUSINESS NOTES.

Bankruptcy Proceedings.—Samuel Stephen Coster, trading as S. S. Coster & Co., electrical and mechanical engineers, 14, Gladstone Road, West Ham.—Creditors met on April 3rd, at the London Bankruptcy Court, under this failure. No accounts were presented, but the Official Receiver reported that the debtor returned his liabilities at £650, against assets consisting of book debts to the face value of £400, but not expected to realise anything whatever. The debtor commenced business in partnership with another in August, 1908, at 116, Bishopsgate, and stores in Calvert Avenue, Shoreditch, he providing a capital of £150. The trading was not a success, and in June, 1909, the partnership was dissolved, and the business closed. The debtor next started alone at West Ham, and he attributed his failure to ill-health, to bad trade owing to the lighting restrictions and shortage of labour, and to bad debts. In the absence of any offer, the case was left with the Official Receiver to be wound up in bankruptcy. The creditors include the following:—

Beacon Carbons, Ltd., Bingley	£150
Scott & Co., F. G.	145
Associated Rubber Co., London	70
Simpson & Co., Bristol	30
Sceando Lamp Co., Manchester	45

Private Arrangements.—Turner & Kitson, 99b, Eastbank Street, Southport, electrical engineers.—The creditors interested herein were called together on March 30th, when they were presented with a statement of affairs showing liabilities £297, and assets estimated to produce £150. The estate disclosed on paper a deficiency of £155. It was reported that the debtor Turner started trading in January, 1913, Mr. Kitson being taken into partnership in July, 1914. The turnover apparently declined considerably in 1916-17. According to the books the present deficiency is practically accounted for by loss on trading. The deed of assignment, which had been executed to Mr. F. Marsh, had been rendered necessary owing to the fact that there were suing creditors, and in order to protect the estate. It was resolved to confirm the deed of assignment.

Dissolutions and Liquidations.—Knowledge Publishing Co., Ltd.—Owing to paper restrictions and other causes, and to the directors having been compelled to suspend the publication of *Knowledge*, the company is being wound up voluntarily.

Oldham Boiler Works Co., Ltd.—A meeting is called for May 9th at Oldham, to hear a report on the winding up from the liquidator, Mr. H. Hague.

Kirkland & Capper, civil engineers, 17, Victoria Street, London, S.W.—Messrs. T. Kirkland, D. S. Capper & T. J. R. Kiernan have dissolved partnership so far as concerns D. S. Capper. The business will be carried on as Kirkland & Kiernan.

Harman Electric Co., Ltd.—A meeting of creditors is called for April 23rd, at 9, Wallbrook, E.C., to hear an account of the winding-up from the liquidator, Mr. P. F. Huddleston.

Adnil Electric Co., Ltd., London, E.C.—April 21st is the last day for the receipt of proofs for dividend by the liquidator, Mr. J. H. Stephens, 6, Clement's Lane, London, E.C.

Book Notices.—"How to Lay-out Turret Lathe Tools." Coventry: Alfred Herbert, Ltd. Price 2s. 6d.

"Practical Dynamo and Motor Management." London: S. Rentell & Co. Price 6d. net.

"Soldiers' and Sailors' Guide to London." By C. Sheridan Jones. London: "Review of Reviews." Price 3d. net. Unquestionably a very handy little guide.

The M. & C. Apprentices' Magazine, a copy of the first number of which is to hand, is being issued quarterly (3d.) by Messrs. Mavor and Coulson, Ltd., of Glasgow, as a result of the Welfare of Youth Scheme, which is under the leadership of Mr. M'Rae. It aims at fostering literary talent and inventive genius amongst the firm's apprentices, and is, we understand, the first magazine of its kind in Scotland. It contains a good deal of very readable matter, some in serious vein—such as Mr. W. B. Hird's article on "Some Notes on Elementary Electrical Engineering"—and others humorous. Excellent page photographs of Mr. Sam Mavor and Mr. W. A. Coulson occupy the centre opening pages.

"Department of the Interior, Ottawa." "Water Powers Branch," "Water Resources," papers. No. 2, "Bow River Power and Storage Investigation"; No. 3, "Winnipeg River Power," Vols. I and II; No. 7, "Manitoba Water Powers"; No. 12, "Small Water Powers"; No. 17, "Canada: Hydraulic Power Development and Electric Power in Canadian Industry."

Trade Announcements.—Mr. E. Elliott has removed to Victoria Works, Warstone Lane, Birmingham.

The Monometer Manufacturing Co., Ltd., of Whitehouse Street, Aston, Birmingham, are further extending their works, owing to increasing demands for their furnaces. They have purchased the leasehold, goodwill, &c., of the Griffin Ironworks and Albion Foundry Co., Ltd., and Ladywood Foundry, Birmingham.

Lead.—A further order respecting the purchase and use of lead has been made by the Ministry of Munitions. It appears in the *London Gazette* for April 6th.

Italy.—A new company has lately been formed at Sesto S. Giovanni, with a capital of £12,000, and the title La Società Acciaierie Elettriche di Sesto S. Giovanni, to establish a plant for the production of steel by means of electric furnaces. La Società Elettro Siderurgica, of Lodi, has also recently increased its capital from £20,000 to £80,000, with the object of extending its manufacturing operations.

The Bosch Magneto Interests.—According to the last issue of the *Autocar*, Messrs. Vickers, Ltd., have acquired the British interests in the Bosch magneto, which were recently put up for sale by tender, by authority of the Board of Trade, in connection with the winding up of enemy businesses in this country.

Catalogues and Lists.—Electrical Apparatus Co., Ltd., Vauxhall Works, South Lambeth Road, London, S.W. 8.—April edition of the "E.A.C. Quarterly Review." High torque, the testing of E.A.C. apparatus, A.C. drum type switchgear, cable arrangements on drum type apparatus, are the subjects discussed. Further additions to the "Roll of Honour" since the last issue appeared are indicated.

Messrs. E. Bennis & Co., Ltd., of Little Hulton, have issued the March number of their magazine, "Cheap Steam." The articles deal with: The Care of Mechanical Stokers, Coal-handling Plant at Southend-on-Sea Electricity Works, the Boiler-house Plant at the Liverpool Royal Infirmary, Determination of the Calorific Value of Fuel, the Tensionless Drive, and other subjects.

Callender's Cable and Construction Co., Ltd., Hamilton House, Victoria Embankment, London, E.C.—88-page catalogue of electrical distribution appliances. It contains brief particulars, with tabulated details of sizes, prices, and shipping details, also numerous excellent diagrams, of standardised dividing boxes covering all ordinary requirements and representing modern practice. The "Woodhouse" patent dividing box, inverted pole dividing boxes (a series), porcelain sealing ends, and other lines are included.

LIGHTING AND POWER NOTES.

Aylesbury.—New Plant.—The T.C. proposes to install additional plant at the electricity works, at an estimated cost of £5,000 or £6,000. The plant is needed for power purposes, and will bring in an additional annual income of £875. Tenders for the plant are to be advertised for, but no money is to be spent until the scheme has been finally sanctioned.

Barrow.—The T.C. last week decided to contribute £10 in the event of the Hackney Council obtaining a determination of the question involved in the action with the Gas Light and Coke Co. The L.G.B. has sanctioned loans for electrical purposes amounting to £13,871.

Blackpool.—Proposed Loan.—The Electricity Committee has received a letter from the L.G.B. on the report of its inspector in connection with the Corporation's application for sanction to borrow £13,429 for electricity purposes. The Board intimates that it must limit its sanction to the sum of £6,766; it has been decided to make a further appeal in the matter.

Clayton.—The electricity problem looks like continuing to be a puzzle for some time yet. A public meeting called with a view to endorsing the action of the Council, by a large majority demanded that the Council's decision be reversed, and that the L.G.B. be informed of the fact immediately. It being now stated that the meeting was not held in accordance with the Local Government or the Public Health Acts, and had no power to enforce any resolution, a member of the Council (Mr. Andrews) has given notice to move a resolution re-opening the question. In the meantime, the Council deems itself to have received no request to alter its decision.

Colchester.—The T.C. has decided to circularise the various works in the district, intimating that the question of establishing a generating station at The Hythe is being considered, and inquiring if electricity for power will be required.

Colne.—Price Increase.—The T.C. has adopted the recommendation of the Electricity Committee to increase the charges for electricity; the advance is due to the increased price of coal, and is recommended with a view to making the department a paying concern.

Continental.—Spain.—The Union Electrica Espanola has compiled statistics of the growth of the Spanish hydro-electric industry in 1917, from information supplied by individual canvass of the various establishments in existence. These statistics show an available horse-power for all the rivers of Spain of about 6,000,000 H.P., a much larger total than previously credited to that country. Of this total only 881,084 H.P. has been appropriated, and but 384,297 H.P. utilised by the 170 companies now working. These concerns are divided into three classes—large, medium, and small—the first class, to the number of 67, comprising companies with installations ranging from 800 H.P. up to 301,700 H.P.; the second, embracing these of 300 H.P. up to 800 H.P.; and the third installations from 300 H.P. down to 25 H.P. In the first-class, the largest company is the Fuerzas y Riegos del Ebro, having five falls on three rivers, with a total capacity of 301,700 H.P., but of which only 35,283 H.P. are as yet utilised. This company, with a capital of $2,500,000, is an off-shoot of the Barcelona Traction, Light, and Power Co. (capital $32,500,000), of Toronto, Canada. This company has acquired a large number of central stations in the provinces of Barcelona and Tarragona; has arranged an agreement with the tramway companies of Barcelona and Tarragona, and formed therewith the Sociedad Ferrocarriles de Cataluna; it has bought up the Sarriá line, which is to be extended to Sabadell and Tarrasa, and has, "in a word, captured a great part of the market of the capital and of the industrial centres." It contemplates setting apart 75,000 H.P. for an electrochemical undertaking, having constituted, three years ago, the Sociedad Iberica del Azoe, for the production of nitrates, besides other important schemes.

The next largest company is the Energia Electrica de Cataluna, whose potential capacity is 200,000 H.P., of which only 50,000 H.P. are at present utilised. Two other companies utilise 11,000 H.P. and 12,000 H.P. respectively, namely, the Hidroelectrica Espanola and the Sociedad General de Fuerzas Hidroelectricas; and other two companies, the Electricas Reunidas de Zaragoza and the Electra del Viesgo, utilise 12,600 and 15,000 H.P.; 49 other companies stand for four-figure utilisations, and six for three-figure. In the medium class, there are 29 companies, with an aggregate of 14,795 H.P. utilised; and in the third, or small class, 79 companies, with all the potential power utilised to a total of 7,945 H.P.

The Fuerzas y Riegos del Ebro employs 110,000 volts for a distance of 180 km.; the Energia Electrica de Cataluna, 88,000 for a like distance; the Hidroelectrica Espanola, in order to supply Madrid, a distance of 254 km., employs 66,000 volts, and the Union Electrica Madrilena, also to supply Madrid (78 km.), a voltage of 50,000. The Sociedad General de Fuerzas Hidroelectricas has a scheme in hand to transmit 40,000 H.P. from the Falls of Seros to Barcelona, a distance of 225 km., at 140,000 volts, which, it is believed, will be the highest in Europe. Transmissions between 10 and 100 km. are more common, with voltages between 8,000 and 30,000.

As regards electric traction, the first railway electrified in Spain was the Barcelona-Sarriá line in 1906. Continuous current at 600 volts was employed, but in the later extension to Sabadell and Manresa, the same kind of current at 1,200 volts was employed. Following this was the Pamplona-Sanguesa single-phase line, 6,000 volts, 54 km., the San Sebastian-Hendaya single-phase line, 20 km; the three-phase lines of the Compania de Ferrocarriles del Sur de Espana, from Gergal to Santa Fé (22 km.), and the Rio Tinto mineral railway, just completed. Besides these, some 29 lines, termed electric railways, but really urban or suburban tramways, utilise continuous current at 500 to 550 volts, the suburban lines (13) being for various distances ranging from 12 up to 45 km.

As regards the electrochemical and electrometallurgical industries, the making of carbide calcium is the only important industry, represented by 13 works with a yearly output of 15,000,000 tons—an output in excess of the country's requirements. Furthermore, two smaller factories produce, the one chloride of soda and caustic soda from common salt, and the other chloride of lime, with a yearly output of 10,000 tons. Lastly is the more pretentious company previously mentioned, the Sociedad Iberica del Azoe, with a capital of 12,000,000 pesetas, and works erected at Lerida for the production of nitrates from the atmosphere, which is at present at a standstill owing to the war. Nothing in metallurgy has been achieved beyond the erection of two small electric furnaces at Araya, a copper refinery at Lugones, and the more important arc-furnace installation for the production of special steels of the Altos Hornos de Viscaya Co.

Although Spain possesses some 30 more or less considerable firms manufacturing electric machinery and material, she is still dependent on imports from abroad for the satisfaction of part of her requirements. In the immediate past, more especially, Germany has enjoyed the lion's share of this trade, close in order following Switzerland, then France and the United Kingdom. Whether these relative positions will be maintained after the war, especially as regards the first-named, is more than doubtful, owing to the growing opposition on the Continent to German "penetration."

Crewe.—Price Increase.—The E.L. Committee has recommended that the existing charges for current be increased by 15 per cent. as from July 1st, and the discount allowed to consumers be reduced to 2½ per cent.

Dublin.—It will be remembered that some time ago the Dublin Electricity Supply Committee recommended, as the result of the reports submitted on the plant, equipment, and general administration of the electrical undertaking by Colonel P. W. D'Alton, that that gentleman should be appointed to chief control for a period of three years. The matter remained on the Corporation agenda, protests being entered meanwhile by Mr. Mark Ruddle, chief electrical engineer, and other officials to the reports which Colonel D'Alton had furnished, Mr. Ruddle himself claiming that his long services to the Corporation deserved better recognition than that implied in the recommendation referred to.

It now appears that Colonel D'Alton, being engaged on war work, is unable to accept the appointment, even if confirmed, and, in the circumstances, the Committee has recommended that Mr. Ruddle be given full control for a period of two years.

The Corporation Electricity Supply Committee has recommended to the Council that in future no application from members of trade societies for increase of standard rates of wages or allowances be considered individually by any Committee if the same class of men are employed by any other Committee, but that a joint conference be held, and joint decisions be submitted for the Council's ruling.

Eccles.—Proposed Loan.—The Electricity Supply Committee has decided to obtain a supply of electricity in bulk from the Lancashire Electric Power Co., and will apply for sanction to borrow £8,017 in respect of the capital expenditure required in connection with the same.

Farnworth.—At a meeting of the D.C., last week, Mr. Steele, chairman of the Electricity Committee, said they had found that it was too expensive to produce electricity for the small demand they had, and so had contracted with the Lancashire Electric Power Co. for a bulk supply.

India.—*Indian Engineering* says there is every sign that people in South India are awakening to the advantages and conveniences of electricity, and there is a great desire on the part of more than one Municipality in South India to emulate the example set by Bangalore. A scheme is under consideration for the utilisation of certain waterfalls to supply the necessary power to Cochin, also one for the cheap supply of electric power to the town of Coimbatore, from the Sirmani River, close by, is likely to materialise, and will develop the industrial concerns of this important South Indian town to no little extent.

The Madura Municipal Council has decided to address the Government, with a view to reconsideration of the order that the electrical scheme for the town should be deferred, pending the supply of power from Periyar.

Mr. R. B. Joyner, of the Tata Hydro-Electric Co., has issued a memorandum, which he had intended to lay before the Industries Commission, drawing attention to the enormous economy of water power for industrial uses, and the necessity of developing Indian water power in order to compete with other industrial nations after the war.

According to *Indian Engineering*, the municipal electrical engineer in Simla has built, and has been experimenting with, an electric baker's oven, and it is expected that most of the ovens in the municipal bakery will shortly be converted into electrically-heated ovens; the change, it is anticipated, will result in a considerable saving in the cost of fuel, and that a better quality of bread will be obtained, owing to the uniform distribution of heat as compared with the present type of brick oven; in addition, the out-put will be considerably increased per oven, because of the short time that will be required to bring the oven up to its full temperature with electric heating.

Ireland and Electricity Supply.—Objection is being made by certain critics in Ireland to the non-representation of that country on the B. of T. Electricity Supply Committee. It is pointed out that, although Sir Charles Parsons is an Irishman, his interests are bound up in English undertakings, and it is urged that, as Ireland requires a cheap supply to develop her industries, this branch of the question should not be forgotten when the reference is being considered.

Littleborough.—The U.D.C. has written to the Rochdale Corporation complaining that the supply of electricity from the latter's works was unsatisfactory, and that frequent stoppages were causing serious loss. The reply was that the conditions were abnormal, but that it was hoped to maintain a continuous supply within a few weeks' time.

Liverpool.—There was opposition at the City Council meeting to proposed increases of salary to six officials on the tramways and electrical staffs, though the chairman of the Committee said the advances logically followed a rearrangement of the staffs to supply vacancies. A Committee was appointed to consider the revision of these and other salaries.

Manchester.—In moving the recommendations of the Electricity Committee as to the increases of salary to officials, Councillor Dagnall said they had stokers earning upwards of £5 a week—men obtaining more than their superiors. The increases were agreed to.

Middleton (Lancs.).—At a special meeting of the Electricity Committee, it was decided to ask the L.G.B. to sanction the borrowing of £5,110 to meet expenditure incurred in connection with the cost of furnishing a supply of current to a local works.

Nuneaton.—Loan Sanction Refused.—The L.G.B. has informed the T.C. that it is unable to sanction a loan of £1,950 for the provision of a new boiler for the electricity works.

Oldham. — Meter Clocks and Summer Time.—Electricity charges were discussed by the T.C. last week. Alderman Hardman, chairman of the Electricity Committee, said they could not agree to the request that the meter clocks should be altered to summer time. The Committee was willing to lose under the Early Closing Order, but objected to suffering a further loss by altering the clocks. For the December quarter they had a reduced revenue of £1,300, of which £800 was from the two-rate meters: in the September quarter they had a loss of £600, £400 of which was from these meters. It would take the department a month to go round to alter the clocks, and another month to put them back. Councillor Dixon said he wondered what would have happened had the difference in the rate of 2½d. per unit operated the other way: would the Committee have put forward the clocks? Alderman Hardman said Oldham was the largest user of the two-rate meters in the country, having over 2,000.

Reigate.—Price Increase.—The T.C. has increased the price of current by a further 18⅓ per cent. as from April 1st.

Rochdale.—A discussion took place at a recent Council meeting concerning the conditions at the Corporation electricity works. The Committee recommended that application be made to the L.G.B. for permission borrow £22,000 for extensions. Councillor Walker, the chairman, said that when they had installed the three new stokers they ought to be quite safe for the existing load. The extensions would increase the output of the station from 7,000 to 9,000 kw., and until they were carried out no further large power consumers could be connected with the mains. Replying to questions, he said the Committee would immediately have to look out for a new site if electricity was to be used in the future as they expected it would; owing to the war, and the delay in obtaining delivery, no benefit had been obtained from the recent £10,000 scheme.

Salford.—Subject to the necessary consent, the Manchester Ship Canal Co. is to be supplied with E.H.T. energy at the Irwell Park Wharf, upon a minimum payment of £500 per annum, for 10 years. The sub-station, transformers, converters and switchgear will be provided aud maintained by the company.

Sheffield.—Subject to approval, plant No. 3 at Neepsend is to be increased from 4,500 to 6,000 kw., at an estimated cost of £19,450. The expenditure is to be defrayed out of the renewals and special expenditure fund. Instructions have been given for the fixing of electric lights on tramway standards at important street junctions, and a Sub-Committee is to consider and report upon a scheme for lighting all the tramway routes by means of similar lights.

South Africa.—The Pietermaritzburg municipal electrical undertaking is to be extended, it being proposed to expend £19,500 on the following:—A 1,200-kw. turbine set with condenser, &c.; marine type boiler with superheater, economiser, and draught plant; 500-kw. converter, a 150-kw. motor for converting a three-phase set into a motor generator; also foundations, pipes, &c. The turbo-generator and boiler will be paid for out of depreciation reserve.

A McMyler coaling plant to handle 1,000 tons an hour has been opened at Durban by the S.A. Railway authorities, for coaling steamers. It is electrically operated, the British Westinghouse Co. having supplied the equipment, which includes three 150-h.p. motors for the dumper; seven to operate the jib and two 65-h.p. motors controlling the conveyor belt.—*S.A. Mining Journal.*

St. Anne's-on-Sea.—Price Increase.—The Electricity Committee has increased the charges for the supply of current to all consumers from the date of the March meter readings. The consumption of electricity for the year to February 28th amounted to 1,307,223 units, as compared with 1,182,877 last year. The consumers number 1,828.

Swansea.—Proposed New Plant.—At last week's meeting of the Electric Lighting Committee, the engineer reported on the extension of plant, and said the Council had approved of the principle of installing the following plant:—One 3,000-kw. turbo-alternator, complete with all auxiliaries, and with a new circulating pump suction to the dock; two water-tube boilers, with all auxiliaries; mechanical coal conveyors and overhead bunkers, with a storage capacity of 600 tons. It had been decided to install the boiler, and tenders had been accepted, but permission was refused for its manufacture. A special meeting is to consider the matter.

Tasmania.—The Zehan Council has called for tenders for the additional plant required in connection with the new electric light and power scheme.—*Tenders.*

Watford.—The electrical engineer has been instructed to report upon the employment of women.

York.—On account of difficulties which have arisen owing to the war, and the withdrawal by the L.G.B. of sanction to expend £500 on a wiring scheme, the proposal to install the electric light in workpeople's cottages has been deferred for the present.

TRAMWAY and RAILWAY NOTES.

Australia.—The chief engineer for construction in the Victorian Railways Department, Mr. M. E. Kernot, considers that it will be possible to commence a service on the electric street railway between Sandringham and Black Rock early next year. The laying of the double track has been practically completed, and the overhead work is well in hand, but the line cannot be operated until power is available from the suburban electrified railway, and this is being delayed owing to the war.—*Australian Mining Standard.*

The result of the working of the N.S.W. Government Tramways for the six months ended December 31st last was a gross revenue amounting to £983,177, being an increase on 1915 of £11,974. Working expenses were £830,254, an increase on the corresponding six months of 1915 of £52,526. The net earnings were £152,923, a decrease of £40,552; the passengers carried were 144,970,879, an increase of 1,936,347, and the car-mileage 12,704,552, a decrease of 523,475 miles.—*Sydney Daily Telegraph.*

The Shire of Moorabbin (Victoria) proposes installing electric tramways in the municipality, and notification of application to the Governor in Council for the necessary order has been made. *Tenders.*

Blackpool.—The Tramways Committee has referred an application from 54 male motormen and conductors for an advance of wages, and an alteration in working conditions, to a Sub-Committee for consideration and report.

An application for the purchase of contract tickets on differential terms, or on the deferred payment system, has been refused.

Bradford.—Year's Working.—The Corporation financial year ended on March 31st, and it is stated that the tramways carried 76,869,642 passengers, as compared with 74,082,612 in the previous year. The mileage figures were 6,086,515, as compared with 6,199,582, a decrease of 113,067. The receipts per car-mile were 13·72d., compared with 12·94d. The total units used were 12,422,950, as against 12,435,679. The receipts, including traffic department, railless system, and parcels department, were £348,162, as against £334,315; the wages paid totalled £158,155, as compared with £138,921, and the bonus paid was £22,087, compared with £7,125. Allowances to dependents of men in the Forces increased from £8,338 to £14,376. There have been fewer cars running, owing to shortage of labour, the mileage has been less, and the wages and bonus bill very much greater than usual.

The Tramways Committee recently considered an application from the Amalgamated Society of Tramway and Vehicle Workers requesting that the rates of payment for overtime and seventh day apply to all those who are not receiving overtime rates or extra pay for Sunday duty. It was decided that the application be granted as regards all employés of the department who are paid by the hour and not already receiving overtime rates or extra pay for Sunday duty.

Burnley.—Year's Working.—Councillor E. Heap, in moving the minutes of the Tramway Committee, said during the year they had carried 17,687,753 passengers, against nearly 17,000,000 the previous year, and the receipts showed £4,065 increase on last year and £4,961 over the estimate.

Continental.—Spain.—The scheme for building an underground railway at Madrid has secured official approval, and, in consequence, a company has been formed, to which the public has readily subscribed 10,000,000 pesetas (including 1,000,000 pesetas from King Alfonso) for the construction of the first section of the line. The plans contemplate four sections, the first of which, that from Cuatro Caminos to the Plazo del Progreso, is to be taken in hand at once. Its construction is expected to take three years, the remainder of the scheme to be completed in eight years. The public stations will be situated in the Puerto del Sol, Plaza de Alonso Martinez, and at the point of meeting of the Calles de Goya and Serrano, the power station being located in the Plaza de San Marcial. The scheme is noteworthy as being a purely voluntary and popular venture, receiving neither Government subsidy nor guarantee of interest.—*Industria e Invenciones.*

Italy.—The Sangritana Railway Co. has presented a scheme to the Ministry of Public Works for the electrification of some 93 miles of railway by utilising the water power of the River Sangro. —*Board of Trade Journal.*

Haslingden.—Electric Vehicles.—A Sub-Committee has been appointed to consider and report on the question of electrically-driven vehicles for the respective departments of the Corporation.

Huddersfield.—Snow Delays.—The heavy snowstorm, last week—reported to be the heaviest snowfall for 45 years—practically brought the tramways to a standstill, except in the centre of the town, on the Monday. Working parties were busy chiselling out of the lines the hardened snow all Monday night, and on the Tuesday the service was nearly normal.

Lancashire.—Female Employes and Bonus.—Considerable interest will attach to the forthcoming decision of the Committee on Production, concerning the application made on behalf of the female tramway employés for a 6s. 6d. war bonus to 14 Lancashire and Cheshire undertakings. The application was made on the grounds that where women were doing men's work, they should be paid men's wages, and that the increased cost of living had made the bonus necessary. On behalf of the authorities, it was pointed out that the average wage paid to tramway women was considerably higher than the average rate for women operatives; that many of the women were in receipt of separation allowances, and that if the bonus was granted, the cost would fall on the rates.

Lancaster.—It is stated that the deficit on the year's working of the Corporation electric tramways is expected to be less than £500, as compared with a deficit of £3,200 eight years ago. The introduction of 'buses has served districts not previously catered for, and has assisted in the growing success, out of a very costly venture, of the tramway undertaking.

Leeds.—Year's Working.—The accounts for the year ended March 31st show that the tramway undertaking has had a record experience in receipts, the income having passed the half-million for the first time. The total receipts have been £515,805, as against £475,505 the year before, an increase of £40,300. The miles run have been 9,658,595, an increase of 253,474. The number of passengers carried was 112,151,882, an increase of 8,698,082. The receipts per mile have been 12·817d., an increase of ·683d. The average fare has been 1·080d., the same as in the previous year. The working expenses have not been got out, but the estimate of the amount available for relief of rates is £79,470, after allowing £24,000 for repairs and renewals.

Preston.—Year's Working.—The Tramways Department has made a net profit for the past year of £3,697, after paying £5,617 off the new tramway debt and £1,348 off the old debt, and also £3,750 in aid of the borough rate.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Melbourne.—May 23rd. Victorian Railways Department. Twelve months' supply (8,250) of incandescent electric lamps as ordered.*

Aylesbury.—Electricity Department. 200-kw. direct-coupled internal-combustion engine and generator, fuel plant and accessories. See "Official Notices" March 30th.

Dundee.—April 21st. Corporation Electricity Department. Steelwork in floors, &c., and straining screens, guide rails, &c., at No. 2 pump-room at Carolina Port. Schedules, &c., from General Manager and Engineer.

London.—Hammersmith.—April 25th. B.C. Electricity Department. Induced-draught fans, mechanical stokers, boiler feed pump, centrifugal pump and strainer for condenser. See "Official Notices" to-day.

South Africa.—Johannesburg.—April 30th. Municipal Council. 10,000 traction carbon brushes, 63·5 × 35 × 12·5 m/m.*

May 21st. Municipal Council. Gear wheels for tramcars. Contract No. 241.*

Spain.—The municipal authorities of Caceres have recently invited tenders for the concession for the electric lighting of the town during a period of 15 years. Tenders have also been lately invited by the municipal authorities of Sorio for the electric lighting of that town, the concession in this case being for a period of four years.

[*Specifications may be seen at Department of Commercial Intelligence, 73, Basinghall Street, London, E.C.]

CLOSED.

Barrow.—The T.C. has approved contracts for the Borough Electricity Department as follows for the year:—

Oils.—Vacuum Oil Co., Ltd.
Copper wire, joint boxes and switch cut-outs.—B.I. & Helsby Cables, Ltd.
Shellac, varnish, &c.—H. G. Mable & Son.
Para strip, tape, &c.—L. Andrew & Co.
Insulating compound, bitumen, &c.—Dussek Bitumen Co.
Switches and lampholders.—General Electric Co., Ltd.
Adapter plugs and pin plugs.—A. P. Lundberg & Sons.
Fuse wire, &c.—A. F. Goodwin & Co.
Electric meters (ordinary and two-rate).—Chamberlain & Hookham, Ltd.
Prepayment meters and meter boards.—Ferranti, Ltd.
Tantalum lamps, &c.—Drake & Gorham, Ltd.
Earthenware pipes and troughs.—Doulton & Co., Ltd.

Tenders have been accepted for:—

Water-tube boiler, £4,221.—Stirling Boiler Co., Ltd.
250-kw. rotary converter, £1,165.—B.T.H. Co., Ltd.

A contract for coal was approved for six months from April 1st, at an increased price of 6d. per ton.

Blackpool.—Electricity Committee. Accepted tender:—B.I. & Helsby Cables, Ltd., high-tension cable.

Bradford.—The Tramways Committee has accepted the tender of the British Hele-Shaw Patent Clutch Co., Ltd., to supply 27 tramcar gear wheels for £155.

Derby.—T.C.:—

B.T.H. Co., Ltd.—Extension of switchboard equipment for main station, £340.
General Vehicle Co.—Electric tip wagon, £1,260.
Hall's Colliery Co., Swadlincote.—Coal for the electricity works.
A. Wiseman, Ltd.—Tramcar gear wheels and pinions, £102.

Manchester.—Electricity Committee. Accepted tenders:

Cooling tower.—Davenport Engineering Co., Ltd.
Coal-conveying plant.—W. J. Jenkins & Co., Ltd.
Cable.—C. Macintosh & Co., Ltd.; Pirelli-General Cable Works, Ltd.; B.I. & Helsby Cables, Ltd.; W. T. Glover & Co., Ltd.
Electric tipping wagon.—Jowett Motor Manufacturing Co., Ltd.
Synchronous condenser.—B.T.H. Co., Ltd.
E.H.T. switchgear and reactances.—B.T.H. Co., Ltd.
Motors for cooling towers.—Mather & Platt, Ltd.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, April 13th. At 39, Victoria Street, S.W. "Fire-resisting Materials," by Mr. D. W. Wood. April 20th. "Gas Turbines," by Mr. S. E. Hutson. April 21st. 6.30. Bohemian Concert at Holborn Restaurant.

Salford Technical and Engineering Association.—Saturday, April 14th. At 7 p.m. At the Royal Technical Institute, Peel Park. Paper on "The Hydraulic Press," by Mr. J. Bacon.

Chief Technical Assistants' Association.—Saturday, April 14th. At 3.15 p.m. At the Tavistock Hotel, Covent Garden. Discussion on "The Treatment of Water and the Removal of Scale."

North of England Institute of Mining and Mechanical Engineers.—Saturday, April 14th. At 2 p.m. At the Memorial Hall, Newcastle-on-Tyne. General meeting.

Birmingham and District Electric Club.—Saturday, April 14th. At the Swan Hotel, New Street. Paper on "Electricity in Factories," by Mr. W. Y. Anderson.

Institution of Electrical Engineers (Newcastle Local Section).—Monday, April 16th. At 6.45 p.m. At the Mining Institute. Discussion on "Wayleaves," with introductory paper by Mr. C. Vernier.

Association of Supervising Electricians.—Tuesday, April 17th. At 7.15 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "The Wiring Rules of the I.E.E.," by Mr. W. R. Rawlings.

Royal Institution of Great Britain.—Thursday, April 19th. At 3 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Industrial Finance After the War: The Character of the Industrial Struggle of To-day," by Prof. H. S. Foxwell.

Chemical Society.—Thursday, April 19th. At 8 p.m. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

Belfast Association of Engineers.—Thursday, April 19th. At 7.45 p.m. At the Municipal Technical Institute, College Square. Paper on "Engineering Notes on a Tour in the Antipodes," by Mr. J. H. Chambers.

Institution of Mechanical Engineers.—Friday, April 20th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. General meeting. Presidential address.

NOTES.

Lundberg "Batch Exams."—Notwithstanding the fact that everybody is extremely busy nowadays, the latest of Messrs. Lundberg and Sons' "batch exams." secured 85 successful competitors, in addition to a number who were not successful. The names of the winners of certificates are set out in full on another page, and it will be noted that a number hail from the Navy and Army, and one each from India and the Sudan. It is clear that the working out of switching problems provides an interesting occupation for intervals of spare time; and those desiring a set can obtain one free of charge by writing to the firm at 177-189, Liverpool Road, London, N.7.

The Metric System.—According to the *Journal of Electricity*, the non-use of the metric system in the United States among engineers and among the trade is beginning to be felt as a serious handicap in American efforts to secure a commercial and engineering foothold in South America. Their Consular reports are full of statements to this effect. Brazilians are unfavourably impressed when they receive commercial correspondence in which references are made to feet, yards, and miles, instead of the metres and kilometres to which they are accustomed. Within the past decade there has been a strong tendency in American export trade to encourage the employment of invoice clerks who make out documents not only in the language, but also in the measurements of the country to which the goods are directed. Details of the practice among business houses in various lines in Rio de Janeiro have been obtained by the Amerian Consulate-General, and show how important it is that exporters should pay special attention to this phase of the commerce between nations.

"Now is the time for engineers the country over to exert every influence in promoting the use of the metric system at home and abroad. And the best way to do this is for each one of us to begin to think and act in this system of units, and put aside our outgrown garments of feet, inches, pounds, yards, and the like, and speak only in metric units, the now recognised scientific system of all enlightened nations."

Volunteer Notes.—First London Engineer Volunteers.—Headquarters: Balderton Street, Oxford Street, W.

Orders for the Week, by Lieut. Colonel Clay, V.D., Commanding:

Monday, April 16th. Technical for Platoon No. 9 at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30–8.

Wednesday, April 18th.—Instructional Class, 6.15. Platoon Drill, Platoon No. 1.

Thursday, April 19th. Platoon Drill, Platoon No. 7. Ambulance Class by M.O., 6.30. Signalling Class.

Friday, April 20th. Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Recruits' Drill, 6.30–8.30.

Saturday, April 21st. Commandant's Parade, 2.45, uniform for route march. Fall in at Putney Bridge Station. Drums and bugles to attend.

Sunday, April 22nd. Special work at Bombing School. Parade, Clapham Junction Station (City and S.L. Tube Railway), 9.45 a.m.

(By order), Macleod Yearsley, *Captain and Adjutant.*

Newcastle-upon-Tyne Chamber of Commerce: Electrical Section. A meeting of the Committee of the Newcastle-upon-Tyne Chamber of Commerce Electrical Section was held on the 3rd inst., Mr. H. W. Clothier, the newly-elected chairman, presiding. In reply to congratulations on his appointment, the chairman said he did not accept the office lightly, because he was convinced that it was within the sphere of the Committee, representing as it did the local commercial and technical works, to exert a powerful influence upon the general welfare of the electrical industry in the country. Newcastle had ever been a leader in engineering matters, and its electrical men were now, as in the past, taking a live part in the great development measures which were moving with the times. They had the advantage of the advice of the Local Section of the Institution of Electrical Engineers and other learned Societies; and, based upon recent discussion, the chairman mentioned the following as among other subjects which came within the scope of the Committee:—(1) The general uplifting of British ideas in relation to origin of design and production, assistance in any movements tending to maintain and to identify as British the high standard of quality; (2) the encouragement of greater attention to the needs of scientific research; (3) the consideration of a simplified system of weights and measures; (4) the consideration of recognised ways of computing the depreciation of plant; (5) the development of means for removing restrictions and difficulties in the spreading of the service of electricity to national industries and the convenience of men; (6) improvements in telephones, and the possibility of machine switching and automatic telephone gear; (7) the consideration of the welfare of men in the industry who had suffered by the war. At the moment, the most direct call was to give suggestions to existing local institutions for the training of disabled sailors and soldiers.

A long discussion took place on this last matter, and their employment in electrical work, and it was resolved that a meeting should be held in the Cowen Training Home for Disabled Soldiers and Sailors, Newcastle, on April 20th, after which a further meeting of the Committee will be held.

The I.E.E. Temporary Premises.—The premises of the Institution of Electrical Engineers having been taken over by the Government, the address of the Institution is, for the present, 1, Albemarle Street, London, W. 1. The telephone number is unaltered: "Gerrard 764." Telegraphic address: "Voltampere, Piccy, London." The meetings for the remainder of the session will, by kind permission, be held at the Institution of Civil Engineers, at 6 p.m. On April 26th, Mr. G. V. Twiss will read his paper on "High-Tension Overhead Transmission Lines," and on May 17th the annual general meeting will be held.

The Magneto Industry.—At a meeting of the Aeronautical Society of Great Britain, on April 4th, Mr. A. P. Young delivered a lecture on "Magneto Electric Ignition on Aircraft." He said that without the high-tension magneto it was certain that the aeroplane would never have reached its high state of development, and it was reasonable to assume that the whole course of the war would have been different and much less in our favour. Prior to the outbreak of the war the number of high-tension magnetos produced in this country formed a negligible proportion of the total number being used for a variety of purposes, and through laxity on our part this most vital industry was allowed to develop in Germany. During the war the magneto industry in this country had developed at a really wonderful rate, and he thought it was agreed by those in a position to judge that the British magneto as at present constructed was the equal of the pre-war Bosch magneto emanating from Stuttgart. Developments now taking place would result in British manufacturers producing new types that would prove vastly superior to anything turned out of Germany in the past. He therefore pleaded that when the war was over British magneto manufacturers should be given full encouragement and support by the Government and the public, so that there might be established on a solid foundation a British magneto industry that would endure through the years to come an industry producing magnetos and ignition apparatus for aeroplanes, motor-cars, and other purposes, of superlative quality and design, not surpassed by anything manufactured outside of these islands.—*Morning Post.*

The Education of Marine Engineers.—The Council of the Institute of Marine Engineers has considered the subject above named, and has issued a report stating that the present system of education is capable of great improvement. Its recommendations include the teaching of physics, electricity, and chemistry in elementary schools, the provision of junior technical or trade schools for boys of 14 to 16, facilities for apprentices to attend classes, and the provision of scholarships to enable boys of exceptional ability to continue their studies. Modifications in the examinations of marine engineers for first and second-class certificates are also recommended, as well as the institution of a third class. An apprenticeship of at least five years is called for. No specific reference is made to training in electrical engineering, and in view of the growing importance of electrical applications on board ship, which are likely to attain the first rank in the near future, we think this is a regrettable omission.

United States Wireless Stations.—All commercial wireless stations in the United States have been taken over by the Navy, and all private stations are being dismantled.

According to the *Wireless Press*, the New York police seized 800 wireless sets on Monday last. It is estimated that there are 10,000 private stations in the State of New York, and some 4,000 in the city itself.

Udder Nonsense!—It was told to a Tribunal at Chichester, last week, that an electrical engineer who had never worked on a farm was sent on a Friday night to take up duties as a cowman, stockman, and milker. Before midday on Saturday he was gone.

British Science Guild.—We read in the *Times* that the annual meeting of this Guild will be held at the Mansion House on Monday, May 30th, at 4 p.m. Lord Sydenham will deliver an address on "National Reconstruction," and other speakers will be Mr. Fisher, the Minister for Education, and Sir William Mather.

British and Allied Patents Registered in Berlin.—According to the statistics of the German Imperial Patent Office, the following applications have been registered in Berlin:—

From Great Britain: 353 patents in 1915 and 289 in 1916; 71 designs in 1915 and 70 in 1916.

From France: 81 patents in 1915 and 49 patents in 1916; four designs in 1915 and six in 1916.

From Italy: 102 patents in 1915 and 40 in 1916; 14 designs in 1915 and four in 1916.

From Belgium: 58 patents in 1915 and 84 in 1916; 14 designs in 1915 and 30 in 1916.

From Russia: Nine patents in 1915 and ten in 1916; six designs in 1915 and 27 in 1916.—*The Times.*

Electric Arc Welding.—In *Power* some data on electric welding in railway practice are given. The values of current and voltage employed are illustrated by the following table:—

Kind of electrode.	Size.	Current.	Voltage.	Work.
Mild steel ...	$\frac{1}{8}$ in.	60—90	14—16	2-in. flues
Mild steel ...	$\frac{5}{32}$ in.	110—140	16—20	5-in. flues filling
Mild steel ...	$\frac{3}{16}$ in.	150—180	18—25	Filling
Carbon ...	$\frac{3}{4}$ in.	250—350	35—50	Cutting—welding
Carbon ...	1 in.	350—500	35—50	Cutting—welding

The same tensile strength and softness can be obtained in the weld, which practically consists of cast-steel, as in the adjoining metal, but equal ductility cannot be ensured. The process is, however, entirely practical as a means of welding cast-steel and boiler plate, as the welded area can be reinforced, so that under severe stress the unwelded metal will fail rather than the metal in the weld. The relative costs of acetylene and arc welding are given by curves as 4½ to 1, and the costs of cutting steel as equal up to about 2 in. thickness, and 3 to 2 at 6 in. thickness, taking the price of acetylene gas at $1 per cb. ft., oxygen gas at $2, and electrical energy at 1 c. per kw.-hour. The cost of labour is not included in the first comparison, but in the case of cutting steel it is taken at 30 cents per hour.

Appointments Vacant.—Resident engineer (£250), for the Leek U.D.C. electricity works; mechanical engineer (£500), for the City of Belfast electricity works; junior shift engineer, for the City of Birmingham electric supply department. See our advertisement pages to-day.

Fatality.—"Accidental death" was the verdict at an inquest on a Dukinfield labourer named Nash, who was killed in a chemical factory at Stalybridge. It was stated that when emptying a filter he handled an electric lamp, the holder of which was afterwards found to be faulty, and he received a shock from which he died before a doctor arrived.

Institution and Lecture Notes.—Institution of Electrical Engineers. -The annual general meeting of the Western Local Section was held at Bristol on April 2nd. Owing to the ill-health of the author, Mr. Wakefield's paper on "Automatic Telephone Exchanges," which was due to have been read at this meeting, was not read, and business of a purely formal character was transacted. The chairman (Prof. D. Robertson) briefly reported on the work of the session, and the following gentlemen were elected for the various offices for the session 1917-18:—

Chairman.—Mr. R. Howard Fletcher.

Vice-Chairman.—Mr. H. I. Rogers.

Members of Committee.—Prof. Bacon, Messrs. W. A. Chamen, H. Faraday Proctor, H. T. Sully, and J. E. Teasdel.

At the final monthly meeting of the session of the Scottish Local Section in Glasgow, the office bearers for the ensuing 12 months were appointed as under:—Past chairmen, Messrs. James Lowson, D. A. Starr, and J. K. Stothert; chairman, Mr. Arch. Page; vice-chairmen, Messrs. E. T. Goslin and A. S. Hampton; hon. secretary, Mr. Joseph Taylor; assistant hon. secretary, Mr. Wm. F. Mitchell; ordinary members of committee, Messrs. F. H. Whysall, W. W. Lackie, W. B. Hird, Prof. M. Maclean, Messrs. Alex. Lindsay, A. S. M'Whirter, D. M. Macleod, Arch. Wilson, J. E. Sayers, Sam Mavor, and J. F. Nielson. The annual report showed that the total membership was 352, a reduction of 3 per cent. on the previous year, while the average number present at ordinary meetings was 59 = 17 per cent. Mr. J. Shepherd (Leeds) subsequently read his paper on "Some Points in Connection with Engineering Specifications."

The annual meeting of the Manchester Local Section was held on Tuesday last at the Engineers' Club. Mr. C. J. Beaver was elected chairman, Messrs. A. P. M. Fleming and J. A. Robertson vice-chairmen, Mr. Julius Frith hon. secretary and treasurer, and Mr. A. L. Green assistant secretary.

The Faraday Society.—A general discussion on "Osmotic Pressure" will be held on Tuesday, May 1st, at 8 p.m., in the Rooms of the Chemical Society, Burlington House, W. Sir Oliver Lodge, F.R.S., will preside over the discussion, which will be opened by Prof. Alfred W. Porter, F.R.S. Dr. F. Tinker will read a paper on "The Colloidal Membrane: Its Properties and its Function in the Osmotic System." Mr. W. R. Bousfield, F.R.S., will read a paper on "Osmotic Pressure in Relation to the Constitution of Water and the Hydrates of the Solute." The following have signified their intention of contributing to the discussion:—Prof. H. E. Armstrong, F.R.S., the Earl of Berkeley, F.R.S., Prof. A. Findlay, Prof. J. C. Philip, Dr. G. Senter, Dr. S. A. Shorter, and Mr. W. C. D. Whetham, F.R.S.

Chief Technical Assistants' Association.—The officers for the ensuing session are:—Mr. W. Young (Stepney), chairman; Mr. H. F. J. Thompson (Battersea), vice-chairman; Mr. A. P. MacAlister (Islington), hon. secretary; Mr. J. R. J. Bowden (Hackney), hon. treasurer. The Executive Committee is composed of the above officers, together with Mr. J. T. Baron (immediate past chairman), Mr. J. H. Parker (Croydon) and Mr. B. B. Heaviside (Stepney).

Iron and Steel Institute.—The annual meeting takes place at the Institution of Civil Engineers on May 3rd and 4th. Seven papers are announced in the programme. The autumn meeting will be held at the same place on September 20th and 21st.

Society of Engineers (Inc.).—A paper on "Ball Bearings" was read on Monday, April 2nd, by Mr. A. M. Arter. A brief *résumé* was given of Prof. Stribeck's investigations. He measured the approach of hardened steel balls under compression, and found that the admissible static loads varied as the square of the diameter; he also found that ball bearings in which the load was carried at right angles to the axis of rotation of the balls were alone suitable for heavy loads. Ball bearings could never have been made a commercial success but for the very high degree of accuracy in manufacture. If a load of 130 lb. is put upon a ball ½ in. in diameter, it is compressed one-thousandth of an inch, and hence if one of the balls in a thrust bearing is one-thousandth of an inch larger than the rest, or there is a high place in the race of this amount, failure is certain if the normal load of the ball is at all approaching the safe working limit.

Practical Encouragement to the Use of Electric Motor Vehicles.—One reason that the electric motor vehicle is so popular in the United States is undoubtedly to be found in the greater "service" that is given thereto by central station engineers, and also by the battery manufacturers. In connection with the latter, it is interesting to record that the Exide Battery Co. have recently opened a new battery depôt in New York, making the third owned by the same undertaking in that city. The new building has a floor space of 30,000 sq. ft., and can accommodate 60 electric industrial vehicles. The equipment includes 60 battery charging plugs and every facility for the charging and boosting of vehicle batteries. A stock of charged standard accumulators is kept on hand, so that the least possible delay is caused in making any necessary replacements. The building is open day and night, and two emergency vehicles are kept ready to be dispatched at a moment's notice to the assistance of any electric vehicle that may break down on the road. It is stated that the three depôts of the Exide Co. have a capacity sufficient to deal with about one-third of the electric industrial motor vehicles in the New York district.

Electric Steel in South Africa.—The South African Institute of Electrical Engineers recently collaborated with the Chemical, Metallurgical and Mining Society to form a small committee to investigate and report to the Munitions Committee upon the practicability of shoes and dies being manufactured in South Africa from available steel scrap. The report of this Committee was to the effect that, by means of an electric furnace, the local manufacture of shoes and dies was likely to be a commercial success, and since all the necessary plant and raw materials existed in the country, there need be no great delay in reaching the producing stage. It is understood that, as a result of this report, the Chamber of Mines has installed a small electric furnace, which is now producing shoes and dies of a fairly good quality.—*Board of Trade Journal.*

The Brown Coal Deposits of Victoria.—The *Melbourne Age* states that the more knowledge the Minister of Mines acquires of Victoria's brown coal deposits, the more he becomes impressed with their potential value. At the opening of the new school of applied arts at the Working Men's College, Mr. Livingston said there were syndicates in Melbourne willing to spend £200,000 or £300,000 on establishing experimental works for treating the brown coal and ascertaining the value of its by-products. "The results of drilling for black coal had not been very encouraging, but there were great deposits of brown coal in Gippsland, as well as at Lal Lal and Laverton. Mr. Harper, city electrical engineer, informed him that the horse-power required for Melbourne industries in 10 years' time would be 100,000. We could not get the necessary fuel from our black coal fields, and unless we got it by some means, our industries would fail, as they would not be able to stand against New South Wales with its plentiful supplies of black coal. The Minister urged scientists and students to give special attention to investigation of the utility of brown coal."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The Bradford City Council has confirmed increases of salary to Mr. T. Roles, electrical engineer, by £100 a year to £900; Mr. J. H. Shaw, deputy engineer, by £100 to £450; Mr. Jas. Fairbairn, works superintendent, by £50 to £350; Mr. C. F. Allsop, commercial assistant, by £50 to £300, with £20 war bonus cancelled; Mr. T. Stirk, tramways traffic superintendent, by £50 to £300, with £20 bonus cancelled; Mr. T. B. Moseley, chief tramways clerk, by £25 to £225, with £20 bonus cancelled; Mr. S. Pearson, tramways works superintendent, by £40 to £200, £20 bonus cancelled; Mr. J. W. Falkingham, tramways correspondence clerk, by £40 to £200, £20 bonus cancelled; Mr. E. Webster, engineering assistant, by £22 to £130 16s., including £20 16s. bonus.

The Accrington Council has appointed Mr. A. W. Clegg as electrical engineer, in place of Mr. H. Gray, resigned.

Mr. A. W. Bush, canvassing engineer in the Sheffield installation and motor department, has resigned.

Halifax Corporation has approved advances of salary to Mr. E. E. Hodgson, superintendent of the tramway parcels department, and Mr. H. Spencer, clerk in the parcels department.

Stretford U.D.C. has increased the salary of Mr. T. W. Taylor, chief clerk in the electricity department, from £117 to £130 per annum Advances have also been granted to the shift engineers and to the electrical inspector.

The salary of Mr. T. J. Kendrew, manager of the Southport Corporation tramways, is to be increased from £250 to £300 a year.

The Bury Tramways Committee has agreed to the request, on certain conditions, from the Admiralty that the services of Mr. William Clough, the borough tramways manager, should be placed at the disposal of the Shipyard Labour Department.

It is proposed to give Mr. F. J. S. Hoskin, the Darwen tramways manager, a war bonus of £25 per annum.

The Worcester T.C. has increased the salary of Mr. R. Smith, chief assistant engineer at the electricity works, from £200 to £225 a year, and that of Mr. H. H. Smith, station superintendent, from £180 to £225.

Colchester T.C. has released from his apprenticeship, after three and a half years' service, Mr. E. G. Barritt, senior switchboard attendant, and appointed him electrician-in-charge in control of the all-night shift.

Bedford T.C. has appointed Mr. J. H. Reid, at a salary of £4 4s. per week, as resident engineer in connection with the electricity extension scheme outside the borough.

The Aberdeen Council has resolved to increase from £200 to £225 the salary of Mr. John Downie, chief clerk of the Ferryhill electricity works.

General.—The *Review of the River Plate*, just to hand, says that Mr. Pakenham W. Beatty, chief engineer of the Anglo-Argentine Tramway Co., was returning to England at the end of March.

At a meeting of the Association of Municipal Electrical Engineers of Lancashire and Cheshire, held on March 27th, a presentation consisting of a combined "luncheon and tea" basket, was made to Mr. C. C. Atchison, as a token of esteem and recognition of the valuable services rendered to the Association as honorary secretary. Mr. J. A. Robertson, of Salford, made the presentation on behalf of the members of the Association, and several speakers referred to the excellent work done by Mr. Atchison. It was pointed out that it was through his efforts the Association was formed.

Les Nouvelles, of Maastricht, states that M. Léon Greiner, director-general of the Cockerill iron and steel works, has been arrested by the Germans and detained.—*The Times*.

On April 7th, Mr. W. N. Y. King, A.C.G.I., A.M.I.E.E., was presented with a gold watch-chain by the staff and employés at the Kelham Island Power Station of the Sheffield Corporation Electric Supply Department, on his leaving to take up an appointment under the Ministry of Munitions. Mr. J. R. Williams, station superintendent, made the presentation, and mentioned the long and progressive period—nearly 15 years—during which Mr. King had been connected with the power station.

Sir Home Gordon, having completed the work which the Director-General of National Service asked him to undertake, has now ceased to be Staff Controller of the Department.

Roll of Honour.—Gunner J. S. Jenkins, R.F.A., late of the electric light department of the India Rubber, Gutta Percha and Telegraph Works Co., Ltd., was severely wounded in France on March 21st and died the following day. He is reported to have stepped on a trap left by the enemy during their retreat. Bombardier A. R. Biggs, R.G.A., formerly in the rubber department of the same company, has been awarded the Military Medal.

Private A. Stanton, Cheshire Regt., formerly at Glossop with the Urban Electric Supply Co., has fallen in action.

Mr. F. W. King, who was articled to a London firm of electrical engineers when he joined the Naval Air Service, has died suddenly whilst in training.

Sergeant A. W. Tinsley, Lancashire Fusiliers, formerly employed at the Manchester Corporation Electricity Works, has been awarded the French decoration, the Medaille Militaire.

Lance-Corporal W. Bennett, of the King's Own Royal Lancaster Regt., killed in action, was employed by the British Westinghouse Co., Ltd., Trafford Park, Manchester.

Sergeant Howarth, South Lancashire Regt., who has been awarded the D.C.M. for conspicuous services, was before his enlistment employed at the Manchester Corporation Electricity Works.

We regret to record the sudden death, through a clot of blood on the brain, of Major R. Swire Griffiths, R.G.A., aged 32, who prior to the war was employed by the British Westinghouse Electric & Manufacturing Co., Ltd., for whom he had superintended the carrying out of installations in various parts of the country.

Lieutenant W. E. Chappel, D.C.L.I., attached to the Flying Corps, who was killed while flying on April 4th, at the age of 19, was the younger son of Mr. H. E. Chappel, retired Director of Telegraphs, India-Burma Circle.—*Times*.

Lieutenant Douglas Coe, R.G.A., who has been wounded, was one of the staff at the Blackburn Corporation Electricity Works.

Word has been received of the death in action of Lieutenant H. Butler, aged 30, who held a position at Messrs. Dick, Kerr & Co.'s works, Preston.

The Bronze Medal of the Italian Order of St. Maurice and St. Lazarus for Military Valour has been awarded to Corporal S. H. Hockley, R.E., who was with the Bude (Cornwall) staff of Messrs. Christy Bros., electrical engineers.

At Messrs. Hawthorne, Leslie & Co.'s shipyard, Hebburn-on-Tyne, on the 4th inst., Mr. J. T. Batey, general manager, presented the Military Medal to Corporal J. W. Rushforth, R.E., and a case of cutlery from the officials and staff. Corporal Rushforth was formerly electrician at the yard, and was awarded the Medal for gallant work in repairing broken wires at the front, being wounded while so doing.

Fitter H. Rosser, R.F.A., formerly lamp storekeeper with Messrs. Pope's Electric Lamp Co., Ltd., has been killed in action.

Obituary.—Mr. G. A. Nussbaum.—We regret to record the death of Mr. G. A. Nussbaum, of 29, Ludgate Hill, E.C., which occurred on Saturday last at 42, Penywern Road, S.W. Mr. Nussbaum was an Associate of the I.E.E. He was 66 years of age. Mr. Nussbaum first came over to England to take charge of an exhibit of Messrs. Gerard & Co., of Paris, at the first Crystal Palace Electrical Exhibition. After his return, he entered the service at Paris of the Société Industrielle des Telephones, subsequently coming over to London as that company's representative. He acted in that capacity for at least 30 years, and though that arrangement came to an end several years ago, he was transacting business with the company right up to the last. Mr. Nussbaum had been ill for five months, but his end came very suddenly. We desire to tender our sympathy to Mrs. Nussbaum in her bereavement.

NEW COMPANIES REGISTERED.

Thrutchley, Percival & Co., Ltd. (147,004).—Private company. Registered March 31st. Capital, £2,000 in £1 shares. Manufacturers of and dealers in electrical equipment, magnetos, motor accessories, mining and railway supplies, castings, small tools, &c.; also to act as representatives for manufacturers of such commodities in the United Kingdom, Russia, France, and elsewhere, with particular regard to markets of German or Austrian origin, and to divert such trade into British channels. The subscribers (each with one share) are: E. P. Booth, 206, Albert Road, Handsworth, manufacturer; S. Craven, 58, Grove Avenue, Moseley, Birmingham, engineer; T. T. Tripp, Inversnaid, Mayfield Road, Wylde Green, Birmingham, manufacturer. The first directors are E. P. Booth, S. Craven, T. T. Tripp. Solicitor: W. H. Stubbs, Newton Chambers, Cannon Street, Birmingham.

Wilson-Maenlen Co., Ltd. (1,548F).—Particulars filed March 22nd, 1917. Registered in New York, December 28th, 1914, to carry on the business of manufacturers of and dealers in electrical, pyrometric, and scientific apparatus, &c. Capital stock, $60,000 in shares of $100 each. British address: 2, Myron Place, Lewisham, S.E. A. H. Holloway, of 118, George Street, Lewisham, S.E., is authorised to accept service. Directors: Charles T. T. Wilson, Carolyn E. Wilson, and Cuthbert F. Brown, all of New York.

Surrey Engineering Co., Ltd. (146,943).—Private company. Registered March 28th. Capital, £1,000 in 1,000 10 per cent. cum. pref. shares of 10s. each, and 500 ord. shares of £1 each. Electricians, mechanical and general engineers, &c. The subscribers (each with one ord. share) are: J. A. Hughes, 4, The Grange, Wimbledon, S.W., engineer; F. N. Pickett, 5, Wilbury Villas, Hove, engineer; J. Cameron, Grove Lodge, New Southgate, N., merchant. The first directors are J. A. Hughes, F. N. Pickett, and J. Cameron. Registered office: 34, Surrey Street, W.C.

Holland, Griffiths & Co., Ltd. (146,884).—Private company. Registered March 26th, with a capital of £500 in £1 shares, to take over the business carried on at 27, Ridinghouse Street, Oxford Circus, W., as Holland and Griffiths & Co., and to carry on the business of electrical and mechanical engineers, &c. The subscribers (each with one share) are: J. Harrington, 85, Salisbury Road, Harrow, engineer; G. W. Knight, Hazelmere, 724, Barking Road, Upton Park, E., engineer; J. H. Williams, 94, Chestnut Avenue, Whipps Cross, E. 17, works manager. The first directors are J. Harrington, G. W. Knight, and J. H. Williams. Solicitors: Kenneth Brown & Co., Lennox House, Norfolk Street, W.C.

Lodge Fittings Co., Ltd. (146,987).—Private company. Registered March 30th, with a capital of £1,000 in £1 shares, to take over the business of manufacturer of electrical fittings, &c., carried on by Ella S. Wood at 57, Albert Road, Aston, Birmingham, as the Lodge Fittings Co. The subscribers (each with one share) are: E. M. Lodge, 50, Brougham Street, Hockley, Birmingham, manufacturer; F. J. Wood, 57, Albert Road, Aston, Birmingham, secretary; Ella S. Wood, 57, Albert Road, Aston, Birmingham; Mrs. E. Lodge, 50, Brougham Street, Hockley, Birmingham. Table "A" mainly applies. Registered office: 57, Albert Road, Aston, Birmingham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Birmingham Electrical Accessories Manufacturing Co., Ltd.—Debenture dated March 2nd, 1917, to secure £150, charged on the company's undertaking. Holder: G. Garrett, 8, Devonshire Road, Handsworth.

Electrical Installations, Ltd.—A memorandum of satisfaction to the extent of £300 on March 26th, 1917, of debentures dated December 5th, 1906, securing £2,000.

Brilliant Arc Lamp & Engineering Co., Ltd.—Assignment of proceeds of munitions contract, dated March 28th, 1917, to secure all moneys due or to become due from company to London & South-Western Bank

British Electrolytic Zinc Co. (Isherwood Process), Ltd.—Particulars of £25,000 debentures, created June 5th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue (March 12th, 1917) being £21,200. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Church Stretton Electric Supply Co., Ltd.—Charge on Church Stretton Electric Lighting Order, 1916, dated March 13th, 1917, supplemental to trust deed of February 19th, 1914, securing £4,000 debentures.

Rangoon Electric Tramway & Supply Co., Ltd.—A memorandum of satisfaction to the extent of £6,830 on February 21st, 1917, of debenture stock dated 1906-13, securing £250,000, has been filed.

Caerphilly Electric Supply Co., Ltd. (139,086).—Capital, £6,000 in 400 cum. pref. shares of £5 each, and 1,500 pref. ord. and 2,500 ord. shares of £1 each. Return dated December 31st, 1916. 160 ord. shares taken up, nothing called up. Mortgages and charges: Nil.

CITY NOTES.

Urban Electric Supply Co., Ltd. We give below the directors' comparative statement, showing the profits earned at the various towns during 1916, also the load connected in kilowatts:—

	Kilowatts.		Profits.	
	1915.	1916.	1915.	1916.
Hawick	3,033	3,181	£7,460	£5,653
Stamford	1,648	1,679	2,643	1,625
Weybridge and Walton	3,073	3,297	5,473	4,385
Godalming	1,440	1,498	2,585	2,040
Twickenham and District ..	6,413	8,413	12,960	16,109
Dartmouth	922	978	1,836	1,106
Camborne and Redruth ("A") and Cornwall ("B")	7,102	7,345	"A" 7,490 "B" 14,273	"A" 7,523 "B" 14,039
Newton Abbot	1,084	1,262	2,451	3,242
Grantham	1,668	1,852	7,014	7,640
Glossop	1,265	1,317	3,727	3,113
Berwick	955	1,038	932	647
Caterham	773	862	1,688	1,207
Newbury	1,000	1,164	3,357	3,076
Totals	30,376	33,886	£73,890	£71,407

W. T. Henley's Telegraph Works Co., Ltd.

Mr. S. Gedge, presiding at the recent annual meeting, said that the report was an exceedingly good one, having regard to existing adverse circumstances. They had had the greatest difficulty in obtaining raw material and in delivering goods. They had constantly to keep in mind the fact that they were not doing, and could not do, work for their former customers. Whether or not any rivals were springing up who would endeavour to rob them of their ordinary commercial work when peace was declared it was hard to say. They were preparing for such a state of things, as the accounts showed. No fewer than 796 of the staff and workmen had joined the Forces; 28 had laid down their lives and 90 had been wounded. The managing director (Mr. G. Sutton), who seconded the adoption of the report, stated that their commercial trading had nearly entirely disappeared. The profit, which was very handsome, might be a little larger than was shown. They expected eventually that other sums would come to the credit of the company, as they were making claims upon the Government in regard to depreciation and machinery bought by them. Those claims, however, had not yet been settled, and in dealing with the accounts the profit had been taken after allowance for special taxation and (as the directors had felt bound to do) they had shown the worst position to the company. The shareholders might therefore expect that when a settlement was obtained the position would really be better than appeared from the accounts. He thought it matter for regret that the accounts for 1915 as regarded taxation had not yet been settled. If the accounts for that year had been settled, the directors would have been able to give a more accurate statement of the company's profits for 1916. He might give an instance of the kind of negotiations they had with the Government respecting the payment of excess profits. At the meeting last year he informed the shareholders that the Act provided that an allowance should be made against the excess profit paid by the company in respect of any machinery or plant which they purchased for war requirements and which the directors did not contemplate would be of any use to the company when the war closed; but in their negotiations with regard to the 1915 settlement the taxing authorities suggested that certain claims which had been made on that account should be spread over a number of years. He, however, submitted that if such machinery made excess profits, the first charge upon those profits should be the cost of that machinery, and that there should be no question of spreading it over a number of years. That was the directors' contention, and they would endeavour to insist on it in their negotiations with the Government. Excess profits, he thought, were badly conceived, and he did not think they were being carried out by the taxing authorities as generously or as justly as had been expected when the Act was passed. With regard to trading, there was very little of the company's commercial business left. A good deal of commercial business was included in the accounts for 1916 because this class of business had been gradually shut down since the beginning of last year, and was being shut down now more vigorously by the authorities than previously. He quite agreed that it was necessary to stop all non-essential work; but that was the company's position—that they were not at present commercial traders. Reverting to the excess profits tax, he thought, as he had said before, that the arrangement made with regard to excess profits might have been considerably improved upon by Parliament. He thought that the method, by which the company received 20 per cent. over their standard period and nothing more (except that they got some allowance, which was not fixed yet, in relation to any enlarged capital they might have) was thoroughly bad for the industries of this country. The object of men of business trained in the working of industries was to run the business with which they were connected as economically as possible, to turn out their work as efficiently as they could, to sell at a good price, and to give a good return to those who had invested their capital. That incentive, however, was taken away in present circumstances. He did not object, but with a depleted staff it was regrettable that they had far more work to do than they had ever previously had in connection with statistics and information concerning the company's business which they had to furnish to Government departments. He thought it was a very proper thing that war profits should go to the State. He was only complaining of the way in which the taxation was imposed. The company's relations with regard to their workpeople were very satisfactory. They had made a very great advance in the rates of wages, but that was only right in view of the considerable increase in the cost of living, but he complained of the receipt of instructions from Government departments to increase the wages of certain classes of the workpeople, such instructions being given without any consultation with the management. At one of their works only 30 people came under a certain award of the Board of Trade for an advance in wages, and in consequence they had raised the wages at the works in question by between £12,000 and £15,000 a year to some of their people in order to prevent dissatisfaction. The directors were able to pay a large dividend because a great deal of the profits made in former years had been left to the company to trade with, and no interest had to be paid upon that capital. The large Gravesend works and the tire factory had been constructed without raising one penny of additional capital. With reference to the future, they had plenty of orders on their books, and had a large number of orders which ought to have been executed six, 12, or 15 months ago, which might be good or not at the present time—orders from foreign buyers. Foreign trade was shut down, and meantime certain other nations were pushing their products among the company's customers. Japan and the United States especially were very active in the British Colonies, South America, and neutral States, but he thought that when the war was over the company would have no difficulty in dealing with such competition. They would be able, he believed, to get their connections back and to keep their trade, but they would be confronted with this position when the war closed—that the Government would instantly stop their work, and when that happened, the company would have no work in their factories. They could make work by manufacturing for stock, but as their managing director, he was very doubtful whether he would be willing to place any considerable amount of work on their machinery with copper at two or three times its normal value, and with the certainty that if they made stock with the existing high prices of raw materials they were bound to lose money on everything they manufactured. The financial position of the company was strong—stronger, perhaps, than the shareholders imagined; their reserves were large; and, so far as he could see, speaking with all his experience, the company would be able to weather the worst storm that might arise at the close of the war.

British Electric Transformer Co., Ltd.

Mr. A. F. Berry presided at the recent annual meeting. He said that only about one-half of the earned profit was recommended for distribution. They were not disposed to return to a peace-time rate of distribution while the war was still raging. The average annual profits for the past eight years were sufficient to cover the preference dividend nearly five times over, while the assets, irrespective of patents and goodwill, as they stood in the balance sheet, were nearly two and a half times the par value of the issued preference capital. Their future dividends were the better protected by the conservative distribution adopted. The past year's working was extraordinary to a greater degree than that of 1915. They carried out large volumes of work, and had obtained fair prices, though the question of price was one that had to be watched very carefully in view of the tendency of the prices of materials and labour to rise. With regard to the current year, they started with more work in hand than they had last year, but it was quite impossible to forecast from year to year what might happen. He wished to appeal to shareholders to help the business as much as they could by doing business with the company and bringing business to it. He particularly recommended them to give the company an opportunity to help them and their friends with "Tricity" canteens such as they had latterly installed for some leading works. These were especially important in view of the serious shortage of food, as very considerable savings could be effected by the adoption of what he would call "Tricity" methods of cooking. Many years had passed since he first gave to the electrical world the result of their researches in the direction of economical roasting. Although to-day there were many thousands of persons benefited through the introduction of "Tricity" methods, there was far more to be done. To meet the increased demand they were extending their premises. Some years ago they purchased land to the east of them, and had now acquired the completed works adjoining them on their western side. This would allow considerable latitude for future developments, and would give facilities which would greatly add to the value of their existing works at a comparatively low cost. Last year he referred to the phenomenal rate of growth of the electrical manufacturing industry since the outbreak of war. The past year had seen still greater strides taken in the march of electrical progress. This extraordinary development continued, and was carrying the country swiftly into the electric age and to a general recognition of the value of electrical energy to the engineering and most other trades. Electrical engineering had stepped well forward into the ranks alongside of other branches of engineering and agriculture, and at last the country had awakened to the importance of "producers."

British Aluminium Co., Ltd.

Mr. A. W. Tait, addressing the annual meeting, said that in the accounts they had adopted the practice instituted last year of stating the trading profit after making reasonable provision for amounts payable in respect of excess profits and controlled taxation. The result for the year was undoubtedly satisfactory, but the conditions were entirely abnormal. The price of the metal had been fixed by the Government during the whole period, and would be so, he thought, until the end of the war. Though unable to give particulars of the uses to which the metal was being applied at present, there was no doubt that the experience that was being obtained during the war, including the production of light alloys, would be of the greatest possible use in extending the field of development for the metal for ordinary commercial purposes. There was a strong probability that the motor-car industry, after the war, would manufacture their engines largely from aluminium. An enormous development had taken place in the productive capacity for aluminium all over the world, particularly in the U.S.A. and in Norway, but commercial developments,

&c., would take up the increased supply not long after the cessation of hostilities, and would possibly also call for further production. The company was at present pushing on with certain hydraulic works at Kinlochleven for the provision of additional water supply to the Blackwater reservoir for another catchment area. They hoped that part of that supply would be available by the middle, and the whole of the scheme completed by the end, of the year, and this would, of course, increase their productive capacity. Regulation works had also been proceeding for some time to increase the available water supply for their works at Vigelands, Norway, and they should begin to obtain benefit therefrom this year. The alumina works, which were absolutely necessary to take care of the increased production of aluminium, were nearing completion. The power plant had been put into operation, and they were about to commence the manufacture of alumina. The costs of production continued to be seriously affected by the further heavy increases which had taken place during the year in the costs of labour, material, freights, and other charges, and he was afraid that they would continue to rise so long as the present conditions remained. The maintenance of supplies of raw materials and coal required by their various works in Great Britain and Norway had been exceedingly difficult, and had on many occasions caused considerable anxiety, particularly as the greater part, if not the whole, of their freight was seaborne. It was unfortunate that the large stock of bauxite in the South of France could not have been conveyed to this country before the war broke out. On the return of normal conditions it would be one of their essential duties to see that a large stock of bauxite was maintained in this country to forestall any such contingency as had arisen during the present war. The company's properties in Switzerland were being maintained in good condition, but no further construction work could be proceeded with during the war. It was to be regretted that the Government did not see their way to assist the company to complete the development of that power and the erection of the necessary works in the early stages of the war, because if that had been done the factory could have been producing by this time a substantial amount of aluminium, which would have been available for Government purposes, and would have reduced the necessity for purchases of metal in neutral countries. Referring to the reserve account, which had been increased by £75,000 from the profits of the year to £325,000, the creation of ample reserves had been more than justified in the past, because it had enabled them to very largely increase their productive capacity, and consequently the profits, without the further raising of capital. It had also enabled them to strengthen their position in the industry, and would do so again. Their competitors had, during these abnormal times, been making very substantial profits, as they had been unrestricted as regards the price which they might obtain for the metal, and they had not suffered from the taxation which the industry in this country was bearing. It was somewhat unfortunate that the engineering and metal industries, which had contributed very largely with their brains and skill, as well as with their plant and equipment, should be placed at a disadvantage in comparison with others. The Government should do something to overcome the present inequality in taxation, and representation had already been made to the Chancellor to that effect. The shareholders might look upon the present position with a considerable amount of satisfaction and assurance that whatever might be the prospects of the industry after the war, the company would be able to go through dull times with reasonable equanimity. The aluminium industry was undoubtedly one of the key industries of the country, and well merited such assistance as the Government could see their way to give.

South Wales Electrical Power Distribution Co., Ltd.

At a meeting of debenture stockholders held in London on March 31st, when Mr. G. Collis, of Finch Lane, London, was appointed debenture agent, in succession to the late Mr. S. C. Boulter, the chairman of the company, Mr. W. Gascoyne Dalziel, said the company had now been able, after meeting all prior charges, including interest on prior lien debenture stock and depreciation on a scale agreed with the debenture agent, to pay current ordinary debenture interest for the third successive half-year, and there was still a balance to the credit of suspense account, which would, if need be, go towards the payment of ordinary debenture interest for the current half-year. They had not yet reached the position of actually earning the full amount of the current interest, but the prospect of doing so was steadily improving. The results for the last year, though not as good as they would have been if the prospective new consumers and the Power Co. had not experienced extraordinary delays (due to prevailing war conditions) in completing the plant and mains necessary for the taking and giving of the supply, were, nevertheless, in all respects, a record to date. During the second month of the present year, a considerable proportion of the new business referred to at the last annual general meeting of shareholders, came on to the company's mains, and there was a corresponding rise in output. The bulk of this new load was required immediately in connection with important manufactures, although taken under long-term contracts. Revenue was, therefore, now being earned from the expenditure of part of the new capital. The Power Co.'s board were, in the majority, representative of the colliery owners' interests, and they were, of course, the principal consumers; but the directors fully recognised the mutuality of interest. The chief consideration of the Power Co.'s board had been the development of the company's property. They had kept this in the forefront, and hoped the debenture holders would consider that an increase of output from seven millions of units when they took it over in 1907 to over 30 millions of units in 1916 (the January, 1917, output being over three millions, equal to 36 millions per annum) had given proof of their desire to extend the company's business.

Chelsea Electricity Supply Co., Ltd.

The Chairman, at the annual meeting last week, said that, after providing sufficient sums to preserve the capital of the company intact at the end of their concession in 1931, and after providing for the debenture interest and for the preference dividend, they had out of the profits of the year sufficient to pay a dividend of 3 per cent. on the ordinary capital. Thus, for the second year in succession, they were faced with a reduction in the dividend, which for the year 1914 was 5 per cent., and for 1915 4 per cent. This reduction was due to two causes—an increase of £3,800 for fuel costs and for energy purchased, and of over £3,000 in the amount required for income-tax. Nearly every item on both debit and credit sides showed an increase. The total on the debit side was about £7,800 higher, while the receipts were about £4,500 better, the net result being that they carried to net revenue account over £3,000 less than a year ago. They had suffered, as they would readily understand, from the operation of the Summer-Time Act, which had meant that practically for nearly half the year they had been deprived of an hour's demand a day for artificial light as compared with any previous year of their existence. They had, therefore, been subjected to a double disadvantage: higher costs for fuel on the one hand, and an inroad into the demand of the public for current on the other. These disadvantages had only partially been recouped by an increase in price which, in conjunction with all other electric light companies in the kingdom, they had been compelled to make. They carried out during the year a very important operation, resulting in a great improvement in their financial position, by the purchase and cancelling of £53,212 of their debenture stock, thus reducing the debenture debt from £175,000 to £121,788. By this means they had got rid of the liability to provide in future for the premium of 10 per cent. on the debenture stock of the company when this stock became payable, the provision for which for some years had been an annual charge on the profits of the company. With the discount on the stock so purchased and cancelled, and the provision of £816 placed to the credit of the debenture stock premium redemption fund in the present accounts, they had now provided a sufficient sum to meet the premium on the balance of stock still outstanding, so that no further appropriation to this fund would be necessary. This transaction was carried out partly by their own surplus funds, and partly by a loan of £30,000 from the bankers, which was reduced to £29,000 at the close of the year. The amount had since been reduced to £14,300, and he expected that by the end of the year the whole loan would be wiped off. They had managed to maintain a good service for their customers, and, with a considerably diminished staff, this had at times been a very strenuous work. Sixty-three of their employés were on active service; two had lost their lives, and two had been wounded. If the income-tax remained at the same rate as at present, the amount chargeable against the profits of 1917 would be about £1,500 less than the amount debited to the present accounts. This, with the elimination of the item of the debenture stock premium redemption fund, suggested that next year's accounts would be better off to the extent of £2,300; but, on the other hand, there was the serious contingency, and, in fact, certainty, that the continued rise in the cost of fuel, both of coal and oil, must inevitably result in a largely increased cost under that head. In addition, the cost of labour and materials continued to rise.

West India Electric Co., Ltd.

In spite of the heavy increase in cost of all materials, the results for 1916 were the best in the company's history. The railway receipts show a marked recovery, although $11,267 below 1914. Lighting and power receipts show a decrease of $2,780, due to a reduction in rate made to moving picture shows, restricted lighting Order, and the consequent absence of Christmas decorations, &c. Miscellaneous receipts increased by $3,399. Total receipts from all sources were $286,322, an increase of $12,003 over 1915. The operating expenses increased by $691. As the result of careful economy, the operating expenses were 50.31 per cent., as against 52.26 per cent. in 1915. The company has on hand the entire cargo of coal which was purchased while the price was normal. The hydraulic pipe line suffered very considerable damage from heavy floods. The coal heap at the steam station took fire through spontaneous combustion, destroying several hundred tons of coal. During the president's visit of inspection three lines of No. 6 copper wire which were not in use were removed from the transmission line, and, taking advantage of the high price of copper, this wire was shipped to England, where it met with a satisfactory market. The net income was $92,370 (11.54 per cent. on the capital stock). Four quarterly dividends amounted to $40,000. The balance at credit of surplus account is $478,143. The annual meeting was held in Montreal, on March 14th.

Edison Swan Electric Co., Ltd. An extraordinary general meeting was held on April 4th, Mr. C. J. Ford presiding, to confirm the resolutions already adopted dealing with the alterations in the Articles. He stated that the New Issues Committee of the Treasury had since the last meeting given its sanction to the issue of the 100,000 preference shares mentioned in the scheme of arrangement. The meeting then confirmed the resolutions, after which the chairman said that it only remained for them to obtain the sanction of the Court to the scheme. At the annual meeting in November, he referred to the outlines of a scheme for the provision of further capital; at that time he had anticipated this by making application, on October 10th, to the New Issues Committee of the Treasury for permission to issue £100,000 of preference shares. After somewhat lengthy correspondence with the Treasury, spread over a period of nearly five months, and with the very fullest facts dealing with the situation placed before it, the consent of such issue was refused, in spite of it having been explained that the necessity for the new capital was brought about in consequence of the general expansion of the company's operations, practically the whole of which were of national importance. It was also pointed out that if this money was not forthcoming the company, although absolutely solvent, would have to cease its operations, realise its assets, and pass into liquidation. It was obviously the duty of every British manufacturer to use his utmost endeavours at this grave national crisis to expand, in every direction, the trade of the country, particularly in those directions where our enemies had, previous to the war, obtained such a hold. He thought he was right in saying that in the electrical industry the Germans were the most serious opponents to be met with. To all these exhortations the Treasury Committee turned a deaf ear, it apparently being of no interest whatever to it that one of the oldest electrical concerns would pass away for want of a paltry £100,000. He could understand that, in view of the issue, or pending issue, of the recent War Loan, it was necessary for the Treasury to suspend, and possibly refuse to sanction, any new capital issues, and he therefore again made a renewed application after the War Loan lists were closed, but still without success. As a last resource, he intimated to the Treasury that unless their consent was granted it would be necessary for the directors to give notice to various Government Departments that important contracts on hand for such departments could not be carried out. This had the desired effect, and the matter was reconsidered by them, and recently the necessary permission had been granted. What had happened was eminently unsatisfactory from a national point of view, and if that policy was generally pursued it must inevitably prejudicially affect the whole future position and trade of the country. It went to show that the department in question was not concerned in supporting national trading interests, which, after all, were the life of the nation, and it appeared that it was only when it was put to them that Government needs could not be fulfilled, consideration was given to such a request.

Wycombe (Borough) Electric Light & Power Co., Ltd.—During 1916 the connections increased by 224 kw. to 2,616 kw. Greatly increased cost of coal and oil, restricted lighting, and Daylight Saving, largely reduced the profits notwithstanding the larger demands of power users and advances in charges. The profit was £5,748 (against £6,881 in 1915), plus £802 brought forward. After paying interest on debentures and outstanding accounts, £3,166, a dividend of 2 per cent. is to be paid, absorbing £800; £2,000 is put to reserve for renewals account, leaving £584 to carry forward. A dispute has arisen with the Wycombe Corporation in regard to the contract for street lighting, which is now the subject of litigation. Units generated 1,952,910, units sold 1,596,156, average price obtained 1.84d.

Argentine Tramways & Power Co.—For the year to September 30th last, the gross receipts of the tramways were $m/n370,092, an increase of $m/n41,041. In the light and power department the gross receipts were $m/n106,654.23. After making provision for doubtful debts and other charges in Santa Fé, the net operating revenue was £12,255, increased by interest from investments and other income to £13,358. After charging interest and sinking fund on the debenture stock and London expenses there remains £356. The directors regret that it is not yet possible to recommend any payment on account of the cumulative dividend on the 6 per cent. preference shares.—*Financial Times.*

Pritchett and Gold & Electrical Power Storage Co., Ltd.—The directors recommend the following dividends (subject to income-tax) on the undermentioned shares, for 1916: On the ordinary "A" shares at the rate of 15 per cent.; on the ordinary "B" shares at the rate of 10 per cent.

Victoria Falls & Transvaal Power Co.—The net earnings, including those of the Rand Mines Power Supply Co., for the quarter ended December 31st, 1916, amounted to £215,179.

Kalgoorlie Electric Power & Lighting Corpn., Ltd.—Dividend on the preference shares at the rate of 4 per cent. per annum for the six months ended March 31st, 1917.

Newmarket Electric Light Co., Ltd.—During 1916, 489 lamps (33 watt equiv.) were connected, making 31,925. The profit, including £219 brought forward, was £1,843. After providing for debenture interest £710, the balance is £1,133. £650 is to be carried to reserve for renewals, and £483 is carried forward.

Hart Accumulator Co., Ltd.—The profit for 1916 is £19,555, plus £16,949 brought forward. After paying the preference dividend (£125), and 10 per cent., less income-tax, on the ordinary shares, £27,371 is to be carried forward.

Indo-European Telegraph Co., Ltd.—Final dividend for 1916 of £1 2s. 6d. per share, making 7 per cent. for the year, free of income tax, and also £1 10s. per share, free of income-tax, out of interest received.

Stock Exchange Notice.—Application has been made to the Committee to allowing the following to be quoted in the Official List:—

Aluminium Corporation, Ltd.—£206,323 ordinary stock, £179,512 preference stock, £121,897 6 per cent. debentures (registered), and £100,000 6 per cent. debentures (bearer).

Sao Paulo Tramway, Light & Power Co., Ltd.—Dividend of 2½ per cent. on common stock.

Rio de Janeiro Tramway, Light & Power Co., Ltd.—Dividend, 1¼ per cent.

Bombay Electric Supply & Tramways Co., Ltd.—Dividend on the ordinary shares at the rate of 10 per cent. for 1916.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets are good in tone. Returned from their Easter holidays, members found a fair accumulation of orders awaiting them, with buyers predominant. The effect of the splendid news from France, and the United States' action, with the consequent fall in the Bank Rate to 5 per cent. last Thursday, put markets in very firm fettle. Noticeable strength in Consols and gilt-edged securities has helped other investment stocks. People are once more looking forward to the end of the war, and are on the hunt for stocks and shares likely to benefit by the coming of peace. The supply available seems to become daily more restricted.

Home Railway stocks are very much to the fore. Debenture issues stand in many cases on a higher level of prices than the War Loan. Preference, guaranteed, and rent-charge advance literally every day. The reason for this is that investors think such stocks show a great deal wider scope for improvement than the War Loan does. And maybe they will turn out to be right.

This movement finds reflection in the ordinary stocks. All the heavy brigade is substantially better. Lower-priced varieties, like Districts and Metropolitans, are being picked up by people ready to take long-shots. A small, but none the less welcome, recovery has begun in Underground Electric income bonds. Railwaymen's requests for more pay are treated as temporary incidents. Possibly there is not too much backing to the present rise in this market, but the buying orders come mainly from the North and Midlands. The inference is that they are investment of war profits, and that the stocks are not likely to be sold for some time to come. There is little speculative buying going on.

Electric Lighting shares are good, though there is not much change in prices. Manifestly the dividend declarations created a favourable impression, and with the shares looking low in their ex-dividend quotations, fresh inquiries have come in; already the deductions have been largely regained.

Especial strength marks cable and cable-manufacturing shares. All the groups are good—Eastern, American, and Trust. More than half the prices we give are better on the week, and the firmness does not end here. Several of the others are certainly entitled to be put up. The adhesion of the United States has done much to assist this department, and Marconis enjoyed another little spurt on the assumption that the American development constitutes a decided bull point for the company's business. While American Rails have given way sharply, American Marconis, usually influenced by them, have taken a contrary turn, rising to 17s. 3d. Manufacturing companies' shares rose with the rest. Callenders put on 2s. 6d., Henleys 10s., Telegraph Constructions £1. Industrials are firm as a whole. Edison Swan 4 per cent. debenture gained 1½ on the tardy assent of the Treasury to the company's application for leave to raise new money in order to carry out orders placed with the company by Government departments. Permission was most absurdly withheld until the very last minute.

Brazilian Tractions jumped 3½ points to 50, thanks to the increasing favour with which Brazil is now regarded by the investor. Argentines are steady, showing no quotable changes. Mexicans halt a little. There is still lurking doubt as to whether the Germans may be able to stir up strife in the country. Mexican Light first bonds dropped 5 points.

Rubber shares have reassumed strength, and business surges into the market. The eve of Good Friday, usually a very slack day, found brokers and jobbers busily occupied. Rubber itself remains steady, in the vicinity of 3s. 1½d. per lb.; the advent of America into the war area is read as likely to make rubber advance in price. Considering the peace presages, the hardness of armament and ammunition shares is somewhat surprising. Prices on balance improve. The metal groups also are better in tendency.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1915.	Dividend 1916.	Price April 10, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	9	6⅝	—	£7 11 0
Charing Cross Ordinary ..	5	5	8¼	—	7 13 10
do. do. do. 4½ Pref..	4½	4½	8$\frac{9}{16}$	—	7 1 2
Chelsea	4	3	3	—	6 18 4
City of London	8	8	11¼	— ⅛	7 2 3
do. do. 6 per cent. Pref.	6	6	9¾	—	6 3 1
County of London	7	7	10⅛	— ⅛	6 18 3
do. 6 per cent. Pref.	6	6	9¾	—	6 8 1
Kensington Ordinary	7	10	6½	—	5 11 7
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	8⅜	—	5 6 8
Metropolitan	8	8	2$\frac{5}{16}$	—	6 9 9
do. 4½ per cent. Pref.	4½	4½	8⅛	—	7 4 0
St. James' and Pall Mall ..	8	8	6½	—	6 10 8
South London	5	5	2¾	—	7 5 6
South Metropolitan Pref. ..	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	5⅜	—	6 5 9

Telegraphs and Telephones.

	Dividend 1915.	Dividend 1916.	Price April 10, 1917.	Rise or fall this week.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	94½	+ ½	6 7 2
do. Def.	83 6	1½	22	—	6 16 4
Chile Telephone	8	8	7	+ $\frac{1}{16}$	5 14 4
Cuba Sub. Ord.	5	5	7¾	+ ¼	6 9 0
Eastern Extension	8	8	13¾	—	*5 16 4
Eastern Tel. Ord.	8	8	140	+1	*5 14 4
Globe Tel. and T. Ord.	7	7	11¾	+ ⅛	*5 19 2
do. Pref. ..	6	6	9¼	+ ¼	6 3 1
Great Northern Tel.	22	22	37	+ ½	5 19 0
Indo-European	13	13	47½	+1	6 13 4
Marconi	10	10	2⅞	+ $\frac{1}{16}$	3 9 7
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord. ..	10	10	2⅛	—	4 14 1
United R. Plate Tel.	8	8	6⅝	+ $\frac{1}{16}$	*6 0 9
West India and Pan.	6d.	6d.	⅞	—	2 12 6
Western Telegraph	8	8	13¾	—	*5 16 4

Home Rails.

	Dividend 1915.	Dividend 1916.	Price April 10, 1917.	Rise or fall this week.	Yield p.c.
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	25	+ ¾	4 0 0
do. District	Nil	Nil	16¼	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A" ..	Nil	Nil	5/-	—	Nil
do. do. Income	6	5	79½	+1	*6 5 9

Foreign Trams, &c.

	Dividend 1914.	Dividend 1915.	Price April 10, 1917.	Rise or fall this week.	Yield p.c.
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	2⅞	—	9 11 4
do. 2nd Pref. ..	5½	5½	2⅝	—	—
do. 5 Deb. ..	5	5	64½	—	7 15 0
Brazil Tractions	4	4	50	+3½	8 0 0
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	61	−1	8 4 0
do. do. Preferred	—	Nil	46	+1	Nil
do. do. Deferred	—	Nil	39½	—	Nil
do. do. Deb.	4½	4½	63	+ ½	6 15 0
Mexico Trams 5 per cent. Bonds	—	Nil	27½	—	Nil
do. 6 per cent. Bonds	—	Nil	25	—	Nil
Mexican Light Common ..	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	14¼	—	Nil
do. 1st Bonds ..	Nil	Nil	22½	−5	—

Manufacturing Companies.

	Dividend 1915.	Dividend 1916.	Price April 10, 1917.	Rise or fall this week.	Yield p.c.
Babcock & Wilcox	14	15	2⅞	+ $\frac{1}{16}$	6 4 4
British Aluminium Ord. ..	6	7	28/6	—	7 0 4
British Insulated Ord.	15	17½	12¾	—	6 17 3
British Westinghouse Pref. ..	7½	7½	2½	—	6 0 0
Callenders	15	20	12¾	+ ⅛	7 16 3
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	8$\frac{5}{16}$	—	6 13 0
Edison & Swan, £3 paid ..	Nil	—	$\frac{7}{16}$	—	Nil
do. do. fully paid ..	Nil	—	1⅛	—	Nil
do. do. 4 per cent. Deb.	4	4	67½	+1½	5 18 6
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9⅝	+ ⅛	6 4 8
do. Ord.	10	10	14½	—	6 18 0
Henley	20	25	16	+ ½	7 16 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11⅞	—	*8 8 4
Telegraph Con	20	20	87	+1	*6 9 10

* Dividends paid free of income-tax.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month.		No. of weeks.	Total to date.		Route miles open.	
		£	£		£	£		Inc.
Bristol (Trams) ..	Mar. 30	18,640	+1,727	..	57,762	+ 401	30·5	..
Cork	" 29	1,868	+ 139	13	5,669	— 60	9·89	..
Dublin	" 30	23,543	+ 740	13	75,139	+ 1,020	54·25	..
Hastings	" 25	3,629	+ 910	..	10,534	+ 1,951	19·3	..
Lancashire United	" 28	7,364	+1,236	13	2[illegible],954	+ 1,905	42	..
Llandudno-Col. Bay	" 30	749	..	17½	3,160	— 92	6·5	..
Anglo-Argentine ..	" 25	109,619	−4,462	13	607,791	− 1,531	..	..
Auckland	" 9	21,53	+ 624	36	193,408	+ 3,471	26·59	..
Calcutta	" 24	18,140	+ 607	..	..	+ 1,213	..	..
Kalgoorlie, W.A. ..	Dec	2,894	..	52	31,432	..	20.5	..
*Madras	Mar. '6	2,277	+ 157	..	12,540	+ 881	..	..
Montevideo ..	March	31,979	+ 23	..	157,394	— 1,030	..	..
Dublin-Lucan Rly.	Mar. 29	488	+ 57	13	1,503	+ 47	7	..

* Two weeks.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, April 11th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	"	£64	..
a Bisulphide of Carbon	"	£23	..
a Borax	"	£38	..
a Copper Sulphate	"	£61 10	30/- dec.
a Potash, Chlorate	per lb.	2/6	..
a " Perchlorate	"	2/-	..
a Shellac	per cwt.	195/-	..
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers ..	"	£32	..
a " Lump	"	£23	..
a Soda, Chlorate	per lb.	1/-	..
a " Crystals	per ton	120/-	..
a Sodium Bichromate, casks ..	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c " Tubes (solid drawn) ..	"	..	..
c " Wire, basis	"	..	..
c Copper Tubes (solid drawn) ..	"	1/9 to 1/9½	½d. inc.
g " Bars (best selected) ..	per ton	£174	..
g " Sheet	"	£174	..
g " Rod	"	£174	..
d " (Electrolytic) Bars ..	"	£151	..
d " " Sheets ..	"	£176	..
d " " Wire Rods	"	£159	..
d " " H.C. Wire	per lb.	1/7	..
f Ebonite Rod	"	3/-	..
f " Sheet	"	2/6	..
n German Silver Wire	"	2/3	..
h Gutta-percha, fine	"	6/10	..
h India-rubber, Para fine	"	3/2	½d. dec.
i Iron Pig (Cleveland warrants) ..	per ton	Nom.	..
l " Wire, galv. No. 8, P.O. qual.	"	£38	..
g Lead, English Pig	"	..	..
g Mercury	per bot.	Nom.	..
e Mica (in original cases) small ..	per lb.	6d. to 8/-	..
e " " " medium	"	3/6 to 6/-	..
e " " " large ..	"	7/5 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/10	..
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	"	..	..
n " Wire, Nos. 1 to 16	per lb.	3/3	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

A Gas Engineer's Views on Electricity.—In the course of his presidential address at the annual meeting of the Scottish Gas Managers' Association, in Glasgow, Mr. Chas. Fairweather (Kilmarnock), dealt with a variety of topics, including the development in electricity supply. This, he said, had brought the gas industry from what was practically a monopoly down to the level of a competitor, and who would say that the change was not for the good of the industry? A monopoly at all times tended to conservatism, and that might gradually merge into a state of repose inducing a peace which did not willingly seek for struggle. Immediately the development of electricity supply became an accomplished fact, readjustment of gas supply methods was the result, and to-day in all large cities and industrial communities the two industries progressed side by side. There was no question that each had its sphere, and that each had its limitations, and this was amply proved by the fact that within the same community both businesses might be simultaneously developed and increased. In thickly populated industrial districts central stations for electricity supply would be laid down, and current distributed to the surrounding areas at the lowest possible cost for all purposes, and if gas supply was to maintain its place, this was the form of competition which it would be called upon to face. A factor which handicapped, to a certain extent, the gas business, was that small works already existed, and were scattered about, each undertaking a small radius of supply, whereas, electricity being a younger industry, stations had yet to be put down, and the position of these stations could be so chosen that a large district could be taken in. At present it was the case that, in large districts with a number of small gas undertakings, these were being absorbed, and this had been largely brought about by high-pressure distribution of gas, making it possible to stretch out long lines of mains and supply from a central works.

Disabled Fighting Men.—The Manchester City Council has decided that facilities shall be afforded to discharged disabled soldiers and sailors, who are attending the Manchester Technical School for Electrical Instruction, to receive practical training in the working of distributing sub-stations at the Polygon sub-station by the staff of the electricity department.

MUNICIPAL ELECTRICAL PUBLICITY.

By E. P. HOLLIS, A.M.I.E.E., A.Am.I.E.E., M.MiningE.E.

The real object of a municipal electricity supply is not the mere supply of electrical energy, it lies much deeper than that. The policy of municipal electrical supply is based upon adding to the convenience of the community and the prosperity of the industries within the municipal boundaries through a cheap and widely available supply of electrical energy.

Recently it has been announced that one of our large cities has decided to organise a municipal publicity department in connection with its electrical undertaking, and the writer in commending this example proposes to outline his views upon the work lying before such a department.

Prior to the war municipalities had kept themselves clear of any extensive measures of publicity. If anyone wanted electricity he could have it if he cared to approach the department and was near the mains. If he were not in close proximity to the distributing system, he had a struggle to get a mains extension. But the municipalities which realised that an intensive application of electricity within the homes and industries inside their boundaries was essential to the prosperity of the community, were few and far between, and fewer still were those which realised that the only way to attain the maximum prosperity which accrues from electrification was to create the consciousness of a need for electricity, which consciousness could not arise spontaneously, but could only originate from a carefully planted seed.

Pre-war electrical publicity was amateurish, half-hearted, and far from meeting the needs of the community. It was not directed by experts sufficiently technical either in publicity or engineering, which deficiencies militated strongly against the success of any publicity efforts, however well intended.

The care of the health, the improvement in the environment, and the general amelioration of the conditions of its rate-paying workers will, in the future, surely be a charge upon the municipality's endeavours, and it is a matter of certainty that, in the post-war social reorganisation, measures will be taken for the amelioration of the conditions of the workers. Amongst those measures electrification will loom large, but it will only loom sufficiently large if those on whom the decision rests to introduce electrification are themselves completely informed of what can be done by electricity.

Of what avail is it for a municipality to spend huge sums of money on parks for giving fresh air to its workers when it allows thousands of laundry operatives within its area to be slowly poisoned, and to have their health undermined by gas-heated irons? Such unfortunate conditions could be removed by a strong endeavour on the part of the municipality in the direction of a conversion to the electric iron—not through compulsion, be it noted, or anything smacking of compulsion—but by sheer weight of conviction brought about through adequate education of the laundry proprietors, backed, if necessary, by conducted visits to similar, but electrically-operated, establishments in other parts of the country.

Why should a municipality see its industries wane, or be out-distanced by competitors, either abroad or at home, because the management of that industry are ignorant of improved methods of manufacture, possibly by the utilisation of electricity? A municipality must fight for itself, and the success of its industries is equally important to the municipality as to the shareholders of those industries themselves.

One of the most urgent problems to be tackled is one originating from the war. The war has revitalised British industry. It has compelled the introduction of new methods and new machinery, and, in addition, has brought about the laying-down of large factories devoted solely to the manufacture of war material. With the end of the war, the process of converting these plants to other purposes will have to be undertaken. They cannot be allowed to stand idle, and they will ultimately be converted to new manufacturing processes in which electricity ought to figure prominently. It can only figure as prominently as it ought if the municipality is in a position to show where electrical plant (not merely plain motor drive) can be successfully employed, be that plant fans, welders, heaters, refrigerators, ozonisers, or any of the host of electrical devices and processes applicable to industry. It is within the knowledge of every intelligent person that electricity has wrought improvements in cheapening production, in making certain processes possible which, without electricity, would be impossible, and in the amelioration of the conditions of the workers. That knowledge, however, is scantily spread. and there is a woeful ignorance in the factory, shop, and home of what electricity can do. How is that ignorance to be dispelled? There is only one way—publicity.

By publicity I do not mean that system of circularising bills, catalogues, and newspaper advertisements which usually constitutes the be-all and end-all of the publicity methods of many electrical undertakings. I mean the organisation by each great municipality of a Publicity Department in the charge of trained engineers, equipped technically from the publicity and the engineering points of view, for the purpose of tackling every home, shop, and industry in the area, and of assuring that the industries and homes are equipped with every form of electrical plant which can profitably be utilised, that they have the best electrical apparatus available, that the apparatus is economically used, and that the electrical manufacturers are encouraged to produce apparatus satisfactorily for the industries.

Naturally, the most important duty of the Municipal Electrical Publicity Department would be to furnish evidence to its consumers, potential and existing, of the economy and practicability of plant they might be advocating.

To this end it would be necessary to enlist the sympathies of other municipal electrical undertakings whose consumers might have had experience in the working of similar plant, and in those cases resort would frequently be made to the practice of conducted visits to factories in other areas (if evidence were not available at home) for the purpose of convincing the potential consumer.

The department would necessarily be directed by an engineer, thoroughly technically trained and reinforced by experience in heavy power work, as well as of the domestic consumer, and with experience in the electrification of various industries. It would be folly to go to, say, a cement works to advocate electrification if the publicity engineer were not conversant with the requirements of the works, whether, for instance, the circumstances demanded, say, some form of totally-enclosed motors, whether the starting torque of the various operations demanded squirrel-cage or slip-ring motors, and other similar information. Not only that, but the department must be in a position, not only technically, but from the point of view of standing amongst other Corporation departments, to prevent the installation of a plant on lines which would not be successful. A publicity man knows that a failure of this description is difficult to counterbalance.

As a further example, the Publicity Department would see that the engineer who went down to talk rolling-mill electrification was equipped with evidence and information which would permit him to talk on an equality with the mill manager, so that he would not be floored by questions emanating from a manager of conservative opinions and inclined, through his up-bringing, to the steam drive.

Naturally, a very important part of the publicity department's activities would be the collection of evidence and information regarding costs and forms of drive, and so forth. in connection with various industries in the area, so that not only would they be able to convince their own manufacturers, but they would be able, if their co-operation were invited, to convince manufacturers on the mains or other municipalities, which assistance would be reciprocated.

The preparation of literature in connection with the various campaigns would occupy a portion of the department's activities, but the department would not make literature, as many are inclined to do, the main battering ram, but would supplement it by other methods of publicity, including demonstration, for instance, in one form or another. Electrical publicity literature has in the past been of little use. It rarely offered conclusive evidence of the facts it sought to prove, and was not written specially for the class of customer to whom it was addressed.

Amongst the department's duties would figure prominently the collection of early information regarding new electrical plant, and its endeavours would be directed towards securing the trial of any promising plant on its own mains. The reputation of a department would largely depend upon the fulfilment of its statements, and its engineers would have to be competent to see that nothing but satisfactory plant was advocated. The department would organise the teaching of the use of electrical plant in schools, when the mind of the students would be more receptive to this essential education, and the scholars would prove excellent canvassers amongst their parents.

Such a department would, without a doubt, largely increase the sale of electrical plant in its area, and it would be a power for good amongst manufacturers from this point of view. British electrical apparatus has been dear in the past, owing to the comparatively small orders which have been placed at one time with the manufacturer, but by increasing the demands in one's own area and by co-operation in the matter of ordering with other municipalities, no doubt collective orders could be placed with the manufacturer with the object of bringing down prices. Be it noted that the encouragement of the home electrical industry is a matter of national importance. In the past, many municipalities have looked upon the purchase of electrical plant as a simple business proposition. They have bought the cheapest, came it from Germany, America, or Switzerland, and Britain has paid dearly for the discouragement thus given to home electrical industry. A large home demand is the foundation stone of the British electrical industry, and can only be created by efficient and widespread electrical publicity.

The attraction of new industries to its area by the offer of facilities is an important item of the Publicity Department's scheme, and this work demands the service of expert engineers. Some municipalities advertise their sites available, but as many of the new industries will involve the continuous use of electricity in quantity (or may if they are sufficiently well informed on the abilities of electricity) for smelting and similar purposes; the task of procuring tempting electrical terms from the electric supply undertaking, and offering them to the industries concerned, is work for the Publicity Department. The Publicity Department would find internal as well as external necessity for its propaganda. The municipal electricity department requires to be kept up to the scratch in the matter of adopting new developments just as much as the outside consumer.

The domestic side of electrical publicity has in the past been largely misdirected, and new methods must be adopted by a department conversant with modern publicity methods. Every consumer must be systematically tackled in the right way—not by sending out leaflets with the quarterly bills, or by a very occasional visit from a canvasser; but, for instance, by regular visits from a well-bred and specially trained lady canvasser sufficiently tactful not to push where pushfulness was resented, but capable of educating a consumer's wife—taking months over it if necessary—to a knowledge of what electricity can do for her.

On the shop side publicity has been dead. Electric lighting falls into the municipality's lap like ripe fruit, but the use of small motors in shops for refrigeration, coffee roasters, electrical advertising devices, and so forth, has had scanty attention. "It is not worth our while," I have heard it said when I have asked municipal electrical engineers why they did not prosecute a campaign for, say, electrically driving bacon-cutting machines. It is true that the few pence a week which would accrue in revenue would be negligible, even if every provision shop in the city were equipped with an electrically-driven machine, but a publicity department would know that every electrical machine in a shop was a standing advertisement of electricity beheld by thousands of customers weekly, and with skilful publicity would bring home to these customers more than anything else the advantages of electricity.

One of the earliest things to be tackled by the publicity department would be the splendid opportunity (of which no one seems to have thought) of revenue from electrically lighted signs on tramcars, and they would, in the first place, use such signs for advertising their own ware—electricity.

One word about the financial arrangements. Publicity pays for itself over and over again. The most successful industrial concerns are those which indulge in successful publicity, but not only the municipality but also the electrical manufacturer would benefit from the department's activity. In fact, manufacturers would benefit doubly—from the sale of the electricity consuming apparatus itself and from the plant orders necessary to supply the demand. Would it then be too much to ask the manufacturers to make some contribution to the cost of the campaign? Would it not be unreasonable for the manufacturer to refuse? That matter must be carefully kept in mind in budgeting for the department.

I conclude by summarising my propositions: A properly established Publicity Department, reasonably financed and efficiently staffed, would have an important bearing on the industrial efficiency of the municipality, which efficiency would show itself in the amelioration of the conditions of the industrial and domestic workers, in the attraction of new industries to the city, and in the maintenance of the position of existing industries by keeping them well acquainted with modern electrical developments, and in making itself instrumental in securing the adoption of the new methods.

Such a municipal publicity scheme ought to be supplemented by a national propaganda. In the section of *Eclipse or Empire* on electrical engineering, which the writer contributed, was advocated, *inter alia*:—

"The inauguration of an extensive and efficient propaganda by a competent electrical authority (Institution of Electrical Engineers, or British Electrical and Allied Manufacturers' Association), amongst householders, manufacturers, colliery engineers, steelworkers' engineers, and other potential users of electricity."

Such a propaganda would prove a most useful auxiliary to the municipal endeavours.

Our nation has been charged with industrial backwardness in the past. The State equally with the municipality has never considered industry; it must do so in the future, and much encouragement might come from the municipality, which can deal with its industries with a familiarity and a directness which must be absent from State efforts. That encouragement must come from an understanding and competent source, and as far as electricity can aid industry, the encouragement would come best from a Municipal Publicity Department organised on the scheme outlined.

The matter is not one for post-war considertion. We have been too late in many things, and now is the time to frame the organisation for taking up its work on the tide of opportunity.

REGISTRATION OF BUSINESS NAMES.

The war has given rise to a number of curious Acts of Parliament; but of these, there is none more remarkable, and not many of greater importance, than that which provides for the registration of firms, which came into full force on March 22nd. In view of the fact that the Act is not very easy to understand, a legal contributor has, at our request, supplied the following exposition of its terms:—

Speaking broadly, the object of the Act is to compel persons either to carry on business under their true names, or else to register in such a way that the public shall be enabled to ascertain the names of the persons concerned.

The gist of the Act is to be found in Sec. 1, which provides that the following firms and persons having a place of business in the United Kingdom shall be registered, *e.g.*:—

(*a*) Every firm carrying on business under a business name which does not consist of the true surnames of all partners who are individuals, and the corporate names of all partners who are corporations, without any addition other than the true Christian names of individual partners or initials of such Christian names.

(*b*) Every individual carrying on business under a business name which does not consist of his true surname without any addition other than his true Christian names or the initials thereof.

(*c*) Every individual or firm who, or a member of which, has either before or after the passing of this Act (*i.e.*, December 22nd, 1916) changed his name, except in the case of a woman in consequence of marriage.

These are the broad rules. It will be noted that they do not touch the case of a man carrying on business under his own name, or that of a firm or partnership where all the names are fully disclosed in the title of the firm. Regard must be had to Sec. 22 of the Act, which contains certain important definitions. Thus "firm" means "an unincorporate body of two or more individuals, or one or more individuals, and one or more corporations, or two or more corporations, who have entered into partnership with one another with a view to carrying on business at a profit, but shall not include any unincorporated company which was in existence on November 2nd, 1862" (*e.g.*, the London & North-Western Railway Co.). It is clear from this that a limited company is not included—unless it is associated with an individual or another company. The term "business" includes profession.

To the rules above stated there are certain exceptions provided by Sec. 1, of which these are the more important:—

(1) Where the addition merely indicates that the business is carried on in succession to a former owner of the business, that addition shall not of itself render registration necessary; (2) the addition of an "s" where two or more partners have the same surname does not render registration necessary (*e.g.*, Robinsons).

The time for registration is prescribed by Sec. 5. The necessary particulars must be furnished within 14 days of the commencement of the business; but if the business was carried on before the Act (December 22nd, 1916), or was commenced within two months of that date, the particulars must have been furnished after February 22nd and before March 22nd. Where, however, after February 22nd the conditions affecting the firm ceased to be such as to require registration, then the firm need not be registered.

This means that a *locus pœnitentiae* was given by the Act to existing firms. They were enabled by changing the name on their billheads, &c., prior to February 22nd to escape registration.

Sec. 3 describes the particulars to be sent when applying for registration. They consist of (*a*) The business name; (*b*) the general nature of the business; (*c*) the principal place of the business; (*d*) (in the case of a firm) the Christian names and surnames, and the nationality, usual residence, and other business occupation (if any) of each partner, and, if the nationality is not the nationality of origin, the nationality of origin, and the corporate name and registered office of each corporation which is a member of the firm; (*e*) (in the case of an individual) similar particulars to (*d*); (*f*) where the registration to be effected is that of a corporation, its corporate name and registered or principal office; (*g*) if the business was commenced after December 22nd, 1916, the date of commencement.

If a business has two or more names they must all be registered.

Having regard to this Section, it will be seen that the register is likely to provide a large amount of information to parties interested. The wily Teuton who is carrying on business under an English name will stand revealed to the world. The sleeping partner will be roused from his slumbers; while the creditor of a firm with a large "shop window" and small assets will be able to ascertain the home address of each partner to the better enforcement of a judgment by execution.

The particulars given must (by Sec. 4 of the Act) be signed by the individual or each of the individual members of a firm, as the case may be. In the case of a corporation, they may be signed by the secretary or a director, but in that case they must be supported by a statutory declaration.

The Act does not prohibit any change in the name of a firm; but where any change is made in any of the particulars registered in respect of any firm or person, such particulars must be registered within 14 days after such change (Sec. 6).

Default in registering may involve a penalty of £5 *per diem* so long as the default continues (Sec. 6), but the possible infliction of a penalty is by no means the only unpleasant consequence which may follow upon non-registration. The civil rights of the individual or firm may be seriously affected.

Thus by Sec. 6, where default is made in making a statement of particulars for registration, "the rights of that defaulter under, or arising out of, any contract made or entered into by, or on behalf of, such defaulter in relation to the business in respect to the carrying on of which particulars were required to be furnished at any time while he is in default, shall not be enforceable by action or other legal proceeding, either in the business name or otherwise." The Court may, however, in a proper case (as where, for instance, non-registration arose through inadvertence), grant relief against this clause, but no such relief can be granted if the other party proves that, had the Act been complied with, he would not have entered into the contract.

To give an illustration: A firm of Brown, Jones and Co. sells goods to Robinson. Robinson, sued for the price of the goods, alleges that the plaintiff firm was not registered at the date of the contract. If the plaintiffs could prove that they failed to register by accident, the Court might disallow the defendants' defence on terms as to costs. But if Robinson could prove that the firm of Brown, Jones and Co. really consisted of J. Schneider and A. Hindenburg, naturalised Germans, and that he would not, in any case, have contracted with a German firm, the defence would be good.

It is to be noted that non-registration does not *protect* a firm from actions at law; but if such an action is brought, the fact that the defendants are unregistered will not prevent their setting up a counter-claim or set-off as an answer to the action.

It is not to be supposed that mere registration will be a sufficient compliance with the Act. The legislature requires something more. By Sec. 18, after March 22nd every individual and firm required to be registered must "in all trade catalogues, circulars, showcards, and business letters on or in which the business name appears, and which are issued or sent by the individual firm to any person in any part of His Majesty's dominions, have mentioned in legible characters" name, Christian name, former Christian names and surnames, the nationality if not British, and the former nationality if the nationality is not the nationality of origin.

An up-to-date billhead will have to be as follows:—

Snooks & Co., Ironmongers.

Benjamin Moss (British) (late Benjamin Mosenstein, German).
Francis Brown (British) (late Fritz Braun, German).
William Taylor (British) (late Wilhelm Schneider, German).

This edifying superscription will not, it is conceived, tend to increase the home trade of Snooks and Co.!

So much for the general provisions of the Act. It will be seen that, like many sumptuary laws, it may be useless in many cases, and hard upon individuals in others. In numberless instances the composition of the firm is of no concern to anyone dealing with it. The man whose name is on the signboard has long since passed away; and his credit and reputation have been well and worthily maintained by those who now conduct and profit by the business. The mere revelation of names or nationalities in such cases is of little value to anyone. Again, for purely private or family reasons with which the public has no concern, a man may prosecute his calling under a *nom de plume*. But, in the main, and having regard to its principal object, the Act will be productive of good. The man who is about to deal with a limited company can go to Somerset House and acquire a deal of information as to its probable solvency; similarly, the register of firms can be used to discover whether it is really in the hands of respectable and responsible men.

Not the least important section of the new Act is (Sec. 14), which deals with the use of misleading business names. Your German who was practising the methods of peaceful penetration before the war was but too apt to adopt the magic word "British," in order to foist his goods upon an unsuspecting public. In future, if this or any other word is used so as "to lead to the belief that the business is under British ownership or control, and the Registrar is satisfied that the nationality of the persons by whom the business is wholly or mainly owned or controlled is at any time such that the name is misleading," he may refuse to register it, or remove it from the register. Appeal lies to the Board of Trade, whose decision is final.

THE FUTURE OF THE BRITISH X-RAY INDUSTRY.

At the meeting of the Röntgen Society on April 3rd, a discussion took place on "The Future of the British X-ray Industry." It was opened by Mr. Geoffrey Pearce, who pointed out that before the war German X-ray and electro-medical apparatus was imported in large quantities into this country, and into the Colonies. The official trade returns of Germany showed that the total exports of electro-medical and electro-dental apparatus in 1912 amounted to £177,400, and in 1913 to £228,200. In 1912, Austria-Hungary was the largest importer, and the United Kingdom the third largest, with £14,000 in 1912, which increased to £19,000 in 1913. It had been estimated that 50 per cent. of the apparatus used in this country was foreign. So far as workmanship was concerned, foreign-made apparatus was no better than that which we could produce ourselves, but one reason for its predominance might be that new appliances had not, as a general rule, originated in this country, but elsewhere. We had, in fact, followed the lead of the Germans and of others. The application of the alternating-current high-tension transformer combined with a chemical or rotating rectifier, for instance, was the result of the work of Koch, of Dresden, and improvements by Snook, of Philadelphia. The Coolidge tube was the work of an American, and it had a German rival in the Lillenfeld tube. Hitherto in this country it had not been possible to produce in sufficiently large quantities to develop the industry on proper lines, or to employ a trained staff who would be occupied mainly upon investigation and research. Such research could not be undertaken by individual manufacturers, but should be part of a properly organised plan, the benefits of which would be enjoyed not only by the manufacturers themselves, but by the users of the apparatus. Another very important point was propaganda and publicity. A means should be found of attracting the attention of radiologists from all parts of the world to this country. That strenuous competition would have to be faced in the future was unquestionable. Quite recently a consignment of X-ray tubes formed part of a prize seized by the British Navy. Although consigned from a neutral country, there was no doubt that they originated from an enemy manufacturer, showing that even at the present time Germany had enough tubes for her own use, and some available for export. The Americans also had big factories, and there had recently been a fusion of interests in the United States, four large companies being formed into one corporation. Canada used almost entirely American-made apparatus. So important had this field become that one American house was making arrangements to open offices in that Dominion. Preferential protective tariffs by themselves would not open such fields to us.

Prof. A. W. Porter said that the only means of carrying out research was by some kind of combination between different firms. There was already provision in any physical laboratory in England for the proper training of men to undertake research work, but, of course, the actual final training could only be given in the works themselves, and was outside the scope of any academic institution.

Mr. R. S. Wright said that the real obstacle to British enterprise before the war was not the manufacturer of apparatus, but the user of it. When a hospital was about to have a new electrical installation it had been the habit of the medical officer in charge to tour the Continent in order to see what was in use in the hospitals there, and then he recommended the continental installation. There was a feeling among British doctors that they must adopt everything that German doctors adopted, and if a British manufacturer showed any originality his invention could never be taken up until the German doctors had endorsed it. The average German doctor, on the other hand, had it firmly in his head that it was his business to keep German manufactures uppermost; he was as keen upon it as was the German manufacturer himself.

Dr. C. R. C. Lyster thought that it was only by a combination, not only of the manufacturers themselves, but of the manufacturers with the academic scientists, and with the actual medical users of the apparatus, that progress could be hoped for.

Sir James Mackenzie Davidson said that he did not think it would be the case in future that we should refuse to accept any new thing until it had received a German endorsement. The German X-ray tube, they must admit, had had a superiority over those made elsewhere, but our American cousins—our Allies now—had made a tube (the Coolidge) which would hold its own against any German tube, or any other, for many a day.

Captain G. W. C. Kaye said that in pure physics the British had more than held their own, but on the applied side they had been less in evidence, and had done not much pioneer work. What was wanted was a laboratory to which manufacturers could go with some assurance that their difficulties would be met and studied in a sympathetic spirit. A laboratory of that sort was too great a luxury for the individual firm.

Mr. Cuthbert Andrews said that at present there were in this country a small number of separate firms, some of them very large as businesses went nowadays, each working independently for a comparatively small clientèle. Up to now there had been little or no co-operation, and, therefore, no chance of economising or simplifying production so as to enable these firms to compete properly in the world market. How could such methods hope to succeed against the huge concerns of Germany and America with their standardised apparatus, large output, experimental facilities, and world-wide representation? The British conditions were not wholly due to lack of enterprise. The X-ray industry was a young one, and, "with one or two redeeming exceptions," its conduct was in the hands of young men, any one of whom would scrap his present methods and establishment to-morrow if he could see his way clear to reorganisation on a more efficient system. Up to now the difficulties in the way of such reorganisation had been very great—some financial, some sentimental, "and some dyspeptic"—but there was now a chance of such an understanding between electro-medical firms as would enable them not only to give a vastly better service to customers at home, but also to conduct a vigorous campaign in the colonial and foreign markets.

Dr. G. B. Batten fell foul of the opener for his statement that nearly all the practical ideas came from abroad. This was not the case. They came from England; they were rejected in England, taken up abroad, and then came back again. There was naturally a commercial distrust of the inventor. Not only was this true with regard to X-ray apparatus, but with regard to most other things. Manufacturers were generally so frightened of the crank that they rejected the ideas of the inventor without adequate examination.

The discussion at this point was adjourned until the next meeting, on May 1st.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Insulating the Lead Sheathing of Cables.

Adverting to the notes by "G.W.S." on page 387 of your last issue, relative to "Bonding and earthing the lead sheathing of underground cables, &c.," I should like to mention that the idea of trying to maintain an insulated condition on the lead sheathing of cables laid on the solid system has been attempted on many occasions with, so far as I can learn, no permanent success.

Apparently, it will be news to "G.W.S." to know that many years ago a company was formed in this country to lay bare conductors in stoneware troughing on the solid system; hoping to maintain the necessary insulation of the conductors by this means, and thereby avoid the cost of individually insulating and sheathing the conductors in the factory. So far as I am aware, the success of the company lasted as long, or, should I say, as short, as the life of the insulation of the conductors laid on this system.

From this it would appear advisable for "G.W.S." to spend his time in devising some economical means of keeping the lead sheathing insulated before developing any scheme dependent thereon.

A. R. C.

Fault Localisation.

The only practical method I see of locating a fault on V.I.R. cables under the conditions described by Mr. Sommerville in your issue of March 30th is to use the telephone test.

No test depending on drop of potential can be of any value, as the fault resistance does not remain constant, and the results, if any are obtained, are most misleading.

A short time ago I had a similar fault in a V.B. three-wire feeder, and after trying several drop-of-potential tests without result, I located the fault by the following method:—

The two faulty cables were connected together, and a current of 4 amps. was passed through the cables to earth, and interrupted with a pair of carbons. The ends of a coil wound with 220 yd. of No. 22 s.w.g. bell wire were connected to a telephone receiver. The coil was carried over the length of faulty cable, and a distinct click was heard every time the current was interrupted. This click continued until the fault was reached, and then the click disappeared.

I have used this method on several occasions to locate earths and shorts, in some cases where the fault resistance was high, with currents as low as half an amp., and only once been led astray.

R. W. H.

Combination Plug and Adapter.

We are interested in seeing your notice, on page 374 of your April 6th, 1917, issue, showing the combination plug and adapter put on the market by Messrs. Simplex Conduits. We are very pleased indeed to see this combination put forward by Messrs. Simplex, and that they have found a use for it.

We are particularly pleased as this particular arrangement, without the chain, was patented by the writer and his brother, the two proprietors of this business, in October, 1889, which patent also covered the ordinary B.C. adaptor now in general use. These goods were manufactured in 1889 and for some following years by Messrs. Crompton and Co., under licence, and sold to the trade by them, but unfortunately the demand for such accessories was not large enough at that time to warrant the maintenance of the patent, and it was allowed to lapse after a few years.

The writer has at the present time the original adapter made, and also samples of the first new patterns.

We should like to congratulate Messrs. Simplex on the addition of the chain, which makes the combination, we think, particularly suitable for the purpose for which they have re-introduced the combination.

Donovan & Co.
G. D.

Birmingham, *April 5th*, 1917.

WAR ITEMS.

Controlled Works.—The total number of controlled establishments is now 4,802.

Exports to China.—The "London Gazette" of April 3rd contains further lists of persons and bodies in China and Siam to whom exports may be consigned.

To be Wound Up.—The Board of Trade has ordered the following further companies to be wound up under the Trading with the Enemy Act:—

United Machine Tool Co., Ltd., 24, Southwark Street, London, S.E., dealers in machine tools. Controller: E. W. Lean, 19, Coleman Street, E.C.

Wedmore Engineering Co., Upper Holloway, N., manufacturers of machine tools. Controller: E. W. Lean, as above.

Ramsay Marine Engineering Co., Ltd., 11, Long Acre, W.C., dealers in marine inventions. Controller: T. D. Hawkin, Whitehall House, Charing Cross, S.W.

German Electrical Industry.—The following passage is extracted by the British Empire Producers' Organisation from a recent article in the *Frankfürter Zeitung*, discussing the position and prospects of electrical manufacturing, one of Germany's most treasured industries. We quote from the Organisation's *Empire Trade Notes*:—

It appears that on an aggregate capital of £36,390,000 the principal companies paid for 1915 an average dividend of 10½ per cent., as compared with a little over 9 per cent. in 1913 and 1914. *But the profits increased* from £3,873,250 in 1913 to £4,223,000 in 1914, and £5,181,350 in 1915, and as there is no excess profits tax in Germany, large sums are being appropriated towards supporting the resumption of export trade after the war. The comments of the *Frankfurter Zeitung* deserve serious attention:—

"More than any other German large-scale industry, the electrical industry was characterised, already before the war, by enormously extended works and by a carefully organised financial system which spread its net over half the globe. The industry thus became one of the strongest of the pillars on which German industrial expansion rested, but, because of its international interests, it offered many points of attack in a time of crisis like the present. Yet the industry has not only withstood the onslaughts made upon it, but has actually improved its financial position. The remarkable nature of this achievement becomes apparent when it is borne in mind that the industry is cut off from some of its important foreign interests, that these very interests have been endangered by a ruthless policy of persecution, and that the industry has been almost completely deprived of a branch of its activity which is vital to it, viz., its export trade.

"The industry has achieved its successes by reconstructing itself for purposes of war work. The enormous factories, with their exemplary organisation and their hosts of skilled workers and technical specialists, have become indispensable centres of war activity.

"But while the net profits have been high, the dividend rates have not been commensurate with them. This is due—

"1. To the very large sum required for war relief to workers:

"2. To the need for heavy reserves to cover factories abroad, foreign securities, and foreign claims;

"3. To the necessity for laying by sufficient sums to make good the wear and tear of machinery which the war has worked at exceedingly high pressure; and

"4. To maintain the strong financial position of the industry, which alone will enable it to organise itself on a fresh peace basis, and to win back the spheres of influence at present attacked by the hate-engendered business policy of Germany's enemies.

"It is of the utmost importance for the economic position of Germany after the war that large-scale industries like the electrical industry should make far-sighted provision for the future. The disparity between net profits and the dividends actually paid to shareholders in the electrical industry is really evidence of strength."

Exemption Applications.—At Wakefield, Mr. H. England, manager of the local tramway company, appealed for a substation attendant, married, 24 years of age, passed for general service. The Osset Local Tribunal had dismissed the case, reporting that the man had been in his present employment only a short time, and had previously been in a hosier's shop, and they held that another man could do his work. It was resolved to adjourn the case so that the Wakefield Local Tribunal could deal with it.

At Ramsbottom, an overhead linesman for an electrical power company (25, married, C 1), was given temporary exemption to July 1st. It was stated that only one other linesman was left.

At Farsley, the Morley Electrical Engineering Co. appealed for H. Moore (25), foreman armature winder, and L. Bell (34), draughtsman, who both were engaged on work of national importance, and had certificates from the Ministry of Munitions. Both were put back till June 30th.

An appeal was made to the Hants. Appeal Court, by the Aldershot & District Traction Co., against the local decision of one month final to Mr. A. E. Webster (31), secretary to the company, but the appeal was disallowed. The company also appealed for A. J. Chitty, foreman engine fitter, and he was given six months, with leave to appeal again.

At Weston-super-Mare, extended exemption was sought by Mr. W. J. Badman (37, Class B 1), trading as W. J. Badman and Co., electrical engineer, Bristol and Weston-super-Mare. He stated that he was rejected eight times, and was doing guard work with the Bristol University Volunteers. He expressed willingness to go if he had time to dispose of his stock at Bristol. The appeal was dismissed, the calling-up being suspended for six weeks.

Before the Dorset Appeal Court, further exemption was sought by Messrs. Brooking & Co., electrical engineers, of Weymouth, for T. H. Escott (28), electrical engineer, who has to attend to electric appliances at the local factories, breweries, laundries, hospitals, &c. The borough electrical engineer (Mr. J. H. Bolam) supported the appeal, and exemption until September 30th was granted.

At Mansfield, a review was made of conditional exemption granted in May last to Mr. Stanley Dudman (30), resident manager for the tramways since June, 1915. Mr. Walker, a director of the company, said that he did not know where they could get a substitute. The exemption was withdrawn as from April 21st.

An appeal for further exemption was made at St. Thomas (Exeter) for Mr. H. M Gale, electrical engineer in charge of the Topsham electric supply station. It transpired that a Mr. Murphy, who had been exempted on condition that he would act as a substitute for Mr. Gale, had told the directors of the company that he was unable to do so, and that he could only work at the station two days a week, as before, as he had his own business to attend to. Mr. Gale was granted until May 1st, and it was intimated that if Mr. Murphy was not prepared to act as a substitute the Military would challenge his exemption.

After a review, the Ryde Tribunal has allowed conditional exemption to stand in the cases of F. A. White (25), fitter and engineer, and H. F. Joliffe (26), wireman, both on the staff of the Isle of Wight Electric Light Co., Ltd.

At Taunton, the borough electrical engineer appealed for H. H. Morrish (18), premium pupil at the electricity works, who is in charge of a night shift. His time under the indentures expires on May 24th, and the Tribunal granted exemption until May 27th.

At Chesterfield, renewed exemption was sought by the T.C. for a stoker engaged at the electricity works. The borough electrical engineer, Mr. R. L. Acland, said that the man was absolutely essential, and could not be replaced by a woman. Conditional exemption was conceded.

The East Kent Appeal Court has granted conditional exemption to Mr. A. C. Wampach (38), chief electrical assistant at the works of the Folkestone Electricity Supply Co.

At Goring, an appeal was made by the Whitchurch and Pangbourne Electric Light Co. for the retention of J. L. Rushby (18), electrical engineer apprentice, and he was granted until July 23rd to enable him to complete his indentures.

At Dover, Mr. Carden, borough tramways manager, sought exemption for W. Cowan (39), tramcar body maker and repairer. The Tribunal gave conditional exemption until a substitute is obtained.

The Dartford U.C. appealed to the Local Tribunal for exemption for E. Botten, on the electric light staff. The Military Representative admitted that the man was clearly in a certified trade, but he urged that it was no longer in the national interest that he should remain in his present avocation. It was stated that for months efforts had been made to get a substitute through the Labour Exchange, and as it was probable that more and more current would be required, it would be a serious thing to take the man. Conditional exemption was allowed.

Windsor Tribunal have granted conditional exemption to Mr. R. G. Watson, of the electric light works staff, claimed to be indispensable.

At Stratford-on-Avon, a review was made of the case of A. L. Smith (27, in Class A), electrician, on the staff of the local electricity company. The case had been referred for substitution, and a representative of the company said that recently the staff had been still further reduced, and applications for a substitute had been unavailing. The Tribunal conceded six weeks' exemption.

At Weston-super-Mare, appeals were made by the Electric Supply Co., Ltd., for Messrs. W. H. Brooker (31), chief assistant engineer; T. Bees (41), fitter and driver; W. G. Richards (26), chief clerk and cashier. The two former were conditionally exempted, and Richards was refused exemption.

At Southport, R. Cranshaw (18, general service), was appealed for by his father. The Military Representative said the youth's trade card certified that he was apprenticed to an electrician, but at the time of the National Registration he was a book-keeper and clerk. He asked the Tribunal to refuse the application, and let the applicant fight it out on his trade card. A communication on the subject had been sent to the War Office. The youth said he was apprenticed to an electrician in August, 1915, but his employer went out of business last June, and he was then employed by his father until the previous week, when he went to work at Liverpool, and got his trade card. The application was not granted.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

4,311. "Carriers for securing shades to electric lampholders." J. Macey. March 26th.

4,335. "Starting switches for electric motors." British Thomson-Houston Co. & J. Sugden. March 26th.

4,336. "Systems of electrical control." British Westinghouse Electric and Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.). March 26th.

4,341. "X-ray localisation." Sir J. M. Davidson. March 26th.

4,356. "Electric lamps." A. F. Berry. March 26th.

4,370. "Electric ignition devices." W. O. Kennington. March 26th. (U.S.A., April 19th, 1916.)

4,405. "Electrical marine depth-indicator." E. A. S. Swinson. March 27th.

4,418. "Electric arc lamps for projection purposes." A. E. Angold, A. H. Railing & M. Solomon. March 27th.

4,427. "Wireless telegraphy and telephony." G. Marconi. March 27th. (Italy, March 28th, 1916.)

4,445. "Electric pocket lamp." F. D. M. Gordon. March 27th.

4,456. "Diaphragms for talking machines, telephones, &c." H. A. McInnes. March 28th.

4,464. "Lanterns or fittings for incandescent electric lamps." Wardle Engineering Co. & H. T. Wilkinson. March 28th.

4,479. "Switch apparatus for electric pocket lamps, torches, &c." Efandem Co. & A. H. Williams. March 28th.

4,480. "Electric connection between cells or batteries and bulbs of electric pocket lamps, torches, &c." Efandem Co. & A. H. Williams. March 28th.

4,481. "Storage of dry cells and batteries." Efandem Co. & C. H. Stephenson. March 28th

4,485. "Magnetic ship raising apparatus." H. Buckland. March 28th.

4,488. "Catenary suspension of conductors for transmitting and transforming electrical energy simultaneously for use on railways, &c." W. H. Course & H. J. Guise. March 28th.

4,493. "Magneto of the type comprising a rotating shield." Soc. des Moteurs Salmson (Système Canton-Unné). March 28th. (France, May 10th, 1916.

4,506. "Electric signalling systems." L. Fokes & R. Lambourne. March 28th.

4,511. "Starting and lighting apparatus for automobiles." J. Bethenod. March 28th. (France, March 21st, 1916.)

4,526. "Electric flashlamps." C. R. Hall. March 29th.

4,532. "Electric artificial horizon." S. Trounson. March 29th

4,568. "Electrically-operated toy, &c." P. Hayman & W. V. Morten. March 29th.

4,580. "Electric transformers." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). March 29th.

4,588. "Electrodes for electric arcs for medical, &c., purposes." J. C. Round. March 29th.

4,595. "Electric lampholders and cord grips." H. Garde. March 29th.

4,629. "Means for securing shades and globes to holders of electric lamps." H. F. Wheeler. March 30th.

4,644. "Magnetos." W. L. Gullette & C. A. Vandervell & Co. March 30th.

4,651. "Means for rendering water radio-active." T. T. Baker & G. E. Heyl. March 30th.

4,652. "Sparking plugs." V. Perrett. March 30th.

4,659. "Control of electric mechanism." E. H. Hobday and Mann, Egerton & Co. March 30th.

4,661. "Telegraph systems." Automatic Telephone Manufacturing Co., S. R. Smith & R. Woodland. March 30th.

4,662. "Electrical apparatus." International Electric Co. & H. E. R. Roose. March 30th.

4,666. "Battery indicating devices." Domestic Engineering Co. & A. E. White. March 30th.

4,676. "Electric primary batteries of cells." J. W. Warr. March 31st.

4,679. "Electrical switches." J. Roberts. March 31st.

4,683. "Electric wall socket." B. F. J. Studd. March 31st.

4,694. "Sparking plugs." R. Henry & E. Herrmann. March 31st. (France, April 1st, 1916.)

4,698. "Junction connections for telpherage or runway systems." D. Riley. March 31st.

4,701. "Incandescent electric lamps." F. Harrison & J. J. Russell. March 31st.

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1,550. Protective Devices for Alternating Current Electric Systems. A. E. McColl. February 2nd. (Cognate application, 10,227/16.) (104,518.)

1,787. Form of Junction Box or Sleeve for Wire-armoured Electrical Cables. F. H. Davies. February 7th, 1916. (104,520.)

3,346. Dynamo-electric Machinery. H. F. Joel & J. H. St. H. Mawdsley. March 6th, 1916. (104,535.)

3,795. Contact Apparatus for the Electrical Connection of Magnetos. E. J. J. Salmson. March 14th, 1916. (104,553.)

3,796. Interrupting Device for Magnetos. E. J. J. Salmson. March 14th, 1916. (104,554.)

4,335. Ionic Gas Relays or Detectors. S. G. Brown. March 23rd, 1916. (104,566.)

4,733. Protective Devices for Alternating Current Electric Systems. A. E. McColl. March 31st, 1916. (104,571.)

7,733. Electric Starting Systems for Internal-combustion Engines. Bosch Magneto Co. June 12th, 1915. (100,684.)

8,393. Electrolytic Cells. H. C. Jenkins, H. F. Pattinson & R. Wellesley. June 14th, 1916. (Addition to 25,415/13.) (104,600.)

8,499. Electrical Turning Gear for Starting Internal-combustion Engines. F. H. Royce & Rolls-Royce, Ltd. June 16th, 1916. (104,602.)

9,607. Method of and means for Code Telegraphy. F. B. Dehn (Martens, R. C. H.). July 7th, 1916. (104,618.)

12,616. Automatic Telephone Systems. Automatic Telephone Manufacturing Co. (Automatic Electric Co., U.S.A.). September 6th, 1916. (104,640.)

16,157. Mechanical Retarding Device applicable to Electric Supply Meters. British Westinghouse Electric & Manufacturing Co. December 18th, 1915. (102,937.)

16,944. Construction of Electric Switch. G. Markt. November 25th, 1916. (104,655.)

17,786. Electric Telephones. L. G. Hammer. December 11th 1916. (104,659.)

1917.

2,281. Way of Mounting Cams in Magnetos. E. J. J. Salmson. March 14th, 1916. (Divided application on 3,796/16.) (104,668.)

Russia: Great Electrification Extension Foreseen.—The Russian engineer, P. Gurievitch, writing in the *Viestnik Finansoff*, on the metallic requirements of Russia, makes the following observations in respect of copper, &c.:—"A great consumer of metals, particularly of copper, will, amongst others, be the electrical industry, for which naturally a brilliant time is expected after the war, when the need for working cheaply and economically will be extreme. This will become possible within existing narrow limits chiefly by the electrification of factories and works, railways, &c., by the use of water power, brown coal, and so on."

THE
ELECTRICAL REVIEW.

VOL. LXXX. APRIL 20, 1917. No. 2,056.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: April 20, 1917. [No. 2,056.

Page
Wayleaves 421
Support Hackney 422
The E.T. Benevolent Institution 422
The Bakerloo—L. and N.W. Watford Extension (*illus.*) ... 423
Lighting Energy at Power Rates.—The Hackney Action ... 425
A Linking-up Scheme: Accrington, Haslingden, and Rawtenstall (*illus.*) 426
The Supply of Electricity to Greater London 427
The Electrical Equipment of Motor Garages 429
The National Service of the Press 430
National Insurance (Part II., Munition Workers) Act, 1916 431
New Electrical Devices, Fittings and Plant (*illus.*) 431
Correspondence—
Johannesburg Cable Trouble 432
Municipal Electrical Publicity 432
Boiler-House Operation 433
Fault Localisation (*illus.*) 433
The I.E.E. Nominations 433
The Electrical Trades Benevolent Institution 434
War Items 434
Business Notes 435
Notes 438
City Notes 440
Stocks and Shares 442
Wayleaves, by C. Vernier 443
Aluminium Production by Electrolysis, by R. Seligman ... 446
Substitution in Electricity Works 447
Foreign and Colonial Tariffs on Electrical Goods 447
New Patents Applied for, 1917 448
Abstracts of Published Specifications 448
Contractors' Column ... ... Advertisement page xx

THE ELECTRICAL REVIEW.
Published every FRIDAY, Price 4d.
The Oldest Weekly Electrical Paper. *Established 1872.*
TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE :—4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.
Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

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4, Ludgate Hill, London, E.C. 4.

WAYLEAVES.

FROM the moment that the linking-up of electrical undertakings came to be generally discussed after the reading of Mr. E. T. Williams's paper before the I.E.E. last spring, a discussion on the subject of wayleaves and consents became inevitable, and we desire to extend our congratulations to the Council on organising one last week, and on securing an introductory paper by such a well-known authority as Mr. C. Vernier, of the Newcastle Electric Supply Co. We may say at once that the paper is one of great practical importance, in that it contains an unchallengeable statement of the wayleave difficulties of the electricity supply authorities, and, in addition, it contains constructive proposals which would give effect to the scheme outlined in our columns on November 10th, 1916.

We should add that the discussion was worthy of the occasion, and the whole incident shows what great help the I.E.E. can give to the industry when it occasionally departs from purely technical subjects. No criticism of Mr. Vernier's proposals was forthcoming. This in itself was a striking testimony to the well-balanced judgment of the author, and a practical endorsement of the action of the Council in awarding, in advance, the Paris Premium to him. It was a graceful act on the part of our tactful President, Mr. Sparks, to make the announcement of the award after the discussion.

It is of no use disguising the fact that the discussion took place under a shadow. It is common knowledge that importance evidence on the subject of wayleaves was given before the Electrical Trades Committee appointed by the Board of Trade, under the chairmanship of Sir Charles Parsons, and it is believed that the Committee reached some very definite conclusions on it. It would be interesting to know why the Committee has not yet officially reported to the President of the Board. Again, rumour has it that the delay is not in any way due to lack of unanimity among the members, and so we feel justified in joining in the demand that the report should be forthcoming as soon as possible. It is bound to be epoch-making when it appears, and we cannot help surmising that its non-publication is in some way connected with the formation of the further Committee under Mr. Huth Jackson.

It is obvious that the findings of the two Committees mentioned, and of the various other Board of Trade Committees, will require much legislation to give them effect, and there may be controversies over principles as well as details. For these reasons, we fear that Mr. Sparks was too optimistic in predicting the coming of compulsory wayleaves within two years as part of a general Bill dealing with electrical matters. It may be, of course, that the present Government intends to give electricity priority over other domestic legislation during the war in view of the importance of saving coal.

Fortunately, there are no real differences of opinion among electricity supply authorities as to the need of compulsory wayleaves. The matter is exceedingly urgent in view of the large extensions which are being planned in various parts of the country in readiness for after-the-war conditions, and particularly in connection with big linking-up schemes, such as the one in Lancashire and Cheshire. After much reflection, we have come to the conclusion that the suggestion thrown out in the discussion by Mr. A. J. Stubbs—Assistant Engineer-in-Chief of the G.P.O.—should be followed up and forcibly urged on the Board of Trade, not as a permanent measure, but as a provisional one for helping the industry along until more extensive legislation can be undertaken. The request would be that the Board of Trade should make good the promise of necessary legislation in the well-known Saving of Coal and Linking-up Circular of May, 1916, by putting through, this Session, as a Government measure, a short Bill on similar lines to the Telegraph Construction Act of 1916. We think it should contain a provision that a final decision *must* be given within three months of negotiations for wayleaves or consents being commenced with the owner of the land or with the local authority.

The Board of Trade may possibly say that all urgent cases can be dealt with under the Defence of the Realm Acts, but electricity supply authorities know that landowners have long memories, and that it is preferable to proceed by less arbitrary methods. In any case, this procedure would not be available immediately after the war, when they expect to be really busy connecting up deferred customers. We desire, therefore, to urge full and immediate consideration of this matter by the I.E.E., the I.M.E.A., and the I.A.E.P.C. with a view to joint representations being made to the Board of Trade.

In conclusion, we trust that our readers will not grudge us the feeling of satisfaction that comes from having consistently called attention to the wayleave problem in electricity supply work, and the further feeling that a solution of it is rapidly coming into the realm of practical politics in the near future.

Support Hackney.

We publish elsewhere in this issue a spirited article by a central-station engineer (not in the London area), in which he draws attention to the failure of the municipal electricity supply undertakings of the kingdom to come to the support of the Hackney Borough Council in its fight with a powerful gas association. It will be remembered that at the annual conference of the I.M.E.A. last year, Mr. H. Faraday Proctor recommended the case to the members, and a resolution was passed pledging the Association to support the Council, with evidence and money; since then, the matter has been laid before the local electricity committees, with a view to the formation of a substantial guarantee fund, but so poor has been the response that, we believe, the total amount so far promised is less than £1,000. This is a very discreditable showing, and we fear that the local authorities have not appreciated the very great importance of the matter, not only to their undertakings, but also to their industrial consumers. Briefly put, the question at issue is whether the supply of electricity for lighting purposes at the rates charged for power is lawful, the contention of the gas association which has instituted the proceedings being that the practice constitutes a form of preferential tariff, in contravention of the Electric Lighting Acts. We cannot here enter into the merits of the question, which is *sub judice*, but we hardly need point out to readers conversant with the circumstances under which such terms are granted that a very strong case can be made out for this practice on technical grounds, that there is no element of unfairness in its working, and that power users will be put to serious and unnecessary expense if it is declared illegal, at a time when every assistance and encouragement ought to be afforded to them in the national interest. We should have thought, with our contributor, that in such a case the municipal authorities would have rallied to the support of the Council which is fighting their battle, and we must confess to a feeling of disappointment and regret that so few of them have realised the importance of the matter. It is not too late to make amends—and we may point out that in the highly probable event of victory for the Council, the guarantee fund will not be largely drawn upon. True economy is laudable; but to refrain from supporting so good a cause is not economy, but parsimony, and calls for the severest censure.

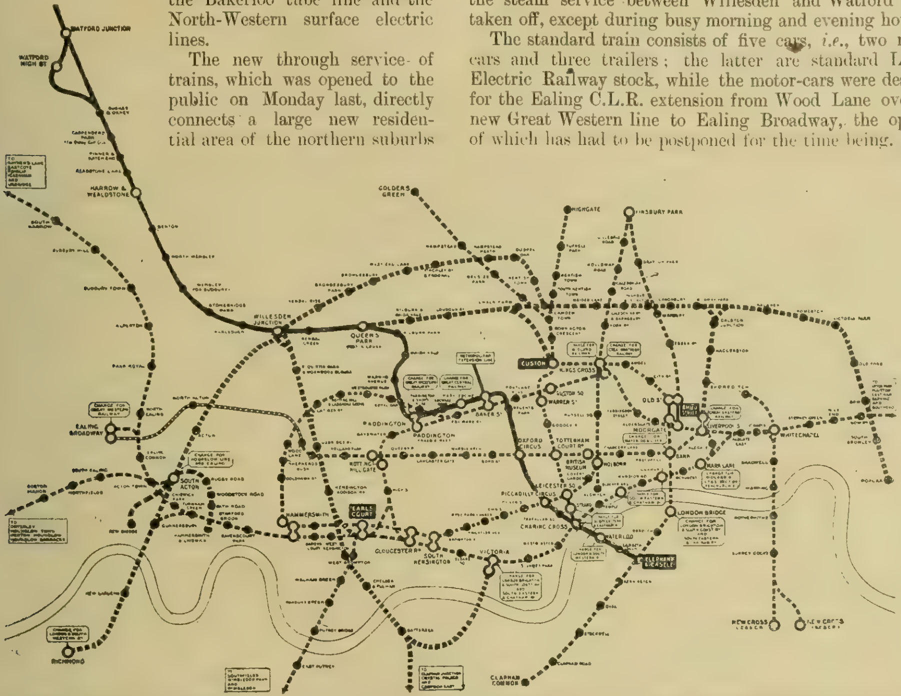
The E.T. Benevolent Institution.

Thanks to the abundance of opportunities for employment resulting from the war, the Electrical Trades Benevolent Institution experienced fewer calls upon its resources last year than in 1915, and we are glad to note that the subscriptions of members and annual subscribers increased; but the figures reveal the regrettable facts that the membership is still far below what it ought to be, and that the Institution has received but scanty support from the industry by way of donations since the Festival fell into abeyance. Now, as was pointed out at the annual meeting (reported elsewhere in this issue), the electrical trades have been exceedingly prosperous during the war, and it is only reasonable that this admirable Institution should share in their prosperity; it is in the sunny days that provision can and should be made for the rainy days of the future, and we commend to the directors of thriving electrical concerns the suggestion that it is their moral duty to support the Institution liberally, and to bring its merits to the notice of their employés. The capital fund, which is destined to provide for pensions, still falls short of £9,000—it should be raised to at least £20,000, and that quickly, for no one knows how soon the end of the war may throw a burden upon the Institution. We appeal to our readers to help in providing for the needs of their poorer brethren, both by contributing to the funds and by advertising the Institution as widely as possible—for there must be thousands who are not yet aware of its existence, objects, and advantages.

THE BAKERLOO—L. & N.W. WATFORD EXTENSION.

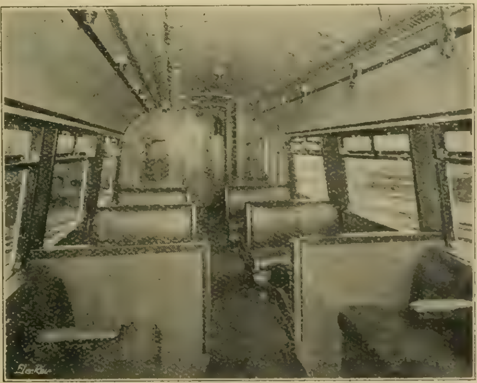
On Friday last we were privileged to take part in a trial run over the Bakerloo—Watford electric line, which, as no doubt many of our readers are aware, is a joint enterprise of the London Electric Railways and the London and North-Western Railway, the service having been rendered possible by the physical junction at Queen's Park between the Bakerloo tube line and the North-Western surface electric lines.

The new through service of trains, which was opened to the public on Monday last, directly connects a large new residential area of the northern suburbs with the extensive Underground system of London; incidentally it will give passengers using the L. & N.W.R. system a direct connection with the terminal stations at Paddington (G.W.R.), Marylebone (G.C.R.), Charing Cross (S.E. & C.R.), and Waterloo (L. & S.W.R.).



The London Underground Railway System, with the Bakerloo-Watford (L. & N.W.) Section (shown solid).

Bakerloo Train on the Watford Route.



Interior of Motor Coach.

The extended service gives the Bakerloo trains a run of nearly 21 miles, with 30 stations on the route, two of which on the L.N.W. section are, however, temporarily closed; for the present the Bakerloo—Watford trains will also not stop at Maida Vale and Regent's Park, and during the rush hour period other Bakerloo stations will be omitted, with a view to giving a quicker run and relieving the trains of a certain amount of local traffic.

The full journey will take about one hour, and a quarter-hourly service will be provided, with 72 trains in each direction. The inauguration of the new service will enable the steam service between Willesden and Watford to be taken off, except during busy morning and evening hours.

The standard train consists of five cars, *i.e.*, two motor-cars and three trailers; the latter are standard London Electric Railway stock, while the motor-cars were designed for the Ealing C.L.R. extension from Wood Lane over the new Great Western line to Ealing Broadway, the opening of which has had to be postponed for the time being.

It will be seen that the motor-cars are provided with a hovered vestibule at the trailing end, and that middle doors ave been fitted. The control of the latter is similar to that in connection with the new stock for the Queen's Park extension.

This is the first tube stock to be run in passenger service on a main line, and provision has had to be made to enable passengers to get on or off at the stations on the L. & N.W line which have platforms of the standard main line height. This has been done on the trailer cars by superimposing a raised platform on the existing gangways of these cars. It has been possible to do this without encroaching on available headroom, owing to the open character of these gangways. The closed vestibule has prevented any similar provision being made on the motor-cars.

The number of seats in the motor-cars is 32, and in the trailer cars, 52; the seats of the motor-cars are upholstered in red pegamoid, and in the trailer cars, in moquette, but some of the cars will enter service with the original rattan seats.

Motor Coach Employed in the Bakerloo–Watford Service.

The interior steel panels of the motor-cars are painted a light brown to tone in with the colour of the mouldings, &c., which are of teak or steel, painted to match; the lamp fittings and ends of cross seats are finished in oxidised bronze; other fittings are of aluminium alloy. The exterior colour of the cars is lake, with white upper panels and gold lettering.

With regard to ventilation, in addition to the ordinary drop lights, an air duct with perforations runs the whole length of the car, and is open to the air at the ends.

The cars are constructed of steel, with some wood interior finish.

The motor trucks are of the equaliser bar type, with helical springs; the framing is built up of mild-steel rolled sections.

The trailer trucks are built up of pressed steel sections, and are fitted with laminated side bearing springs.

The motor-cars were constructed by the Brush Co., and have a length overall of 47 ft. 9 in., while the weight of car completely equipped is—motor end, 21⅛ tons: trailer end, 9⅛ tons: total, 30¼ tons.

The total weight of a 5-car train (unloaded) is 110 tons.

The brake equipment is of Westinghouse type, with improved triple valves on the motor-cars and quick-acting triple valves on the trailers. The brake blocks are of unchilled cast-iron. The air compressor is of the B.T.H. C.P. 28A type.

All the cars are fitted with emergency electric lights, supplied from accumulators carried on the motor-car, and arranged to automatically switch on in the event of the main supply of current failing at any time.

Electric current at 600 volts D.C. will be supplied north of Queen's Park to Bakerloo trains from the L.N.W.R. power house at Willesden (see Elec. Rev., Aug. 11th, 1916).

As the C.L.R. system employs an earth return, while the L.E.R. system employs an insulated return, it has been necessary to modify the equipment of the motor-cars accordingly.

For this purpose, two additional sets of shoe gear have been fitted on the motor-trucks, one on either side. On the trailer-truck of the motor-car there was insufficient clearance below the sole-bar of the body to fit positive shoes, so that these have had to be arranged on the truck of the adjacent L.E.R. trailer-car, and connection made to the motor-car by means of jumpers.

Other points in the conversion from earth to insulated return were the provision of negative switches and fuses to the main circuit and each of the auxiliary circuits. In doing this care was taken to reproduce the standard arrangement of London Electric Railway wiring, so that, electrically, the difference between the two types of stock should be confined to the control equipment.

The control equipment supplied by the B.T.H. Co. is of the relay automatic type. The normal method of operation with this system is to place the controller at once to the full-on position when starting a train. The contactors are then picked up in their correct sequence by the current limit relay, which operates as soon as the motor current has dropped to a predetermined value.

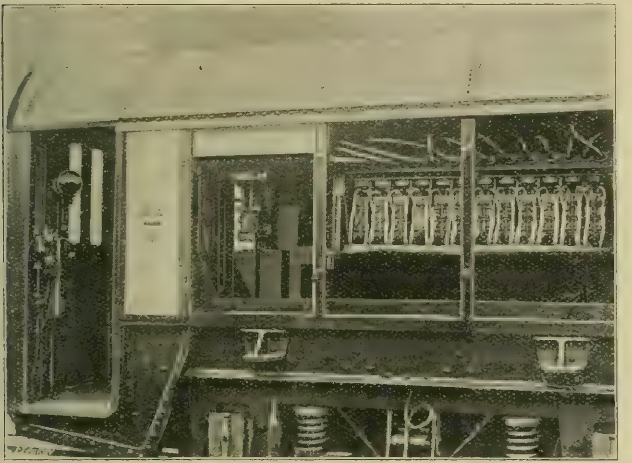
The relay consits of two shunt and one main coil. The latter carries current equal to that of one motor only. The actuating coils of the contactors are energised through one or other of the two shunt coils in such a manner that, if one is energised through one shunt coil, the next one to close will be energised in series with the other shunt coil. The two relay shunt coils act on two plungers controlled by gravity. Each plunger, when in its lower position, closes a disk switch in series with the other shunt coil; but when raised (due to its coil being energised) opens this switch. Thus, when one of the plungers is raised, the shunt coil, acting on the other, cannot be energised because of the break in the circuit produced by the above-mentioned switch, but although it is the control current that raises the plunger, so as to produce this break, it is the current passing through the main coil which maintains the break, and the plunger is not released until this current has dropped to the pre-determined value. Then the plunger falls and closes the switch which completes the circuit for the next contactor coil to be energised.

Main Switchboard, Contactors, &c., in Motor Coach.

Raised Gangways to Equalise Difference in Platform Levels.

The principle underlying the method of control adopted in connection with the current limit relay is that, after a contactor has been picked up, as described above, its coil is immediately transferred (by means of interlocks) to another wire. There are thus essentially two operating wires, the picking up wire and the retaining wire (although other wires are introduced for forward and reverse, circuit-breaker setting, &c.

As there are no main bus lines down the train a potential relay is fitted on each motor-car, which drops all contactors on that car when the shoes lose current. This is necessary, because when no current passes through the main coil of the current limit relay it ceases to exercise its control over the rate of picking-up of contactors.



Switch Compartment, Motor Coach, with Side Panels Removed.

The controller has four forward points and two reverse (series only), of which Nos. 2 and 4 are running points, where all resistance is cut out.

A useful provision in the control is that if in the course of the automatic notching up the controller handle is brought back to the first or third notch, as the case may be, the automatic closing of contactors is stopped, but those already closed are kept up.

The working of the safety button on the controller handle differs from the L.E.R. standard in that the safety button can be released, except when the handle is at off position. If, however, the handle itself be let go, it flies back to off position, when current is immediately cut off and the brakes applied throughout the train.

Another safety device, which is now part of the standard L.E.R. equipment, is the control circuit governor. By interrupting the control circuits it prevents the train being driven forward unless the train pipe of the Westinghouse brake is charged with air and the tripcock is cut in.

Each motor-car is fitted with two G.E. 212 motors of 240 h.p., geared for a free running speed of 35-40 m.p.h.

LIGHTING ENERGY AT POWER RATES.

The Hackney Action.

[communicated.]

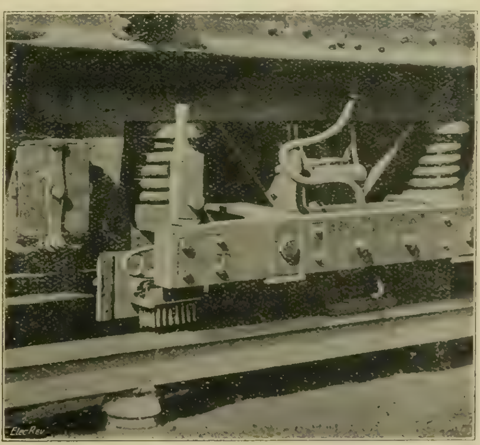
When the Gas Association decided to go for Hackney, we electrical optimists smiled, with the great big smile of the tiger when he sees his dinner walking the right way. As well as the gas men, we knew that all the pother was not for the benefit of Hackney, but that a verdict was wanted which would prevent factories from obtaining lighting energy at power rates. If the gas men win, our factories will require two sets of cables throughout, one for power and the other for lighting; a motor set up a hundred yards from the mains will require two sets of cables, one for the motor current and one for the lamp beside it. The silly change will require the expenditure of thousands of pounds for new wiring, money thrown away for nothing at all: and if it comes, it will hamper our trade in the coming struggle in a way that will make the Huns shout for joy.

We optimists thought of all that, and we watched for the instant response from the whole electrical industry. We knew that Hackney had nothing to fear. They were only the nominal object of the fight, and we—all of us—would see that they paid no more than anyone else—not a penny more. We knew the electrical industry, and we knew it would do its duty.

Then a strange thing happened. "It's a hard world," said the balloonist when he hit the ground, but not so hard as something is soft in the tops of a number of those who manage our affairs. Take the case of Bolton. Bolton Town Council received the Hackney appeal for support, and took no notice of it. Now, if it had been their football team that was in danger! Ah, that would have been another story. Meetings, processions, money, and everything necessary for fighting to victory there would have been, and in plenty. But it was only a half-million pound electricity works that was in danger, and the good of the town's industry. So these hard-headed, keen-as-mustard business men of Bolton received Hackney's appeal, doubtless recorded it on their minutes, and that was all. "What Lancashire thinks to-day, England thinks to-morrow." The Lord preserve us!

Then Hull. Hull is Yorkshire, and we all know that even the hard-headed Lancastrian yields to the man from Yorkshire. But Hull was not much better than Bolton. They have a half-million pound station which is growing in importance, but, judging from their response to the appeal, they think little of it. They gave something, to be sure, which is to their credit, but it is a small credit.

Other Committees have asked the Local Government Board, and have made the reply an excuse for doing nothing. As if they could not have voted it to their engineer as salary, and arranged for him to send it in his own name!

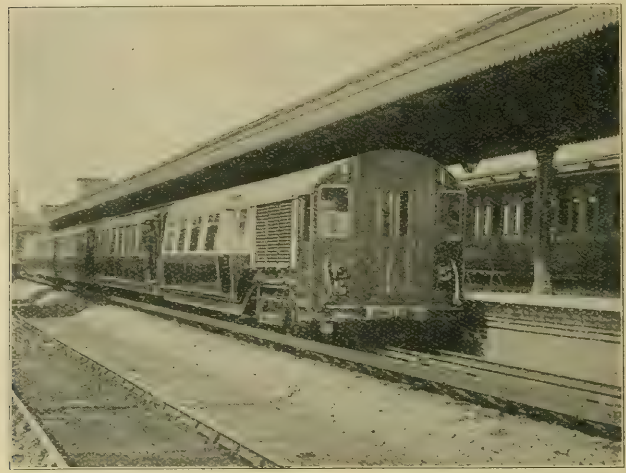


Sleet Brush Fitted to Truck, in "off" Position: Bakerloo—Watford Line.

You people who are standing by, idly watching Hackney fight your fight, like so many Conscientious Objectors, have you ever thought that it would pay Hackney and the Gas Association to come to terms secretly, so as to promulgate a verdict which would give the gas people all they want?

They could even make it well worth while for Hackney to accept such a defeat. Then you would be squealing just as hard as the Conscientious Objector who found that the Zep. had bombed his shop!

Come along, electrical men! Be yourselves, be British! The very gas men will respect you if you fight them. But if you will not stand up for your rights, and if you are beaten for lack of energy to defend yourselves, then in Heaven's name take your whipping, and do not whine and call the gas men nasty names.



The Bakerloo-Watford Extension: Train in Watford Station (see page 423).

A LINKING-UP SCHEME: ACCRINGTON, HASLINGDEN, AND RAWTENSTALL.

Considerable interest is being shown at the present time in linking-up schemes, and it may be of interest to set out some of the details of the arrangement which has recently been put into operation between the Corporations of Accrington, Haslingden, and Rawtenstall.

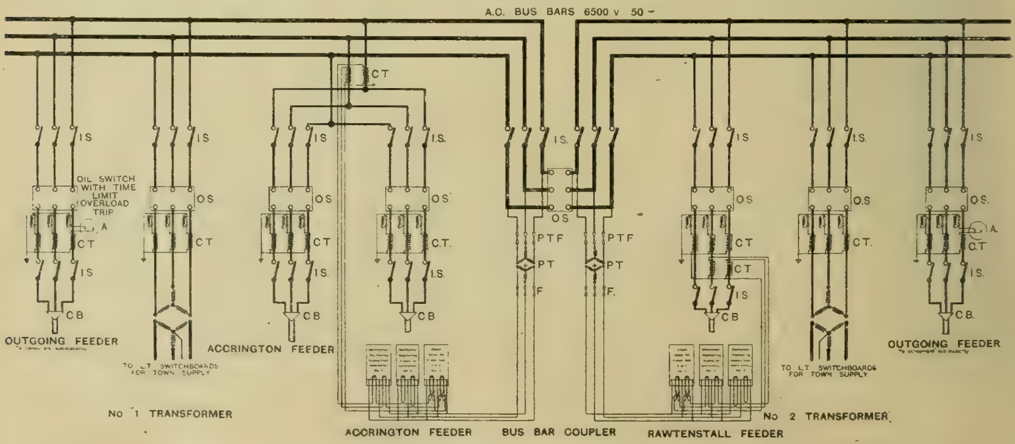


Fig. 1.—Diagram Showing Linking-up Connections.

Haslingden is situated about halfway between Accrington and Rawtenstall, and for the past five years has been served by a three-phase, 50-period, 6,000-volt alternating-current supply in bulk from the Accrington Corporation. The supply in Haslingden is distributed by that authority, and a number of important power consumers are now supplied from static transformer sub-stations, as well as from a three-phase, four-wire, low-tension alternating-current network in the centre of the town. A rotary converter is also provided to supply the tramway system.

Some few months ago it was decided to link up with Rawtenstall, which, fortunately, had the same pressure and frequency as Accrington, and by agreement between the three authorities, the cables and other works have been provided to give effect to this decision. Haslingden is at present taking about half its full requirements from each of the two generating authorities, and Accrington and Rawtenstall are placed in a position to be of mutual assistance to one another by means of the interconnecting mains. When necessary, of course, the whole of the Haslingden supply can be taken from one source. The arrangement is mutually beneficial to all three undertakings; Haslingden has the alternative of two supplies; Accrington and Rawtenstall can interchange power in an emergency or at light loads, and the interconnecting main is always in use for affording a regular supply to consumers in Haslingden and on the run of the main in Accrington and Rawtenstall.

The above arrangement is likely to be adopted wherever possible in the numerous linking-up schemes at present under consideration, as obviously it is most economical for interconnecting mains to be laid, not for emergency only, but to serve industries or towns on their route.

Under present circumstances it is not intended that the Accrington and Rawtenstall systems should regularly run in parallel, although the arrangement of the E.H.T. switchgear will enable this to be done, if found desirable, in the future.

The original supply from Accrington to Haslingden was by two feeders, each separately feeding a power transformer in the principal sub-station for local distribution, and an E.H.T. ring main to consumers' sub-stations. The low-tension mains from the transformers were brought to a three-phase, four-wire switchboard, and, by means of change-over switches, it was possible for either transformer to deal with the load. There was therefore duplicate apparatus throughout. This proved exceedingly useful when changing over to the new scheme, as it enabled all the alterations to be made without shutting down the supply. Fig. 2 illustrates part of the original arrangement, and fig. 3 shows the revised arrangement.

Under the new scheme it was necessary to group all the E.H.T. cubicles together, and connect them to a common set of bus-bars, the two Accrington feeders being arranged on one side, and the Rawtenstall feeder on the opposite side of a bus-bar coupler switch. One power transformer and one-half of the ring main feeder is connected to each side, as shown in diagram, fig. 1.

With this design it is almost impossible that a total interruption can occur in the supply to Haslingden, as each half of the E.H.T. switchboard can be used absolutely independent of the other half.

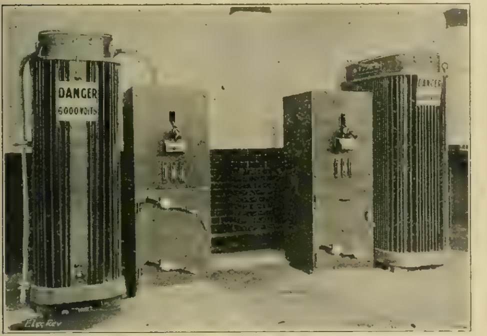


Fig. 2.—Original Feeder Switchgear, Haslingden.

The cubicles are equipped with the usual oil switches and isolators, together with the current and pressure transformers for operating the integrating wattmeters and automatic switches.

By reason of the necessity to obtain correct records, not only of the supply to Haslingden by either Accrington or Rawtenstall, but also of any interchange of supplies by the two generating authorities, special attention has had to be given to the meter equipment. Six unbalanced load wattmeters of the Aron type, with Merz maximum-demand attachment, are provided, one set of three being connected to the Accrington feeder, and the other set to the Rawtenstall feeder. Each meter is provided with a ratchet and pawl attachment to the gearing, so as to register the supply in one direction only, and one meter is used as a check against either of the other two.

It will be noticed from the diagram that each check meter is provided with a two D.P. non-break change-over reversing switches for the two current elements of the meter. With the switches in the top position, the current through both elements flows in one direction, and will check meter No. 1, whilst with the switches in the bottom position, the current will flow through the meter in the opposite direction, and check meter No. 2. In order to prevent the current transformer secondaries from being open-circuited, the switches are made of the non-break pattern.

There is no doubt that a metering arrangement of this kind presents some difficulties, especially when charges are based on the maximum demand principle, but these can be overcome by a little give and take on the part of the contract-parties, and are insignificant in comparison with the immense boon of interconnection.

The work has been designed and carried out under the direction of Mr. S. J. Watson, of Bury, the advisory engineer to the Haslingden Corporation; and the contractors for the E.H.T. switchgear were Messrs. Ferguson, Pailin & Co., Ltd. The E.H.T. mains between Haslingden and Rawtenstall were laid by the Rawtenstall Corporation, under the supervision of Mr. C. L. E. Stewart, borough electrical engineer.

THE SUPPLY OF ELECTRICITY TO GREATER LONDON.

[COMMUNICATED.]

The announcement made recently that the President of the Board of Trade, Sir Albert Stanley, has appointed a Committee to consider and report what steps should be taken, whether by legislation or otherwise, to ensure that there shall be an adequate and economical supply of electric power for all classes of consumers in the United Kingdom, particularly industries which depend upon a cheap supply of power for their development, will be welcomed by all who have at heart the satisfactory progress of the electrical industry. The members of the Special Committee selected for this great task are men of tried ability and great experience. The choice reflects credit on Sir A. Stanley, and we cannot doubt that such professional and commercial men as are closely connected with the development of the industry will seize the opportunity, and give freely of their best should they be called upon to give evidence or assist in so great a cause.

It is difficult to realise the importance and magnitude of the task undertaken, but no one knows better than Sir Albert Stanley the inevitableness of tackling the problem, and we can only admire the promptness which he has shown in setting the wheels in motion.

No one, who had given the least thought to the matter, questioned, even before the war, the far-reaching importance of providing even a small community with cheap light, heat, and power in convenient form for industrial and social purposes; but recent events have shown that not only the power of local communities to produce, prosper, and add to the comfort and welfare of the individual is at stake, but also the very existence of a State depends on the provision, in an adequate and far-seeing way, of the supply of electrical power at a low cost. We say electrical power advisedly, for although under certain doubtful circumstances it might be found that some other form could be produced and distributed more cheaply, yet the adaptability of electricity to the needs of the nation in her great trial has proved its right to the premier position. We have only to look at our munition factories to grasp the truth.

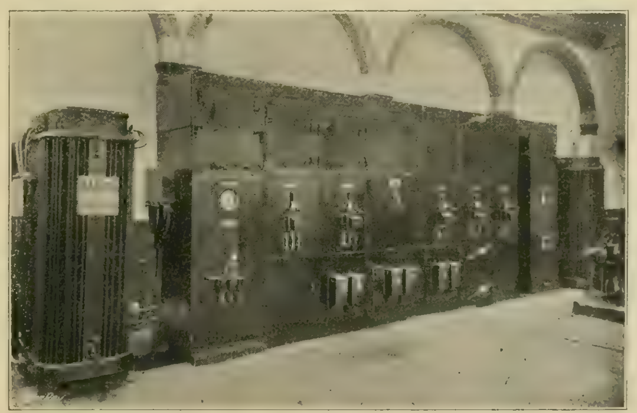


Fig. 3.—Re-arranged Switchgear at Haslingden, for linking up.

As part of the problem of providing electrical power to all parts of Great Britain, the question of a cheap and efficient supply to London will form a weighty factor. It is generally accepted that development in Greater London has been, in the past, most unsatisfactory. Although electricity has held out its helping hand to humanity since the early eighties, our Parliament, Government Departments, financiers, and engineers have brought forth to an uncomprehending community as sickly, ill-favoured, and ill-disposed a child as ever saw light of day. The child, ill-born, knows not itself nor its political parents, is wilful, perverse, and prone to fits, and the struggling millions who were to benefit so largely from this new gift of the gods "look up and are not fed." No doubt the new Committee in whose hands the welfare of the child will now lie, will diagnose the complaint and apply the proper remedy.

It is not difficult now to look back and see how the Electric Lighting Act of 1882, the original Act for granting Provisional Orders, has been, because of its narrow and limited conception, the great drag on successful development. In this Act the grant of the Order to companies or local authorities by the Board of Trade was limited to the too short period of 21 years, only to be extended by the Electric Lighting Act of 1888 to a period of 42 years. The local authority if not itself the owner of the Order would in 21 years be entitled to acquire the property of any company operating within its boundary. Neither Act legalised a standard pressure, or system of supply, and they may be likened to a measure giving powers to lay down in all parts of the kingdom and each district in London, railways differing from one another in track and loading gauge. The self-sufficient local authorities in London were thus set in their own water-tight compartments, and with the assistance of youthful and enthusiastic engineers evolved quaint schemes, interesting and to some degree instructive maybe, but carrying the seed of their own or their neighbours' ultimate destruction.

Sir Francis Marindin's inquiry, made at the instigation of the Board of Trade in 1889, into the questions as to whether lower pressure generating stations in the central districts would be, as compared with large high-pressure stations outside the central area, more economical, and as to the relative advantages of direct and alternating currents, resulted in both systems being established. The direct-current low-pressure undertakings were generally confined within parish or like boundaries, while the large alternating-current undertakings were given leave to compete with them over areas embracing many parishes, and generally the right of companies to combine was forbidden. Apparently this was the soft compromise so fatal to effective progress and development. Nevertheless companies were established, and commenced supply. The industry struggled along, weltering in this legislative soup, and it was found that by extending the area supplied and increasing the size of the power station, the cost of electricity could be reduced. In 1898 Parliament had many schemes before it for consideration, involving large scale supply in several parts of England. A Committee of both Houses, known as Lord Cross's Committee, was formed, and considered the matter. In their report they drew attention to the importance of electricity for power purposes as distinct from that of lighting, emphasised the advantage of generating on a larger scale than heretofore, and drew attention to the point that the supply of electricity in bulk and in retail were distinct questions.

In this year the L.C.C. and the local authorities within its boundary, in conference, decided that it would be desirable for the Council to supply to the local authorities electricity in bulk. This conference was the forerunner of various appeals to Parliament in 1902, 1903, 1904 and 1905, supported by the L.C.C., whose first important bulk supply scheme was introduced in 1906. The Bill of 1906 asked for powers to supply from Greenwich Power Station, in conjunction with a new station to be erected in Battersea, electricity in bulk to authorised distributors in the County of London, and in a large district outside. This Bill was thrown out by the Commons Committee on the ground of its being only permissive, whereas authorised distributors, it was contended, should be able to demand a supply if they required it. The Committee also disapproved of the proposed voltage of 6,600, and of the distribution scheme. They agreed, however, that the Council was the proper supply authority, and that they might either (1) do the whole work themselves, or (2), retain one part of the undertaking, and permit private enterprise to undertake the other part, or (3), lease the whole enterprise. A new Bill was prepared for 1907 to carry out the first recommendation, but after the elections in February of that year the policy of the Council changed, and the Bill was altered, so that a lease of the undertaking might be given to a private enterprise. The House of Commons Committee called for particulars of the terms of the lease and the name of the lessee, which the Council were unable to furnish, and the Bill was accordingly thrown out.

In 1908, the London Electric Supply Act came into force. This measure allowed nine of the London companies to connect their undertakings, in order to give mutual assistance, and empowered the L.C.C. to purchase the undertakings in 1931.

The Electric Lighting Act of 1909 authorised the Board of Trade to allow authorised undertakers to acquire land for generating stations compulsorily, or to supply in bulk, or to supply railways, &c., within their area with power to be used partly within and partly without the area, and, further, allowed linking-up to all authorised undertakers.

The London Electric Supply Act of 1909 included the remaining London companies within the provisions of the Act of 1908 as regards purchase by the L.C.C. in 1931.

Thus by 1909, the L.C.C., by its efforts, was charged with the responsibility of providing for the future an adequate and cheap supply of electricity in London.

In 1912, the Council referred the consideration of the whole matter to a Special Committee, presided over by Mr. G. H. Hume, one of the members selected for the Board of Trade Committee now formed. This Committee went into the matter most exhaustively, and just prior to the outbreak of war (in July, 1914) prepared their report, and submitted it to the Council in October of the same year. Its recommendations provided for the application to the whole of the London supply undertakings of a combination of municipal control and private operation, and suggested that "an arrangement might be made under which the capital required should be provided in definite proportions by the authority and a company, the company to have possession of the whole of the undertaking (including any undertakings acquired) for a definite period, subject to full powers of control and supervision by the authority." The scheme involved the co-operation of authorities outside the Council's boundary, and no compulsory purchase of existing undertakings was contemplated. As the report reads, "the key-note of the whole proposal is that an offer to the existing undertakings of a means of increasing the efficiency of their present undertakings, or, if they prefer it, an offer of a means of handing over their complete undertakings, upon terms to be agreed, to a central authority. Under the scheme put forward no immediate or drastic 'scrapping' of existing capital is contemplated, but a great increase in consumption and a reduction in the selling price will be effected at an early date."

Much water has passed under London Bridge, and the minds of all interested, both inside and outside the Council, have been steeped in the melting pot of the war since this report was written, and now, although the necessity for unification of general control and co-operation for all electricity undertakings within Greater London is freely granted, any successful scheme must, it is recognised, be freed from the paralysing effect of changing political influences, and be based on statesmanship of a high order and integrity. Although only a brief outline has been given of the development of the industry in London, sufficient has here been written to show that, patiently conceived and as patiently applied, measures will be required to counteract the ill-prepared plans of the past.

Let us hope that all who may be called upon to think, advise, and act on this great occasion so opportunely and so prominently offered, will remember one of the customs of our rude forefathers, which was periodically to burn in the person of their High Priest and King, the god they worshipped, in the hope that his spirit, having thrown off the paralysing coil of mortality, might return purified and strengthened with his sojourn in Spirit Land, and take up once more the work of material and spiritual assistance. Let us burn our old ideas, and seek guidance from a new and wider vision of duty, and a truer perception of the meaning of the new dawn; heralding a blazing day when all other motives will give place to co-operation of capital, brainwork, and labour for the realisation of the material and artistic wants of our race.

Whether the capital certain to be required be derived from the individual *viâ* the coffers of a public authority, or from the individual *viâ* the purse of a private company, will not be, we venture to think, a matter of such great importance as the consideration of the due control to be exercised by the consumers over those interests, which will naturally centre round a low tariff. The administration and organisation offering the customer the best result will, no doubt, be the one ultimately adopted. The tariff, we venture to prophesy, will be so arranged as gradually to eliminate those stations—be they municipally or company owned—which cannot show ability to produce for a considerable time ahead, electricity at a cheaper rate than it can be delivered to their terminals by an adjoining company or public undertaking.

We welcome the Committee, if only as giving a lead to those clear definitions of policy so much required in anticipation of our boys' return from the war, and the then necessity of finding them useful work with the least possible delay.

We hail the formation of the Committee with the greatest satisfaction, and wish it every success.

THE ELECTRICAL EQUIPMENT OF MOTOR GARAGES.

There is undoubtedly a good field for enterprise in connection with the use of electricity in public and private motor garages, especially in large garages where petrol cars are overhauled. For inflating tires, for instance, a small motor-driven air-compressor, mounted on a truck so that it can be transferred from place to place, is exceedingly useful. Compressed air can be utilised not only for inflating tires, but also for cleaning upholstery, although a portable motor-driven vacuum cleaner is, perhaps, preferable for the latter purpose. In large public garages it may be better to install a stationary compressor. This arrangement, however, involves the provision of a pipe system and a fair-sized storage tank. Some American motor garages have been equipped with compressed air plant of this kind, but unless compressed air is likely to be required at more than one place at a time, the portable equipment leaves little to be desired. The electric motor, in the latter case, is usually started with an ordinary starting switch, whereas in the case of the stationary equipment an automatic pressure regulator starts and stops the motor at predetermined limits of air pressure.

Portable electric tools—such as drills, buffing machines, and grinders—are also of considerable value in connection with the repair and renovation of cars, for with their aid, work, which under ordinary conditions is difficult and tedious, can often be carried out with comparative ease. With portable electric drills, for instance, holes can be drilled in awkward places, and a great deal of work in the way of dismantling may, in certain cases, be avoided. Many mechanical engineers still exhibit a distinct preference for compressed air tools, which, of course, have proved very reliable; but electric tools offer certain advantages. The wires which supply the current are more flexible and more easily handled than the pipes used for compressed air. Moreover, electric tools are more efficient. Portable electric tools are made in two distinct types. In one case, the motor is combined with the drill, or whatever kind of tool it drives, whilst in the other case the motor drives the tool through a flexible shaft. The merits and demerits of these two arrangements are fairly obvious. In the former case, the power of the tool is limited by the weight of the motor, which has to be lifted into position; whereas in the latter case, the weight of the motor does not count, since the power is transmitted to the tool through a flexible shaft. A motor of the desired power can be mounted on a truck, which can be transferred from place to place in the same way as a portable air compressor or vacuum cleaner, and any amount of power within the capacity of the motor can be supplied to the tool through the flexible shaft. But this arrangement is only really necessary when the work is heavy, the combination of the motor and tool being quite satisfactory for almost all motor-car repair work. Tools of the latter type are more efficient than those involving the use of a flexible shaft. Flexible shafting, though quite satisfactory from a mechanical point of view, introduces a certain amount of loss in power, and is less easily handled than a flexible cable or wire. In motor garages, and, in fact, everywhere where electric tools are employed, the use of substantial leads for the supply of current is very essential. The leads of electric tools are nearly always subjected to very rough treatment, and unless properly insulated a great deal of trouble is liable to arise. The C.T.S. wires are very suitable for electric tools, because they will stand any amount of rough usage. For wiring garages, moreover, these wires offer advantages, especially when a cheap wiring system is required.

The heating of motor garages is a very important matter, and in this connection there appears to be a good opening for the electric radiator. If a motor garage be imperfectly heated during the winter months, the water in car radiators and cylinder jackets is apt to freeze. With the ordinary methods of heating there is, owing to the presence of petrol, considerable risk of fire, and it is for this reason that electric heating is advantageous. So far, however, few motor garages in this country are heated in this manner. The heating arrangements in some cases, in fact, are very inadequate, with the result that when the weather is severe, freezing troubles are occasionally met with. Freezing of the cooling water often results in cracked cylinder jackets and other damage to the cooling system, so that adequate heating is very important. Of course, such trouble can always be avoided by draining the water out of the cooling system every time the cars are put away, but this is a troublesome job that ought to be avoided. One method of heating garages, which has been adopted in America, is to draw hot air by means of an electrically-driven fan from a stove situated in an adjoining building, but the most convenient method is to employ electric heaters. For private motor garages in which freezing troubles occur most frequently, electric bonnet heaters are made which answer the purpose admirably. Heaters of this description consume very little current. They are made for pressures ranging from 12 to 240 volts, so that they can either be worked from the house service or from an accumulator. If the engine bonnet be covered with a rug, the heat supplied by the apparatus is quite sufficient to maintain the temperature of the water well above freezing point; indeed, it is said to keep the water warm enough to maintain the oil in a fluid condition, and thus allow the engine to be easily cranked when the time for starting arrives.

Although many motor-cars are now fitted with dynamos that charge the accumulators en route, and separate battery ignition is rather out of date, a fair amount of accumulator charging still has to be done in connection with the motor industry. When the supply is a continuous one the cells are usually connected in series with lamps, but many garage proprietors have no means of charging from A.C. mains. Central station engineers and others who may undertake the electrification of motor garages ought, under these conditions, to get some sort of rectifier or motor-generator installed. A small mercury-vapour rectifier might be used with advantage. If, however, the accumulator charging business is small, and low initial cost is an important consideration, use might be made of a Nodon valve. Although these chemical rectifiers have been displaced to a large extent by mercury-vapour and mechanical rectifiers, they are cheap, and can be manufactured by anyone possessing a little mechanical skill. A motor mechanic could easily make one if told how to proceed. Mercury-vapour and mechanical rectifiers, however, are more satisfactory, and where a fair amount of accumulator-charging has to be done, either a motor-generator or one or the other of these rectifiers ought to be employed. The hot-cathode argon gas rectifier described some time ago in the Electrical Review may also eventually prove useful for charging cells belonging to motor-cars. The practical results obtained with this rectifier appear promising, but, so far, the apparatus has not been placed upon the English market.

In the future, electricity is sure to play an important part in the petrol car industry. Within the last few years, the electric lighting of cars has made remarkable headway, which is attributable very largely to the advent of the metallic-filament lamp. Half-watt motor-car lamps have recently been placed upon the market, but the candle-powers are at present too high for side and tail lights, and apparently they are intended for head lights. The introduction of these lamps should, however, considerably accelerate electric car lighting when normal conditions are restored. The starting of car engines by electricity has also been adopted within recent years, especially on American cars, many of which are now turned out complete with electric lighting and starting outfits. Not long ago the only part of a petrol vehicle that had any connection with electricity was the spark coil or magneto, and the average motor engineer knew little, and cared less, about electrical affairs. But the time appears to be coming when every large motor garage will require the services of an experienced electrician to carry out or supervise electrical repairs. Moreover, when electric vehicles are used more extensively, existing motor garages may be provided with charging arrangements. All electrical engineers recognise that if the electric vehicle is to make headway in this country, adequate charging facilities must be provided, and it seems that steps ought to be taken at the earliest opportunity to get large motor garage proprietors, in districts where there is likely to be a demand for current, to make arrangements for the installation of charging equipments on the standard lines recommended by the Electrical Vehicle Committee of the I.M.E.A.

THE NATIONAL SERVICE OF THE PRESS.

The United States Congress has recently rejected a proposal, embodied in the Post Office Appropriation Bill, for increasing the postage rate upon periodicals. In coming to this decision, Congress has shown consideration for some of the highest interests of the national life, and has set an example which might well be emulated by other Governments nearer Home. The American *Electrical Review and Western Electrician*, in commenting upon the matter, remarks that the taxation of journals in the manner proposed is not a matter affecting the publisher and subscriber alone, but one with which the nation, as a whole, is very closely concerned. "Many of the journals are a national asset of a high order, for they are doing a magnificent work in the service of the country." If this statement fairly applied in the case of the journals in the United States before it had actually accepted Germany's challenge, how much more will it do so under the actual conditions of war, and still how much more must it be so here, where journals of many kinds have acted during the war in such close co-operation with the Government, assisting it in its propaganda as new and serious situations have arisen. The Forces never could have conducted their operations on such a scale had not the assistance of the Press been availed of so freely. The publicity that has been given to requirements in such matters as finance, men, munitions, and food, has been of the greatest possible value, and it has been freely and efficiently accorded. But it is not merely in actual publicity that the Press has assisted the Allied effort; in a variety of other ways specialised co-operation, such as trade journals, by virtue of their experience and available sources of information, are alone able to render, has drawn from Government officials such remarks as: "We are absolutely unable to do without you at the present time." Yet apart altogether from such matters as publicity and specialised information, there are other reasons of wider application which would seem to justify the fullest possible consideration in reason being extended to trade journals, so that in these times of stress and shortage they may be enabled to maintain, as far as practicable, their standard of efficiency and usefulness. We quote the following extracts from our aforesaid American contemporary because of their timeliness, and because in these days it is all too easy for such points to be lost sight of:—

> Many of the journals are a national asset of a high order, for they are doing a magnificent work in the service of the country. The imposition of increased postage would restrict circulation, place an additional burden upon the publisher, and one which would have to be borne eventually, if not immediately, by the reading public. As it is, the present high price of paper is working a hardship with many of the nation's periodicals; in some instances, subscriptions have already been increased, in others, circulation curtailed and reading matter retrenched, to the detriment of the publisher, the subscriber, and the advertiser.
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> The work of many journals is not merely individual, but national. Perhaps no two things have done more to bring North and South, East and West, close together than have the railroads and the nation's journals. By means of low postage rates, it has been possible to dispatch these journals broadcast over the country, placing them within the financial reach of everyone. Many of these technical journals, whether in the field of engineering, medicine, law, art, or any other domestic, industrial, or scientific sphere of endeavour, are fulfilling a function impossible to evaluate. They are circulating knowledge and experience, creating inspiration, building incentive from the example set by others, and making possible the intimate exchange of ideas. To the credit of the technical journals, in no small measure, is due the rapid development of civilisation and human progress of the last decade. The technical journal brings one into intimate contact with the world's work, and dreams and aspirations and accomplishments of others; through it you learn what the world is doing, how it is doing it, and why. The technical journal imparts information, it suggests, inspires, creates, and guides. Surely, this is the most efficient manner of using knowledge, and permits of its utilisation to the best advantage.
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> The technical periodical is not a luxury. It is a necessity. It is necessary to the engineer, or anyone else endeavouring to keep abreast in his profession or calling and obtain eminence in his domain. To remain uninformed to-day, is not merely to stagnate, but is to fall behind. Things move with such rapidity in these days, that one must either keep pace or be lost in oblivion. One cannot mark time. New methods and new demands, new ways of meeting old needs arise, and make the rapid circulation of knowledge of greater necessity and value now than it ever was before.

A short time ago, in an article on "National Service in Germany," which appeared in the *Daily Telegraph*, a Special Correspondent stated that the German Government promised, in the Reichstag, that journalists and those engaged in educational work would not be called upon for service under the Act. The necessity for maintaining publicity services and securing reasonable continuity in connection therewith as a means for assisting to hold things together, was apparently recognised. In a more recent article, which appeared in the *Times*, that journal's correspondent, formerly in Berlin, described the German Press as being unaffected by the war, the Government having regarded the importance of publicity abroad and at home as indisputable. It also desired, as part of its Press strategy, to maintain "the Press in the highest possible state of efficiency, with a view to instant operations on the conclusion of Peace." "The exportation of German newspapers and periodicals of all sorts is encouraged, not only with utter disregard to trade policy, but with complete indifference to the cost." It is part of the policy of the enemy to make opinion in neutral countries, and to that end "German papers are scattered, free of cost, through the hotels of Scandinavia, Holland, Switzerland and Spain, and every encouragement is given to the increase of their foreign circulation." Germany is exhausting every possible source of man-power and energy, is cutting off all unnecessary manufactures, but it is conducting a large and remarkable newspaper policy involving very special efforts. "As regards man-power," says the *Times* writer, "the newspapers have throughout received special consideration from the military authorities, being treated on much the same basis as Government offices, which in Germany enjoy no general rights of exemption, but retain such man-power as is absolutely necessary for efficiency. Similarly, under the National Service scheme, the Press will be affected only in so far as inquiry may prove it to be over-staffed."

We believe that the business men in our own Government will not desire to be behind America and Germany in appreciating the necessity for enabling British periodicals, upon which so much must depend in connection with trade development and expansion after the war, to continue, with the smallest possible handicap, to perform their national, colonial, international, and general industrial service.

NATIONAL INSURANCE (PART II) (MUNITION WORKERS) ACT, 1916.

Contributions are payable in respect of :—

2,148 X. Workmen who are employed in an establishment carrying on any trade insured under the National Insurance (Part II) (Munition Workers) Act, 1916 ; and who are engaged in cleaning locomotives or other vehicles which are used mainly on the premises of the establishment.

2,152 X. Workmen (other than those already insurable under Part II of the National Insurance Act, 1911) engaged in the manufacture of metal springs of any kind.

2,153 X. Workmen engaged in making metal name plates and metal letters for fixing on buildings.

2,154 X. Workmen engaged in cutting down old wooden cases, and remaking into cases of a different size.

2,159 X. Workmen (other than those already insurable under Part II of the National Insurance Act, 1911) engaged in the manufacture or repair of anchors, chains, chain couplings, and miscellaneous chain attachments of metal.

2,161 X. Workmen engaged in the repair of biscuit tins, oil and colour tins, &c.

2,165 X. Workmen engaged in the manufacture (including cold rolling, galvanising) of flexible metallic tubing, including workmen engaged in preparing rubber for, or making rubber parts of, such tubing.

2,166 X. Tinsmiths engaged in the manufacture of navigation and other lanterns.

2,169 X. Workmen engaged in the manufacture of speedometers.

2,170 X. Workmen (other than those already insurable under Part II of the National Insurance Act, 1911) engaged wholly or mainly in the manufacture of iron, steel or other metal hardware and hollow-ware.

2,174 X. Workmen (other than those already insurable under Part II of the National Insurance Act, 1911) engaged in the repair, including sharpening, of metal hand tools.

2,176 X. Workmen engaged in the manufacture of rubber tires and elastic air tubes for motors, cycles or other vehicles.

2,177 X. Workmen engaged in making sheet, pipe or pig lead, in rolling lead, or in making lead pipes.

Contributions are not payable in respect of :—

2,155. Workmen engaged in fixing name-plates and letters on buildings.

2,156. Workmen employed as engine tenters or as stokers in connection with uninsured trades.

2,157. Persons employed wholly or mainly as draughtsmen, tracers, office attendants, office messengers, commissionaires, clerks, typists.

2,158. Overlookers, chargehands, storekeepers, warehousemen, when not employed wholly or mainly by way of manual labour.

2,160. Workmen employed by a Town Council, and engaged in sweeping streets, emptying ashpits, or as attendants at a refuse destructor.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

New Mining Electric Bell.

In a paper read before the East of Scotland Branch of the Association of Mining Electrical Engineers by Mr. L. H. Howlett, and reported in the *Iron and Coal Trades Review*, a description was given of a bell specially designed for use in coal mines, where it is necessary to obtain a loud ring without using so much current that there is a danger of igniting mixtures of firedamp and air. The construction of the bell is shown in fig. 1, and its mode of action is as follows :—Current passes from the terminal T_2 to the flexible brass strip *s*, which is held against the platinum screw contact P_2 by the spring S ; from P_2 it goes through the bobbin A to the terminal T_1, as shown by the dotted lines. The armature is attracted by A, with the result that the gong G is hit by the rod *h*, contact being broken with P_2 and made with P_1. The current is now stopped through A, and travels instead through B, as shown by the dotted lines from P_1. The armature is pulled back by B, and the other end of *h* hits the gong ; contact is renewed between *s* and P_2, A is again magnetised, and so on.

The hammer H has an iron rod *h* screwed into it, so as to strike the gong at both ends of the stroke : when the bell is at rest, *h* should be equidistant from the gong at both ends. The contact screws on P_1 and P_2 are brought as close together as they can be without *s* touching both ; they must also be arranged so that when at rest the armature is equidistant from the iron cores of A and B.

The connections to the bobbins A and B are so arranged that the current appears to go round them in opposite directions if they are looked at from the screw *t* at the end of A. The magnetic circuit for each iron core is completed by a vertical side piece to the iron base I, and thence through the axis *a* of the armature, to the armature itself. The gong G is screwed by means of an iron bolt and nuts to a vertical piece V, rising from the base I.

The minimum igniting current of the bell (*i.e.*, the smallest current whose break-spark can ignite the most sensitive firedamp-air mixture when the bell is in circuit), was found to be 0·18 amp. The smallest current that would cause the bell to ring was 0·04 amp. The resistance of each bobbin was 24 ohms. The rate of ringing at the minimum igniting current (0·18 amp.) was found by means of the oscillograph to be 2,880 strokes per minute. By removing the bobbin B and the contact P_1, and shortening one end of *h* (the end nearest to T_2), so that it cannot strike the gong, an ordinary type of single-action bell is left. When this was done the minimum igniting current and minimum ringing current were found to be unchanged, but the number of strokes per minute fell to 1,310 ; there was therefore a loss in ringing power.

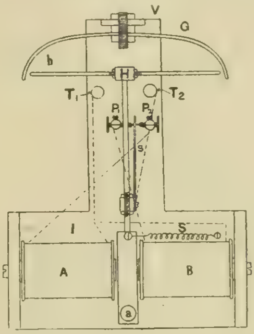


Fig. 1.—New Mining Electric Bell.

By the addition of the bobbin B and the contact P_1 the return stroke of the hammer can be quickened and utilised by making the hammer strike the gong again. The addition of the bobbin B involves no increase in the self-induction of the bell ; it does not therefore become more liable to ignite firedamp mixtures. When a well-constructed bell of the ordinary type is ringing, the current is cut off for about 40 per cent. of the time. In this bell, on the other hand, the current passes practically all the time, as shown by the oscillograph records. Dr. Wheeler allowed this bell to be made and tested at the Home Office Experimental Station, Eskmeals.

Arc Welding Plant.

Messrs. Tilling-Stevens, Ltd., of Victoria Works, Maidstone, have utilised the equipment of their petrol-electric chassis for the development of a mobile arc-welding plant, the dynamo and motor of the chassis being specially wound for this class of work, in which they specialise. The firm also make motor-generators for arc welding, and have supplied welding plant to a large number of important firms in this country, with highly successful results. The accompanying illustration shows one of their equipments in use. Power is derived from the petrol engine, and serves to propel the vehicle by means of the Tilling-Stevens electric transmission, as well as to supply the current for welding, the motor, in the latter case, being cut out of circuit. The body of the vehicle is used to house the welding apparatus, and as a messroom and workshop ; the vehicle can, however, be built in the form of a lorry, the welding plant being then carried in a locker at the back of the cab, so that the whole of the space on the lorry can be utilised for ordinary cartage purposes. Regulation of the welding current is effected by means of an artificial load, which is cut out by a relay switch when the arc is struck, and immediately restored when the arc is broken. A large range of adjustment of voltage and current is provided for. Obviously the outfit can be applied to many other purposes besides arc-welding, and something of this kind would appear to be ideal for the application of electric power to agricultural operations in places where a public supply is not available. Either carbon or metal electrodes can be

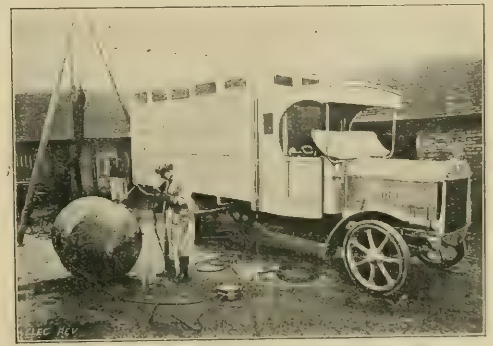


Fig. 2.—Tilling-Stevens Mobile Arc-Welding Plant.

used for the welding process, and the flexibility of this system renders it applicable to an extraordinary variety of operations.

Motor-Control Panels.

We have received from the **British Thomson-Houston Co., Ltd.**, of Rugby, particulars of their "A.T.M." motor-control panels for A.C. circuits, which are designed for starting polyphase slip-ring induction motors against full-load torque; the equipment comprises a baseplate carrying a starting rheostat and switch-fuse, complying with the Home Office rules for the use of electricity in factories, and without any exposed live metal. The panels are standardised for circuits up to 550 volts, 25 to 60 cycles, taking a stator current not exceeding 48 amperes at full load (equivalent to 30 H.P. at 400 volts) and a rotor current not exceeding 125 amperes. The switch-fuse is of the quick-break type, enclosed in a cast-iron case, with the movable parts attached to the hinged cover, which cannot be opened while the switch is closed: the fuses can be rewired. The starting rheostat is enclosed in a cast-iron case, with a glazed opening for inspection of the switch and contacts; it may or may not have stator contacts—in the former case, being fitted with a low-voltage and two overload trips for returning the starting switch to the "off" position. The larger sizes have a slow-motion device to prevent the starter arm from being moved over too quickly. Fig. 3 shows one of the larger patterns, with cover off the starting switch and the switch-fuse open. Meters can be fitted if desired.

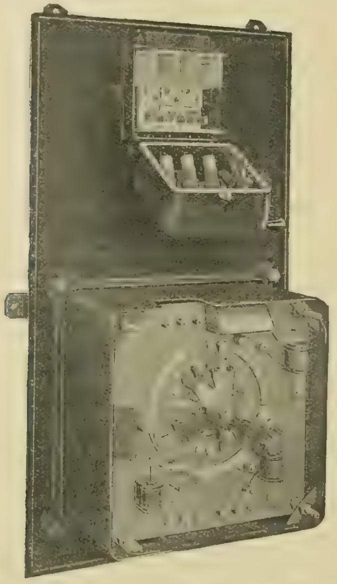


Fig. 3.—B.T.H. Motor-Control Panel, Form G2.

The Garrett Safety Control Gear for Electric Motor Vehicles.

Mr. F. Garrett, managing director of Messrs. Richard Garrett and Sons, Ltd., engineers, of Leiston, Suffolk, has recently taken out a patent for a special arrangement of the control gear for electric motor vehicles, by which, whenever either the foot or hand brakes of the vehicle are applied, the current controller is automatically brought to the neutral position independently of the driver, thus avoiding the throwing of extra load on the batteries and the motor, and consequent damage. The arrangement is shown diagrammatically in the accompanying illustration, fig. 4; it will be seen that when either the hand or foot brake levers A and B are operated, not only are the brakes applied, but the lever C is moved in an anti-clockwise direction; by reason of the cam-shaped right-hand end of this lever the vertical lever D moves in a clockwise direction, and, through its connections, severs the contact between the lever of the hand controller and the controller drum. By the action of a pair of springs, the drum at the same time automatically returns to the neutral position. The controller handle and the brakes are also so linked together that it is impossible for the driver to start the vehicle with either of the brakes on.

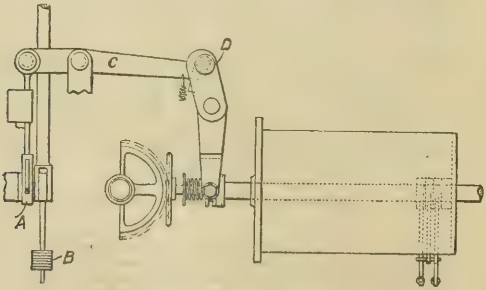


Fig. 4.—Garrett Safety Control Gear.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Johannesburg Cable Trouble.

I have just read the announcement in your issue of the 16th ult., under the above heading. May I be allowed to draw your attention to the implied reflections therein contained upon the wisdom of the consulting engineers who specified, and the skill of the manufacturers who supplied and laid, the direct-current feeders in question?

I am sure you had no intention of making any such imputations when editing your note; and as I was resident in Johannesburg at the time these cables were laid, I hope you will allow me, in the interests of fair play, to add certain information concerning the causes which have necessitated their renewal after the relatively short life of about 12 years.

Your note describes the cables, but no mention is made of the fact that they were laid directly in the ground, without any external protection or warning board to indicate their presence to subsequent excavators.

They were no sooner laid than the streets through which they passed were repeatedly opened by crude native labour engaged on the sewerage, telephone, water, and other public utility services throughout the area.

I have personally seen these buried cables treated as though they were merely tree roots, or other trench obstructions, and hacked out of the way by natives whose brute strength was more in evidence than their intelligence.

Occasionally a direct blow of a pick would reach the conductor, when the damage, of course, declared itself immediately; but in countless other cases, incipient faults were undoubtedly set up which time alone could develop. The wonder is that this ill-treatment has been so long in bearing fruit.

The uninitiated may point out that, according to your announcement, the ultimate breakdowns were due to the decentralisation of the conductor, and the connection between mechanical injury and decentralisation may not be very obvious at the first glance.

It has, however, been authoritatively established (*vide* I.E.E. *Journal*, Vol. LIII, Nos. 238 and 243) that the passage of leakage currents—such as would be set up between neighbouring faults caused by mechanical injury—softens the vulcanised bitumen, and this effect would naturally lead to the decentralisation to which you have referred.

The somewhat drastic attempted remedy of stripping off the armour and relaying the de-armoured cables on the solid system was naturally attended by serious risks, as it involved forceful handling of heavy cables whose dielectric had already been seriously weakened physically as well as electrically by the effects of the above-mentioned leakage currents. **Afrikander.**

Municipal Electrical Publicity.

In Mr. E. P. Hollis's thoughtful and interesting communication on the above, he makes little of the uses of literature in connection with a publicity campaign; now, I have found by carefully watching the results of various means of getting electrical business in private houses, that a well-prepared pamphlet is productive of excellent results, if such literature is drawn up in attractive style, on good class paper, by a good printer. Unfortunately the majority of brochures, &c., which we are able to get are rarely appealing enough to attract the attention of the private consumer, and it was here that the late Joint Publicity Committee really scored; their publications were exceedingly well drawn up, especially so in the earlier days, dealing with only one subject at a time, and the literature *multum in parvo.* It is one of the commonest faults in the preparation of pamphlets to make the wording too lengthy; the average man will not wade through it, however well and correctly it may be written. A stylish picture with a few short, well-thought-out paragraphs, dealing with the essential points of whatever one wishes to impress on the reader, easily readable and digested at a glance, printed on a two-page folder of a size convenient enough to go into an ordinary business envelope, and posted with a penny stamp, is without doubt read and appreciated by everybody to whom it may be sent.

It is a mistake to send more than one subject at a time, or to bombard the district frequently. Such mail advertising should be done in a very systematic way, careful records being kept of what class or subject has brought the best results; and it is really surprising to observe, by examining such records, the number of inquiries that undoubtedly accrue directly from such mailing. I do not wish to convey that this alone should be used, as it is most necessary periodically to follow up with a personal call; but here comes the difficulty. In normal times it is of very rare occurrence that one can obtain a really systematic and conscientious man, who has got his heart in his job, and of all the men for this class of work who have passed through my hands, I can only remember one who was worth more than he was paid. A man, to be really good, must be an enthusiast, and I am inclined to think that the word "canvasser" applied to such jobs does a great deal to stop men from adopting this very interesting, and far from monotonous, branch of the electrical profession. It is not a door-knocking job by any means; in fact, the amount of domestic business obtained by direct canvassing on a "door-to-door" method is not worth the time and trouble. The man should not be treated as a canvasser – he should be a representative of the supply company who is as interested in the prospective consumer as he is in the undertaking. He should be a trained engineer, with a bond behind his word.

The department controlling such business development should have central offices, with a well-equipped showroom, not an array of all sorts and conditions of apparatus, so that the intending consumer is baffled in choosing, but a good selection of every apparatus which results have proved to be good; that is to say, the electrical kettle recommended should be one of the two best makes, the stove the same, and so on, so that the client can be advised at once of what the supply undertaking considers to be the best, and when such a piece of apparatus is out of date, it should be scrapped. How often one sees in electrical showrooms antiquated models of utensils, &c., which should have been broken up long ago; and it is here that the local contractors could help, if they would, by suggesting, at periodical meetings, what, in their opinion, is best; but, for some reason or other, there seems to be, except in the minority, no cohesion between them and the supply authority, though both are essential to one another.

Mr. E. P. Hollis's paragraph on introducing articles which consume a very small amount of current is very true; a vacuum cleaner, hair dryer, or a fan, consumes so little that, on first thoughts, it hardly seems worth while pushing them, but these small fry do a great deal to popularise the domestic uses of electricity, and are a pleasing prelude to more productive business.

In conclusion, the whole subject of publicity work in connection with an electrical undertaking is of such vast importance to business development, and its management, methods and results are such an interesting and absorbing subject, that I often wonder why more enthusiasm is not shown, or more encouragement given to us in England.

A. G. Bostel.

Croydon Electricity Supply,
April 16th, 1917.

Boiler-House Operation.

Messrs. Otley and Pickles's paper, Table I, shows that the Rand Power Co. use large-unit, wide boilers, the average rating exceeding 30,000 lb. steam hourly each. Table III shows the excellent load factors; and Table VI shows that at Rosherville, burning good coal, 3·35 KW.-hour × 3,411½—viz., 11,429 B.TH.U. per. lb as fired, at 23·8 lb. per sq. ft. of grates, with fan draught, the steel-cased boiler with superheater and economiser, all in clean condition, gives 78·7 per cent. efficiency.

As the Rosherville coal is stated to have about 15 per cent. ash, this test was presumably made with peas or nuts, which can be burnt without wetting. But, for all fuels except peas and nuts, it is clearly shown that good combustion on chain-grates necessitates careful wetting of the coal as it descends the chutes from overhead bunkers, so that it is neither too dry nor too wet for the stokers.

At Vereeniging, with the extraordinarily high load factor of 67·4 per cent., the fuel averages only about 18½ per cent. ash, but in the wetted condition as fired, it is only 2·88 KW.-hours—viz., 9,825 B.TH.U. per lb.; and on this basis, the efficiency is 75 per cent., including economiser, but falls to 67·7 per cent. when the coal is dusty. It seems clear that on dry samples this coal would be about 11,000 B.TH.U. per lb., and on that basis the efficiency would naturally be much less.

It is only in the small Brakpan station that low-grade fuel, averaging 27 per cent. ash, is burnt; but, with the exception of nuts and peas, all fuels burnt are artificially wetted to suit the stokers.

It is interesting to compare these large-unit, steel-cased, cross-drum boilers of the Rand Power Co. with the largest units of the same type in America, viz.:—

Cross-drum, steel-cased units.	Rand Power Co. (as fig. 6.)	Chicago. Edison.	Essex, N.J. P.S. Corpn.
Inside width of furnace	21 ft. 0 in.	24 ft. 10 in.	24 ft. 10 in.
Number of tubes ..	45 × 14, 630	42 × 14, 588	42 × 16, 692
Length and diameter ..	11¾ ft. 3¼ in.	18 ft. 4 in.	18 ft. 4 in. dia.
Boiler heating surface ..	6,200	12,200	13,727 sq. ft.
Superheater ,,	2,333	2,400	1,711 ,,
Economiser ,,	3,610	6,566	7,750 ,,
Coking arches	2 each 9 × 9 ft.	2 each 10¼ ft. × 8 ft.	None
Stokers	2 chain-grates	2 chain-grates	One 16-retort
Grate surface	252 sq. ft.	273 sq. ft.	Riley, no grates

Any of these large-unit boilers can be properly compared with one-half of a double-ended boiler at Detroit; the latter is 26½ ft. inside width of furnace, with 53 tubes wide, 3¼ in. diameter, 11,827 sq. ft., plus 1,200 sq. ft. superheater; no economiser used; 13-retort stoker with archless setting. With good coal burnt in dry condition, 76 per cent. efficiency is attained with no economiser.

British practice with the Erith-Riley continuous-cleaning stokers, even when burning low-grade coal in dry condition, with as much as 24 per cent. actual ash by analysis, and about 9,500 B.TH.U. per lb. on smaller units of various makes of boilers, shows that with this entirely underfeed combustion the boiler efficiency is so high that in most cases the economiser and induced draught fan are omitted as not worth while thus greatly simplifying the boiler plant.

Where short-tube boilers are adopted, with small heating surface and water capacity for a given width and duty, the overhead economiser is generally retained: thus for a 21-ft. boiler (of same type as Rand Power Co.'s units) in Lancashire, the 12-retort Erith-Riley stoker, with archless setting, is adopted to burn without wetting slack with about 20 per cent. actual ash, for 50,000 lb. hourly evaporation on boiler 45 × 18 tubes, 8,000 sq. ft. heating surface, with superheater and overhead economiser.

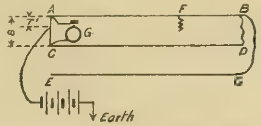
At the Chicago Edison plant, with chain-grates, the fuel is wetted in the same way as the Rand Power Co.'s fuels; but both in America and in England, the expert regulation for such watering, as well as the loss of capacity and the increased coal consumption it involves, are entirely avoided wherever the modern multiple-retort continuous-cleaning stoker is adopted, and this method is equally applicable to every make and size of water-tube boiler.

Charles Erith, A.M.I.Mech.E.

London, E.C., *April 16th*, 1917.

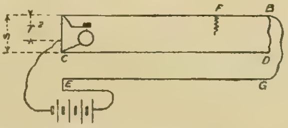
Fault Localisation.

In reply to your correspondent's query under the above heading, the following should give an accurate result. First couple up with a slide-wire bridge thus:—



A B = One faulty feeder.
C D = 1st trolley wire.
E G = 2nd ,, ,,

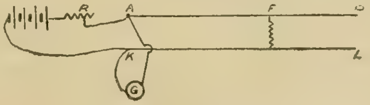
Obtain balance on the galvanometer. Secondly, couple up with the slide-wire bridge thus:—



Obtain balance again on the galvanometer.

The position of fault from the testing end is $r_1 \times AB/r_2$. This method obviates the necessity of knowing the resistance of the return wire. A simple loop method with one trolley wire will give a false result, as the trolley wire is of hard-drawn copper, and its resistance, according to its sectional area, cannot be compared with that of the cable under test.

This adaptation of Murray's loop test should be confirmed by a drop-of-potential test to check any error, due to fault resistance, thus:—



A B = No. 1 feeder.
K L = No. 2 ,,

Reading No. 1, as connected gives drop A F K.

Reading No. 2, galvo B to L, gives fault resistance.

Then take similar readings from the other end; B L and A K should be the same. If not, subtract the mean of these from A F K and B F L. Then distance of fault from A = A F K × length of A B (A F K + B F L).

H. E. Blake, A.M.I.E.E.,
Mains Superintendent.

Eastbourne, *April 2nd*, 1917.

The I.E.E. Nominations.

With reference to the question of the election of Mr. C. H. Wordingham to the Presidency of the Institution, the nomination seems to be especially impolitic at the present moment. Mr. Wordingham is engineer-in-chief to a Government department. Probably in the near future the Government departments will be drafting new regulations dealing with one or other of the sections of the electrical industry, and it is quite conceivable that the industry may not always see eye to eye with the Government departments. In such cases, how could Mr. Wordingham properly represent the industry?

The Institution ought to exist for the protection of the industry, and to elect as president a Government official at the present time would be about as sensible as if a ratepayers' protection association chose as their chairman one of the clerks in the local rates collector's office. Would it not have been ridiculous for an Admiralty official to have headed the deputation representing the electricity supply industry, which a few days ago waited upon the Reserved Occupations Committee, as the present President did ? This would have meant that an Admiralty official would have taken the lead in arguing points against the Admiralty and War Office representatives sitting on the other side of the table. If the new Board of Trade Electrical Committee have to be approached by the I.E.E., how could the President of the Board of Trade receive the paid official of another Government Department representing a critical and protesting deputation ? Now, more than at any other time, it is imperative that we should have a President unfettered by his official position who can be relied upon to do his utmost in support of our industry. To be placed in such an embarrassing position as Mr. Wordingham would have to occupy would obviously be unfair to Mr. Wordingham himself.

L. L. Robinson.

London, E., *April* 17*th*, 1917.

You may be interested to know that at a meeting of the Associated Municipal Electrical Engineers of Greater London, which took place last Monday, the question of the presidency of the I.E.E. was considered, and disappointment was expressed at the nomination of Mr. Wordingham, in present circumstances, especially in view of possible negotiations with Government departments, he being a Government official. It was decided to ask Mr. Chattock, of Birmingham, to accept an alternative nomination for the presidency, and a letter to this effect was dispatched. Unfortunately, he feels unable to act in the matter, but it is desired to place on record this expression of opinion.

Edward Calvert,

Hon. Secretary, Associated Municipal Electrical Engineers (Greater London).

London, N., *April* 17*th*, 1917.

THE ELECTRICAL TRADES BENEVOLENT INSTITUTION.

The annual report of the Committee for the year ending December 31st, 1916, states that for the second year in succession the annual festival did not take place, and there was again a serious falling-off in the contributions compared with the years in which the festival had been held : but there was a satisfactory improvement in the receipts compared with the previous year. The income from contributions was £609, and the total income £944 ; the net income was £796, out of which grants had been made (amounting to £64), and £595 had been invested, bringing the total of the invested funds up to £8,711. Applications for relief were fewer, and every qualified applicant received assistance. The Committee expresses a hope that heads of firms will assist the Institution by appointing collectors, and by bringing the advantages of membership to the notice of their staffs.

The annual general meeting of the Institution was held on Monday last, April 16th, at the Institution of Civil Engineers. Mr. A. A. Campbell-Swinton presided, and after the minutes of the last annual general meeting had been read, moved the adoption of the Committee's Report and Accounts for the past year. Mr. Campbell-Swinton said that the accounts, on the whole, showed larger receipts and smaller expenses than in the previous year, but the differences were not very great. The grants paid during the year were less in number and amount than in 1915, owing largely to the lessened degree of unemployment last year. The Society not only provided for electrical people in case of need, but also laid itself out to find employment for them, and last year it had been exceptionally successful in this respect. There was a satisfactory increase in the subscriptions of members (from £93 to £150), but, unfortunately, there were no donations from life members and governors, owing to the financial conditions of the times. The total subscriptions had not varied greatly, being £270, as compared with £300. They had a credit balance of nearly £9,000—could they not, by a little effort, increase it to £10,000 ? With a view to inducing others to assist towards this end, he would set the example by contributing a gift of £100 to the funds. It was true that the time was very unfavourable to the raising of subscriptions, as many professional men had been hard hit ; but, nevertheless, the attempt should be made. There was a considerable falling-off in income owing to the suspension of the festival : in 1914 the net receipts were £3,127, while last year they were £796, the difference being accounted for by the omission of the dinner. Moreover, as the Electrical Engineers' Ball did not take place, the usual donation out of its surplus funds was not received. The Society dealt with the electrical trades in general, the Institution of Electrical Engineers and other bodies having their own benevolent funds ; the Society provided for employés who did not belong to those institutions or to trade unions. Mr. Justus Eck, who had worked very hard for the Benevolent Institution almost from its inception, resigned at the last meeting, and they accepted his resignation with regret.

Mr. W. B. Esson, in seconding the resolution, referred to the great need of such an Institution, and pointed out that though it was not called upon last year to make many grants, immediately the war ended there would be a large demand for its assistance. He congratulated the chairman upon becoming a Life Governor, and said he would like to see the number of such increased from 8 to 20 ; every donation of £100 by a Life Governor went to build up their capital, and until a large capital sum was available they were hampered in granting pensions, to do which was one of the principal objects of the Institution.

The secretary, Mr. F. B. O. Hawes, remarked that having in view the omission of the festival dinner, the finances of the Institution were in a very favourable state, as the contributions of the members had increased from £93 to £150, and those of annual subscribers from £87 to £120, which was also a sign of strength. As donations they had not received any "plums" such as had fallen to them in previous years, but the total in comparatively small amounts had increased from £284 to £338. He cordially endorsed Mr. Esson's appeal—to bring the investments up to £10,000 ; the electrical industry was doing very well indeed, and he appealed to the manufacturing branch to increase the invested sum to more than that amount. He hoped that Mr. Campbell-Swinton's example would be followed by many who were able to do likewise.

The report and accounts were adopted unanimously, and the chairman proceeded to the election of the Committee for the year.

Messrs. Esson, Garcke, Gatehouse, Hunter, Ratcliffe-Small, Sir Ernest Spencer, and Messrs. Campbell-Swinton and L. Thurnauer retired by rotation, and were eligible for re-election, but Mr. Thurnauer did not wish to continue, and the chairman proposed that in his place Mr. George Sutton should be invited to serve on the Committee ; this was agreed to, and the remaining members were re-elected. The hon. auditors, Messrs. Price, Waterhouse and Co., were also re-elected, and votes of thanks were accorded to the hon. solicitors, Messrs. Sugden & Hextall ; the indefatigable secretary, Mr. F. B. O. Hawes ; to the Press, technical and other, for their assistance, and to the I.E.E. and the I.C.E. for accommodation.

Mr. E. Garcke moved a vote of thanks to Mr. Campbell-Swinton for his conduct of the meeting, and expressed the hope that his appeal would be widely read and his generous example followed. He would do all that he could to assist in securing the £10,000. The meeting then terminated.

WAR ITEMS.

Exports to China.—Further names of bodies and persons in China and Siam to whom exports may be consigned appear in the *London Gazette* for April 17th.

Trading with the Enemy.—The "London Gazette" for April 13th contains further lists of bodies and persons in the following countries with whom trading is prohibited :—Argentina, Bolivia, Brazil, Chile, Liberia, Netherlands, Norway, Persia, Spain, &c.

Exemption Applications.—At Dover, the borough electrical engineer applied for exemption for his chief clerk, A. D Axford (25), who has been placed, after being passed for general service, in Class C 2 by the Special Medical Board. Four months were conceded.

Before the Stroud (Glos.) Rural Tribunal, Messrs. Edwards and Armstrong, electrical engineers, of Cainscross, appealed for 18 men, all of whom are in charge of electrical stations in different parts of the country, most of which supply power to munition works. The Military Representative (Lieutenant Wood) said that the firm had given every possible assistance to the military authorities. At the outbreak of war they had 65 men in their employ, and they had been willing for 50 to go; that, he thought, was almost a record. Obviously, it was impossible to take all the men from this important work, and some he was prepared to pass until suitable substitutes could be obtained. The decisions were that three of the men should join up at once, and the others were put back for the provision of substitutes.

The West Kent Appeal Court, on April 5th, considered a military appeal against conditional exemption held by six employés of the Chatham & District Light Railways Co. Appeals in respect of a storekeeper (29) and a driver (29) were allowed, and the others, relating to a clerk (31), an overhead lineman (25), and two motormen (both 29), were dismissed.

Before the Warwickshire Appeal Court, the Military appealed against exemption granted at Warwick to T. W Mumford (36, in Class B 1), inspector and driver on the Warwick tramways. Two months, subject to substitution in the meantime, were granted.

At Horsham, exemption was sought by the electrical engineer to the U.D.C. for a junior assistant, aged 19, until a woman could be trained to take his place. Exemption was given until the end of May.

At Hastings, a review was made for conditional exemption held by a night clerk (B 1), the chief clerk and cashier (A 1), a fitter's mate (A 1), a coach maker (C 2), and a petrol car lighting worker (B 1), employed by the tramway company. The certificates of the night clerk and fitter's mate were cancelled, and the other cases were referred to a conference between the Town Clerk, the Military Representative, and the company's representative.

Before the Somerset Appeal Court, the Military appealed against exemption held by W. P. Short (28, in Class B 1), managing clerk and spare switchboard attendant at the Taunton Corporation electricity works. The electrical engineer (Mr. A. J. Howard) said that a man over military age had been tried, but he was of no use. The borough accountant informed the Tribunal that he had no one whom he could transfer to replace Short, who was the connecting link between his office and the electricity department. The application was dismissed, but Mr. Howard was informed that the Tribunal would require good evidence that efforts had been made to replace Short if he was required after July 6th.

At Aberystwyth, Mr. Perkins, manager of the Electric Light Co., appealed for R. J. Jones (37), electrician. He entered the Army last July, but was sent back medically unfit. On going before the Medical Board again last September he was put in Class C 2. Mr. Perkins said that, as far as he knew, Jones was the only man working in the town at present as an electrician. Conditional exemption was conceded.

At Maidstone, Mr. Oswald Jones, electrical engineer, appealed for W. H. Brown (36), passed for general service. Mr. Jones stated that Brown was a skilled engineer, and had for some time been engaged on important work. The Advisory Committee recommended that conditional exemption previously granted should be withdrawn, and this was acted upon, and three months allowed. Mr. Jones also appealed for E. Wicks (28, general service), electrical engineer and armature winder, who, besides other work, maintains the electrical machinery at three important mills. The same decision as in the other case was given.

At Coventry, a review was made of the cases of eight employés of Messrs. Van Raden & Co., electrical storage battery manufacturers, who held conditional exemption. It was stated that all the men appealed for were in certified occupations, and that, owing to the nature of the trade, boys and women could not be employed. Each was given two months' exemption.

At the South Yorkshire Appeals Tribunal, the Military Representative appealed against the exemption of two Doncaster tram drivers and a car-shed foreman. The Town Clerk appeared for the Corporation, and did not oppose in the case of the drivers, but put in a strong plea for the shed foreman, and in this case the military appeal was disallowed.

The South Yorkshire Appeal Tribunal considered an appeal by the Military Representative against exemptions of three employés of the Mexborough & Swinton Tramways Co. The company's representative said they were shutting down their Conisboro' section, and had been forced to run a general half-hour service instead of one of ten minutes. If more men were taken the company would have to approach the Board of Trade with an intimation that they could accept no responsibility for whatever might arise. The Tribunal allowed the Military appeal in each case, but one of the men was given grace to May 31st.

At the Hull Tribunal, it was submitted that a tramway motorman, married, 37 years of age, was in a certified occupation. The age limit, it was stated, had been raised two years, but was now only 27. The man had been classified C 1, and there was a great shortage of drivers. Capt. Chapman: There are no women drivers?—No, women cannot handle the Hull cars. Capt. Chapman: I have seen women drivers elsewhere.—I understand the hand brake is the difficulty on the Hull cars. Capt. Chapman: I think that would present no difficulty to a woman if a C 1 man can work it. Conditional exemption was allowed.

BUSINESS NOTES.

Manufacture of Telegraph Apparatus in Spain.—It is announced from Madrid that, owing to the difficulty of obtaining telegraph apparatus from abroad owing to the war, the manufacture of Hughes apparatus has lately been taken up on a small scale, but with good results, in the workshops of the Director-General of Communications. It is also announced that under the ægis of a Bilbao syndicate a new company has lately been formed with the title La Compania Iberica de Telecomunicacion, to establish works in Madrid (18 Pareo del Rey) for the manufacture of telephone and telegraph apparatus both for the ordinary and wireless systems. It is added that the new undertaking is also interested in a project for the establishment of a system of wireless telephonic communication throughout Spain.

Dissolutions and Liquidations.—ANCHOR ELECTRIC CO., LTD.—A meeting is to be held on May 18th, at 5, Lincoln's Inn Fields, W.C., to hear an account of the winding up from the liquidator, Mr. T. T. Rankin.

MILLER ANTI-FRICTION METAL CO., LTD.—A meeting is called for May 22nd, at 3, Gore Street, Manchester, to hear an account of the winding up from the liquidator, Mr. A. Hennings.

BYNOE LOW-PRESSURE SUPERHEATER SYSTEM, LTD.—This company is winding up voluntarily, with Mr. F. Morse, 1 and 2, Great Winchester Street, E.C., as liquidator.

LOW-PRESSURE SUPERHEATING, LTD.—This company is winding up voluntarily, with Mr. F. Morse, as above, as liquidator.

Trade Announcement.—THE L.P.S. ELECTRICAL CO. has removed to 14, Howick Place, Westminster, S.W.

Catalogues and Lists.—CAMBRIDGE SCIENTIFIC INSTRUMENT CO., LTD., Cambridge.—Three illustrated lists as follows:—No. 134, describing the Cambridge measuring microscope for workshop use; No. 191, dealing with the Cambridge thermo-couple potentiometer; and No. 912, relating to the H. & M. recording and index thermometers.

SPRAY ENGINEERING CO., 93, Federal Street, Boston, U.S.A.—Bulletin, No. 501, illustrating and describing in condensed form their Spraco system for cooling condensing water, for washing and cooling electrical machinery, and other Spraco developments.

BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—Descriptive list No. 3,265 (eight pages), giving illustrated particulars, weights, dimensions, &c., of motor-control panels for A.C. circuits.

MESSRS. GRAHAM & LATHAM, LTD., 104, Victoria Street, London, S.W.—Illustrated list (No. 3) of signalling instruction instruments, showing some developments in signalling apparatus. Copies will be sent on application.

"Z" ELECTRIC LAMP MANUFACTURING CO., LTD., Southfields, S.W. 18.—Card giving prices of special stocks of electrical accessories.

Holophane Illumination Calculator.—An ingenious device under this title has come to hand from MESSRS. HOLOPHANE, LTD., of 12, Carteret Street, S.W. It consists of a three-page folder, strongly bound, and fitted with a revolving disk calculator, which takes into account foot candles, lumens, area of space illuminated, height above working plane or street surface, and the type of Holophane prismatic glass refractor employed. Now that illuminating engineering has been brought to so advanced a stage of scientific development, the calculations involved are somewhat complex and intricate, and the advent of this time-saving device should be cordially welcomed by engineers and contractors. Full instructions for the use of the calculator are provided, together with tables showing the relation of lumens to the wattage of lamps, foot-candle intensities recommended for a large variety of cases, the different types of Holophane glassware, and definitions, all most conveniently arranged. It is published at 2s. 6d., and should prove extremely useful.

For Sale.—The Borough of Salford Electricity Department invites offers for the purchase and removal of a Desrumaux type water-softening and filtering plant, and two Mather & Platt pressure filters. For particulars, see our advertisement pages to-day.

Book Notice.—"Scientific Papers of the Bureau of Standards." No. 297, "A Study of Electromagnet Moving Coil-Galvanometers for Use in Alternating-Current Measurements." Washington: Government Printing Office.

LIGHTING AND POWER NOTES.

Ashton-under-Lyne.—The Electricity Committee having considered a report made by Mr. Neville Applebee, the borough electrical engineer, on the recent conference on the linking-up of electrical undertakings in Lancashire and Cheshire, has resolved to take no action in the matter at present.

The Electricity Committee has decided that a minimum charge of 7s. 6d. per quarter be made to all consumers of electricity, and that all motor rentals be increased by 25 per cent., and the charges for delivery and fixing doubled, and that increased charges be made for sundries.

Australia.—The engineer-in-chief of the Sydney Board of Water Supply and Sewerage has recommended that £2,370 be expended in providing an electrical pumping plant, with transmission line, &c., to amplify the power at No. 2, Upper Cordeaux dam in connection with the South Coast towns' supply.

In connection with the Order in Council granted by the Queensland Government to Mr. E. J. Redmond, of Bundaberg, for the installation of an electric lighting and power plant in the town of Gayndah, an extension of time from two to three years has been granted.

A similar concession has been approved in the case of the installation proposed for Dalby.

Barnes.—The electrical engineer has submitted a report on the question of obtaining a bulk supply of electricity from the London and South-Western Railway Co. The engineer also reports having considered the question of installing furnaces suitable for dealing with coke breeze fuel, and finds that some little economy could be effected by this class of fuel provided the relative values remained constant. The cost of equipping a pair of small boilers would be approximately £150, and if the guarantees were sustained there is little doubt that the cost of installing would be repaid on the economy effected in a short period. The Committee recommended that one boiler should be equipped at first, which, if proving satisfactory, the work on the other boiler should then be carried out. The recommendation was approved.

Birmingham.—The annual report of the Birmingham, Tame and Rea District Drainage Board mentions that, in connection with a proposed additional supply of energy, it had been decided to install step-up transformers, with a view to transmitting at a higher pressure, in preference to increasing the copper section of the lines. The alterations would be carried out without interfering with the work of the Board, which is entirely dependent on electric power.

Burton-on-Trent.—Loan Refused.—Regarding the application for a loan of £25,000 for the electricity undertaking, the L.G.B. has informed the T.C. that as the proposed expenditure was not required for national purposes, it did not see its way to sanction a loan at the present time.

Farnworth.—At a meeting of the Council held last week, it was decided, after a long discussion, to restart the destructor works.

Kilmarnock.—New Plant.—The Corporation Electricity Committee has accepted offers for plant in connection with extensions, at an approximate cost of £46,000.

London.—Poplar.—The Electricity Committee has had under consideration the urgent necessity for extending the generating plant to meet next winter's demand. In view of the fact that the cost of extensions at the present time would exceed pre-war cost by at least 50 per cent., negotiations have proceeded with the L.C.C. for linking-up with the Greenwich tramway generating station, and, failing agreement with the L.C.C., the Committee has under consideration alternative schemes submitted by the engineer. Whether interchange of supply with the L.C.C., or the installation of a new generating set be adopted, the erection and equipment of a new sub-station will be necessary, and the engineer has submitted the following estimates:—Erection of new sub-station, £3,000; cable, ducts, and two E.H.T. feeders, £9,581; two 1,000-KW. converters, switchgear, &c., £9,162; mains, £7,200; total, £29,015. The Committee recommends the approval of these extensions.

Lewisham.—The Guardians have received a letter from the South Metropolitan Electric Light and Power Co., Ltd., making application for a further increase in the rate paid by the Guardians for electric current. The Board decided that, during the continuance of the war, a further increase of 5 per cent. be allowed.

Londonderry.—Negotiations have been taking place between the T.C. and North of Ireland Shipbuilding Co. in reference to the terms for a future supply to the shipyard, so far without success. It was explained that the question involved the installation of a new plant, at a cost of £26,000, and the shipyard would be the only consumers. There was a difference of opinion as to the estimate of running costs in particular, and it was therefore agreed to appoint an expert to go into the question of tariff, &c., and with a view to arriving at some agreement with the firm. A small Consultative Committee was also appointed.

A L.G.B. inquiry was held last week by Mr. P. C. Cowan, chief engineering inspector, on the application of the Corporation to borrow £35,500 for the extension of the electric lighting system to the garden suburb, which is being erected for the accommodation of shipyard workers, and for the supply to the yard.—*Belfast News Letter.*

Midhurst.—The B. of T. has extended the Midhurst and District Electric Lighting Order, 1914, for one year.

Montrose.—Public Lighting.—Under a new agreement between the T.C. and the Electric Lighting Co. for the public lighting of the town, the charge per annum will be £611, against £830 under the previous contract, for full-time lighting, and £286, against £575, under the restricted lighting.

Pembroke (Dublin).—Street Lighting.—The Urban Council has decided on a scale of public electric lighting varying from 2½ to 4 hours nightly up to September 21st, instead of the total prohibition of light previously decided upon.

Richmond-on-Thames.—The Richmond (Surrey) Electric Light and Power Co., Ltd., asked the T.C. that the provisions of the agreement of January 20th, 1913, confirmed by the Richmond (Surrey) Electricity Supply Act, 1913, as to the price charged for electric current may in the present abnormal conditions be modified, owing to the increased cost of coal, labour, and transport. Negotiations are proceeding with regard to the matter.

Southend-on-Sea.—In a report of the Electric Light and Tramways Committee, it is pointed out that the profits of both undertakings have been considerable during the past five years, and that there is an urgent necessity for additional generating plant.

Southport.—Year's Working.—The annual report of Mr. A. Black, the borough electrical engineer, shows that the number of units supplied to private consumers was 2,059,590, an increase of 100,076; but the units supplied to the Corporation tramways decreased by 10,674. The year's working showed a net profit of £2,682, an increase of £469 on the previous year.

St. Helens.—Loan Sanction.—The Electricity Committee has received the sanction of the L.G.B. to the borrowing of £710 for enlargement of the boiler house, £4,456 for a water-tube boiler, £634 for a mechanical stoker, and £6,200 for mains and switchgear.

The Electricity Committee has decided that the charge for electricity, both for power and lighting, be increased as from April 1st, 1917, by 30 per cent., in lieu of 20 per cent. as at present.

Tasmania.—A hydro-electric scheme is being considered by the town of Scotsdale; the proposal is to add a generator to the waterworks plant on the Brid river, and a report is to be obtained on the scheme.

Wolverhampton.—Proposed Extensions.—The Electricity Committee has reported on the extension of plant necessary to meet the growth in power load, pointing out that early last year it was decided to install a 5,000-KW. plant complete, but that definite applications have come in for much larger supplies, and that one firm alone will require continuous use of the 5,000-KW. plant referred to, which is now being completed. The Committee therefore recommends that, subject to official sanction, a further extension, at an estimated cost of £67,100, be put in hand. This will include a 5,000-KW. turbo-alternator, with boiler plant, cooling towers, pipes, switchgear, &c., also a new boiler-house wing with bunkers, to house the two proposed boilers.

At a monthly meeting of the T.C., on Monday evening, the report was unanimously adopted. The Council also adopted the recommendations of the Electricity Committee to purchase 2,650 yards of land adjoining the electricity works, together with canal basins, retaining walls, &c., from the Birmingham Canal Navigations, and to lay a high-tension cable to a certain works, at an expenditure of £2,200.

Electric Vehicles.—Three electric vehicles are being purchased by the Electricity Committee, two of 3½ tons capacity at £855 each, from Messrs. Mossay, and one, also of 3½ tons capacity, for £1,220, from the General Vehicle Co.

TRAMWAY and RAILWAY NOTES.

Australia.—In view of the abnormal conditions prevailing owing to the war, and the difficulty experienced in securing material, the Minister of Public Works has decided to recommend the Cabinet to agree to the request of the South Melbourne City Council to extend the time for the completion of the electric tramway line from Patterson Street to Princes Bridge for a further period of three years. The line should have been completed by November this year.—*Melbourne Age.*

Dartford.—Messrs. Balfour, Beatty & Co., Ltd., have applied to the B. of T. for an extension of time until August 18th, 1919, for the completion of the tramways authorised by the Order of 1911.

Huddersfield.—The bad weather of the Easter holiday period resulted in a decrease of £577 in the local tramway receipts for the five days of the holiday, the total being £2,862, as against £3,439 last year.

Ilkeston.—Tramway Purchase.—The Derbyshire C.C. has decided to ask for leave to present an objection against a Bill promoted by the Notts and Derbyshire Tramway Co. for power to purchase the tramways belonging to the Ilkeston Corporation, and any other tramways that can be worked in connection with any of the company's undertakings.

Lancashire.—Female Employes and Bonus.—Tramway working costs will be increased as the result of the award made by the Committee on Production in the recent application by female employés on 14 Corporation and company tramway systems in Lancashire and Cheshire. The request was for a war bonus of 6s. 6d. per week, and the Committee has awarded 3s. 6d. per week to those over 18 years of age, and 2s. a week to those under that age. The award dates back to the first full pay week after March 12th, and between 4,000 and 5,000 women and girls are affected. The districts concerned are Manchester, Salford, Oldham, Rochdale, Accrington, Ashton-under-Lyne, Birkenhead, Bolton, Bury, Stockport, Warrington, Wigan, Hyde, Preston, Mossley, Stalybridge, and Dukinfield. Previous advances since the war are included in the amount, and in Manchester and Salford the award will mean an increase of 1s. 6d. for women and 1s. for girls.

Leeds and Bradford.—Despite the lack of railway facilities, the Easter tramway receipts at Leeds and Bradford—especially Bradford—have fallen off this year, the reason being the wintry weather. The total of the Leeds receipts was £6,688, as against £6,702 last year for the four days. The Bradford receipts dropped from £6,953 to £6,097 for five days.

Walsall.—The manager of the tramways has reported as to experiments he has made with a trolley reverser, and has been authorised to fix the apparatus at the termini.

TELEGRAPH and TELEPHONE NOTES.

New York Telephones.—The report of the New York Telephone Co. for 1916 shows a gross revenue of $57,005,565, a gain of $7,376,019 over the preceding year. The net income amounted to $15,002,260, against $11,250,700, to which was added $5,014,168 derived from investments and $590,826 miscellaneous earnings. After dividends were paid a balance of $7,265,341 remained, a total $3,463,000 larger than in 1915.—*T. and T. Age.*

The Bell System.—The annual report of the American Telephone and Telegraph Co. and associated companies shows that, in round numbers, the total operating revenues of the Bell system were $264,600,000, an increase of $30,151,000 over the year before.

Depreciation and maintenance consumed $84,556,000, an increase of $8,797,000; traffic expenses consumed $53,749,000, an increase of $7,963,000; commercial expenses, $25,699,000, an increase of $2,116,000; general and miscellaneous expenses, $11,902,000, an increase of $853,000; taxes assignable to operations, $14,916,000, an increase of $1,915,000.

The "total gross income" was $79,353,000, an increase of $9,787,000 over 1915. Out of this $22,114,000 was paid for interest, rents, &c., leaving $35,160,000 for dividends and over $22,000,000 to be carried into surplus. Approximately $6,000,000 was paid to the employés as additional compensation to cover abnormal working conditions and living expenses of the year.

The Employés' Benefit Funds aggregated at the end of the year $9,151,000, and in the last four years the expenditures from these funds have amounted to $5,611,016. Pensions are paid to 284 former employés. Benefits were paid last year in 18,760 cases. There were 10,646 accident cases, of which comparatively few were serious, and the payments on these were $557,979. Death benefits of $157,077 were paid to the dependent relatives of 182 employés.

Employés of the Bell system who were in military service on the Mexican border were allowed full pay for the first three months of their absence, and thereafter full pay less the amount they received from the Government. These allowances aggregated $284,194.

The statement of the American Telephone and Telegraph Co. shows that its expenditures are only for the maintenance of the central administration of the whole Bell system, and that its receipts are from its investments in its associated companies, the payments of these companies towards the maintenance and expenses of the central administration, and the earnings of the long-distance lines.

The net earnings of the American Telephone and Telegraph Co. for the year were $44,743,376, which is $3,625,889 more than for the previous year. The interest charges were $6,730,099, and the dividends, at the regular rate of 8 per cent. per annum, were $31,122,187. Of the resulting balance there was carried to reserves $2,500,000, and to surplus $4,391,090. The capital stock of the company outstanding was $395,603,600, and the number of stockholders (of whom the majority are women) was 70,555. In addition, there are 43,000 employés of the Bell system who have purchased stock and are paying for it out of their wages.

An unusually large number of improvements have been introduced in cable, switchboard, sub-station and other apparatus, resulting in economies and advances in service of great public value.

The number of telephone stations on December 31st, 1916, was 9,847,192, an increase during the year of 695,971, of which 577,380 were owned by the Bell companies, and 118,591 were Bell connected stations. The total mileage of wire for exchange and toll service was 19,850,315 miles, an increase of 1,344,770. Fifty-eight per cent. of the wire mileage is underground, and 2,682,910 miles were toll wire. The number of daily telephone connections increased to an average of 29,420,000, or at the rate of 9,789,700,000 a year, which is approximately 100 calls for every man, woman and child in the United States.—*T. and T. Age.*

The Mackay Companies.—The report of the Mackay Companies states that the year 1916 has been a year of extraordinary prosperity in the United States, and the trustees have under consideration the advisability of increasing the dividend upon the common shares from 5 to 6 per cent. per annum. The long-distance telephone business transacted by the Postal Telegraph-Cable Co. has increased greatly during the past year. It is a "by-product," being transmitted over wires which are used at the same time for telegraph purposes. It is remarked that "out of the dark background of the war, the value and stability of the submarine cable property stands out prominently. The service which it is rendering is inestimable. In the prime factors of secrecy, speed, and accuracy it has no rival. Its position is strengthened, rather than weakened, by the results of wireless telegraphy. . . . There is no reason to believe that the wireless can ever render a service as reliable as that of the submarine cables." During the past year a large portion of one of the Commercial Cable Co.'s main cables was renewed in deep water, the expense thereof being paid out of the company's revenue. For the year ending February 1st, 1917, the receipts from investments in other companies were $4,683,265, and the expenses $56,800, the dividends paid on the Mackay Companies' preferred shares being $2,000,000 and on the common shares $2,069,020, leaving a balance of $557,446, which was carried forward. The assets of the companies amounted to $93,293,745.—*T. and T. Age.*

U.S. Wireless.—The radio station built for the United States Navy Department near San Diego, Cal., is now in regular service. The plant is nominally rated at 200 KW., operates on the Poulsen system, and is the most powerful thus far put in service. The aerial is carried by three 600-ft. self-supporting steel towers placed in a triangular position. This is the third in the chain of navy high-powered radio stations, of which Arlington was the first and Darien the second. Pearl Harbour and Cavite are the next two in the progressive development, and these will have apparatus of much higher power than that installed at San Diego. The arcs for Pearl Harbour and Cavite weigh 65 tons each, and are the largest and most powerful pieces of radio apparatus ever built. All of these stations are being constructed by the Federal Telegraph Co. and operated on the Poulsen system.

Tests carried out at the end of January resulted in the maintenance of strong and continuous communication over 12-hour periods between the station of the Marconi Wireless Telegraph Co. of America at Chatham, Mass., and that of the English Marconi Co. at Carnarvon, Wales. The signals received at Chatham from Carnarvon were from three to eight times as strong as those received from any other European station.—*T. and T. Age.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Melbourne.—May 23rd. Victorian Railways Department. Twelve months' supply (8,250) of incandescent electric lamps as ordered.*

Dundee.—April 21st. Corporation Electricity Department. Steelwork in floors, &c., and straining screens, guide rails, &c., at No. 2 pump-room at Carolina Port. Schedules, &c., from General Manager and Engineer.

London.—Hammersmith.—April 25th. B.C. Electricity Department. Induced-draught fans, mechanical stokers, boiler feed pump, centrifugal pump and strainer for condenser. See "Official Notices" April 13th.

Manchester.—April 24th. Corporation Tramways Committee. Hard-drawn trolley wire. General Manager.

South Africa.—Johannesburg.—April 30th. Municipal Council. 10,000 traction carbon brushes, 63·5 × 35 × 12·5 mm.*

May 21st. Municipal Council. Gear wheels for tramcars. Contract No. 241.*

[* Specifications may be seen at the Department of Commercial Intelligence, 73, Basinghall Street, London, E.C.]

CLOSED.

Bedford.—T.C. Accepted tenders:—

B.T.H. Co., Ltd.—Switchgear, £1,650.
J. P. Hall & Son, Ltd. Feed pumps, £340.
T. & T. Vicars.—Coal-handling plant, £718.
Robert Jenkings.—Stores buildings (electricity works), £759.

Chester.—Board of Guardians. Messrs. F. J. Jones and Co., at £587, for equipping the House with electric light.

Heckmondwike.—Electricity Committee. 1,000 tons of Askern slack coal, Messrs. Armitage & Co.

London.—Stoke Newington.—The Highways and Sewers Committee recommends the acceptance of the tender of Mr. C. Spreadborough for the installation of electric power plant for chaff-cutting and corn-crushing at the Council's stables (exclusive of the supply of the machines).

Poplar.—Electricity Committee. Tender recommended for a 1,000-KW. rotary converter, at £3,074, G.E. Co.

Wolverhampton.—T.C. Accepted tenders:—

Gibbons, Dudley.—Platform, handrailing, stairway and ladder to form the operating floor for the new turbo-alternator, £220.
Chloride Co.—Ironclad Exide battery for the delivery van, £142.
George Waller & Son, Stroud. Special automatic self-cleaning water screening plant, £269.
Mossay & Co., Ltd.—Two 3½-ton electric vehicles, £855 each.
General Vehicle Co.—One 3½-ton electric vehicle, £1,220.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, April 20th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. General meeting. Presidential address.

Junior Institution of Engineers.—Monday, April 23rd. At 7.30 p.m. At 39, Victoria Street, S.W. Honorary Members' Lecture, on "Some Applications of Radio Activity," by Prof. H. T. Davidge.

Friday, April 20th. Paper on "Gas Turbines," by Mr. S. E. Hutson.

Saturday, April 21st. At 6.30 p.m. At the Holborn Restaurant. Third Bohemian concert, in aid of St. Dunstan's Hostel for Blinded Soldiers.

(Midland Section).—Friday, April 20th. At the Imperial Hotel, Temple Street, Birmingham. Paper on "Water Softening," by Mr. O'Callaghan.

Royal Institution of Great Britain.—Thursday, April 26th. At 3 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Industrial Finance After the War—its Financial Needs: How they can best be met" (Lecture II).

Institution of Electrical Engineers.—Thursday, April 26th At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Paper on "High-tension Overhead Transmission Lines," by Mr. G. V. Twiss.

(Birmingham Local Section).—Wednesday, April 25th. At 7 p.m. At the University, Edmund Street. Paper on "High-tension Overhead Transmission Lines," by Mr. G. V. Twiss.

(Yorkshire Local Section).—Wednesday, April 25th. At 7 p.m. At the Philosophical Hall, Leeds. Discussion on "Wayleaves," with introductory paper by Mr. C. Vernier. Annual general meeting.

Belfast Association of Engineers.—Thursday, April 26th. At 7.45 p.m. At the Municipal Technical College. Annual general meeting.

NOTES.

A New Source of Platinum.—According to the *Bulletin* of the Siberian Engineers' Society, on the platinum fields of the Nizhni-Tagilsk Mining Circuit, the mining engineer, V. N. Tchorzhevsky, has begun the first experiments in the world on the extraction of platinum from dunite. The experiment promises to be exceedingly interesting. The platiniferous nature of dunite has long ago been observed, and the presence of the metal is apparently connected with the existence in the rock of chrome iron ore, on the abundance of which the greater or lesser content of platinum in the whole dunitic mass depends. All this was known before, but was rather of scientific interest; and it is only now that the investigation of the dunites for platinum on a wide scale is being undertaken, in order to prepare a plan for utilising the immense reserves of dunitic rocks which in the Nizhni-Tagil district alone occupy an area of 11·7 sq. miles. The method of extraction adopted is the simple grinding under runners of the rock, and the collection of the chromitic slack, and then a fresh grinding of the latter in order to leach the pure metal finally from it. The chromitic slack remaining after washing the platinum sands being scrupulously cleared of all visible platinum, yielded with an experimental grinding by runners, in the month of March, when it was still impossible to deliver dunites to the factory, over 200 oz. of metal out of 9,720 lb. The grey slack, which consists chiefly of undecomposed dunite obtained from the dredges when washing platinum, yielded 2·6 zolotniks of metal from 3,600 lb.

Galvanometers for A.C. Measurements.—A new publication of the Bureau of Standards (Scientific Paper No. 297), entitled "A Study of Electromagnet Moving-Coil Galvanometers for Use in Alternating-Current Measurements," gives the results of an investigation of alternating-current galvanometers of the separately excited, iron-cored, electrodynamometer type. It is shown how the operating constants (the sensitivity, period, and damping) depend upon the construction constants, upon the excitation, and upon the electrical constants of the moving-coil circuit. These relations are given in such a manner as to facilitate the design of instruments to have definite operating constants under the conditions of use. Four instruments with sensitivities up to 15 mm. per microvolt are described, and the results of tests with frequencies up to 2,100 cycles per second are given. Those interested may obtain a copy by addressing a request to the Bureau.

The Optophone in Operation.—At the Selenium Laboratory, on March 28th, Dr. Fournier d'Albe gave a demonstration of optophone reading before a small company. The demonstration was interesting, as being the first which has shown the reading of small type by ear. As a test passage, a leading article from the *Times* was chosen. The inventor was blindfolded, and given the article, which he inserted in the optophone, and he then slowly but accurately began to spell out the sentences. The reading was achieved without an error. The speed attained was not more than three words a minute, but Dr. Fournier d'Albe believes that by practice a considerably higher speed can be attained. The line-changing mechanism places an outside limit of 25 words on the reader's progress. To use the optophone students have to learn its alphabet, which is a kind of musical adaptation of the Morse alphabet. There are sound dots and dashes, but these are combined with a range of musical notes falling within the compass of an octave. The sounds are conveyed to the ear by a receiver.—*The Times.*

Ministry of Munitions and Tramway Materials.—According to the *Journal* of the Tramways and Light Railways Association, the following important Instruction has been issued by the Priority Department, dated April, 1917:—

"I am directed to inform you that in order to enable the British tramway companies (the maintenance of whose service is of importance from the point of view of the production of munitions of war) to replace orders for steel and copper required *strictly for maintenance purposes only*, without referring each case to the Ministry of Munitions, it has been decided to allocate a priority reference number to each company. This will entitle such orders to be dealt with under Priority Instruction 5. With regard to steel, this Instruction does not cover requirements for new plant or renewals, nor does it include heavy repairs to track or buildings, but is intended for a limited supply of rolled plates, sheets, tires, axles, blooms, billets, forgings, and castings. It should be noted that high-speed steel, crucible tool steel, manganese steel, and malleable castings cannot be obtained except on special application to this department, and the permit number and reference of this Instruction must not be used for orders of that class. The Instruction with regard to copper, brass, and copper alloys is intended to cover only the most urgent repairs essential to maintain your existing plant, and no request for more than 1 cwt. of copper can be applied for under this permit. Copper pipes of all kinds are excluded.

"It is a condition that every three months detailed returns of the total quantity of copper, brass, and copper alloys obtained under this permit be submitted to this department.

"The priority number assigned to your tramway company is Sub. , which must be quoted on each individual order you place with your manufacturers, as follows:—

"Ministry of Munitions' Permit Number and Priority
Classification Sub.

"Signed, &c.,
"For Deputy Controller.
"Priority Department."

Inquiry.—Makers of the "Limpet" plug are asked for.

Technical Education in Australia.—We are indebted to Mr. H. R. Harper, city electrical engineer of Melbourne, for particulars of a scheme of technical training which has been adopted by the City Council in connection with its electricity supply department, with a view to raising the standard of efficiency in the technical branch of the service. The scheme comprises a system of apprenticeship, with provision for technical training, and a system of scholarships whereby the most promising of the junior engineering staff may be able to gain valuable experience in one or other of the workshops of the best British electrical manufacturers.

It is proposed in future to restrict entrance into the department to boys who have completed a course at one of the Junior Technical Schools, which are really Continuation Schools, having special courses of study to fit boys for the trades to which they are to be apprenticed.

The number of apprentices required each year in the electricity supply department will be about eight. The period of apprenticeship will be five years, and a condition will be that during the first three years apprentices shall attend evening classes, the Council paying the fees.

The apprentice who each year of the three years' period of tuition may be adjudged by the city electrical engineer first in order of merit, will be awarded a prize ranging from £5 in the first year to £10 in the third. The cost to the Council in fees and prizes under this scheme will amount to £120 per annum, which amount the Committee considers will be amply repaid by the attracting to the service of a higher grade of youths who ultimately will become more efficient workmen.

In considering applications for employment in the department as junior engineering assistants, a great deal of weight is attached to the claims of those who have had training abroad. There are, however, few local men who can afford to obtain that training. It is therefore proposed that each year the Council shall send one of these juniors to Great Britain for two years' experience in approved electrical manufacturing works. The members of the staff to receive this special training will be chosen as a result of an examination of their technical knowledge and of their progress in the department.

It is recommended that the Council provide the successful candidate with the sum of £50 to cover his return fare, and an allowance of £1 per week during his two years' absence to supplement his earnings while at home.

Each successful candidate would be required to enter into an agreement with the Council to return to Melbourne at the end of the term of two years, the Council undertaking to employ him as engineering assistant for the term of from one to three years, at the salary ruling for such a position in the department. The cost of this system of travelling scholarships would amount to £150 per annum. The Committee feels that, as in the case of apprentices, this expenditure will also be fully justified by ensuring amongst the staff a growing number of officers who will have had the benefit of this valuable training. Assurances have already been received from some well-known works that they will be glad to receive young Australians of high calibre and give them every opportunity of gaining an insight into the latest developments in the design and construction of electrical plant. The object of the Committee in submitting these proposals is to offer such facilities as will attract to the Council's service the best of the young men available in the community.

It is certainly an admirable and enlightened scheme, and should prove highly beneficial to the electricity department, as well as to the boys and men who are fortunate and worthy enough to receive these privileges.

Fatalities.—At an inquest at Dukinfield on John Nash, labourer, at the Hartshead Chemical Works, who died as the result of an electric shock whilst handling a lamp, a witness stated that the firm had not an electrician; they had been to the Labour Exchange, and the engineer had tried to get one, but could not, and they had to use the labour available. Mr. R. Blackmore, engineer to Stalybridge, Hyde, Mossley, and Dukinfield Joint Electricity Board, thought the lampholder had been brought in contact with one of the supply wires. A verdict of "Accidental death" was returned.

No-Lighting Rate.—The argument that it was ridiculous to have to pay a lighting rate, when owing to the war restrictions there had been no lights, was advanced by Marie Elvin, of Ainsworth, who was summoned to the Bury County Police Court last week for non-payment of a lighting rate of 15s. She said there had been no lights at all for 18 months, the bulbs being removed. It was stated that the Parish Council was under an agreement with the power company, and the greater part of the amount was for the equipment, and only a small amount for light. The rate had been reduced by half. An order for payment was made.

A German in Shanghai Power Station.—The *Times* Shanghai correspondent states that early in April a German ex-Marine, formerly at the Legation in Pekin, was caught inside the Shanghai electric power station in suspicious circumstances. (Was he repairing the A.E.G. turbo plant?) He was being tried in the mixed Court, when the Dutch Consul-General claimed jurisdiction, and the man was handed over to him, and ultimately acquitted after a secret trial in German, held in a private German house, two German Consulate officials assisting. The correspondent says that much public indignation has been aroused.

Electrolytic Zinc Smelters.—Smelters are being erected near Hobart, Tasmania, for the production of metallic zinc by the electrolytic process. It is hoped that metallic zinc will be produced by the beginning of August next. By the time the whole of the works are completed, from £750,000 to £1,000,000 will have been spent upon them.—*Board of Trade Journal.*

German Substitutes for Copper in Electrical Work.—The *Revue Générale de l'Electricité* gives a summary of a lecture given at Frankfort dealing with substitutes which are being or could be used in Germany in place of copper. As long ago as the end of 1914 the Germans replaced many of their copper conductors with aluminium, zinc, iron, &c. In many cases zinc is too brittle, and it is affected by temperature variations. Although these disadvantages are got over to a great extent by using pure metal, the low mechanical strength and low melting point are serious obstacles in the way of its adoption. Cables have been manufactured with steel or iron cores and stranded with zinc wire, so that these "mixed" conductors have both the mechanical strength of iron and the high conductivity of zinc. Bus-bars are made in long lengths of zinc. With certain grades of zinc it has been possible to get cables which, when laid, have the same qualities as copper conductors. For instance, a wire 1 to 2 mm. in diameter can be twisted 20 times round a rod 1 mm. in diameter. When zinc conductors are laid direct in the ground they should be covered with impregnated paper and a lead sheath.

Iron has been tried, successfully, especially for railway and tramway conductors. On the Berlin-Lichterfelde line the copper rail bonds have been replaced by covering the ends of the rails with a layer of zinc on the Schoop system.

For smaller work zinc and iron have competitors in aluminium, magnesium, and alloys such as electron (10 per cent. aluminium, 91 per cent. magnesium), which is non-magnetic and easy to machine, magnalium, and duralumin.

Lamp sockets have been made of cast-iron, and liquid starting rheostats and lamp fittings of iron, zinc, or wood. In measuring instruments copper disks are replaced by aluminium, and the magnets, instead of being of tungsten-steel, are made of chrome-steel, which is only slightly less magnetic.

Zinc has been tried for winding generators and transformers, and with partial success; A.C. motors wound with zinc wire have an output varying from 40 to 60 per cent. of that of copper-wound machines. With transformers, zinc decreases the output by about 27 per cent.

For lubrication a mixture of oil and graphite has been suggested in place of oil, as have also water and dextrin, and even solutions of potash.

Ceylon graphite, used almost exclusively before the war for carbon brushes, has been replaced by Bavarian graphite, which, suitably treated, gives a 97 per cent. product, which is sufficient in practice.

Electric v. Oil Power on Farms.—An agricultural correspondent in the *Autocar* asks: "Are we right in thinking so much about tractors?" pointing out that there are objections to mechanical ploughs on heavy land, and that the great thing is to keep every heavy implement off the land. He says: "My idea has always been that you ought to have a central electric power station which, with the aid of cable to each field, movable or permanent, would work every implement except, perhaps, a hoe. The dream may be impossible of fulfilment, owing to expense." He goes on to point out that, in addition to ploughing, there are a number of following operations on the land which cannot be performed by the tractor. It is unsuitable for reaping, and in the last damp harvest, the wheels pressed into the land so much that the evil was seen after the ploughing, and will be seen in the crops. There is obviously scope for invention in the matter of cultivating land with as little injury to it as in the case of horse-drawn implements.

The Bakerloo—Watford Railway Extension.—Elsewhere in this issue we publish a short illustrated article on the Bakerloo-L. & N.W. electric train service which was opened to the public on Monday last, and which the technical Press had an opportunity of sampling on the occasion of a trial run during the preceding week. Of the trial run we will only say that the users of this route will enjoy a measure of comfort and celerity far in advance of that usually obtaining under steam operating conditions.

The new service represents the first occasion on which tube rolling stock has been regularly employed on a main line railway; but, owing to the abnormal times, the stock employed is such as could be obtained from the existing tubes lines for temporary use.

For this reason, it will be noted that some modification of the equipment of the motor-cars, which were built for use on the Central London third-rail route, has been necessary, in order to adapt them for use with the insulated return rail employed on the Bakerloo and L. & N.W. routes.

A somewhat novel feature of the route, not mentioned elsewhere, is that the running lines beyond Queen's Park pass through the car-shed, thus rendering such lines available for car storage at night.

The past winter has severely tried electric railways in the open, by reason of the ice skin which forms on the conductor rails during frosty nights, thus preventing the shoes from making the necessary contact with them, and one of our views show the sleet-brush which is being tried on this route, with a view to overcoming the trouble.

Appointment Vacant. — Working electrical engineer (50s.), for the Holmfirth U.D.C. electricity undertaking. See our advertisement pages to-day.

U.S. Car-lighting Association.—Eight of the largest manufacturers in America of electric lighting and engine-starting sets for petrol motor-cars have just joined together in the formation, at Toledo, of the Equipment Association, the object of which is to draw up and work to a standard set of "service" reports and forms for "service station" work. Most of the manufacturers of such apparatus for motor-cars run in connection with their business what is known as a "service department," whose purpose it is to assist users in keeping their appliances in good working order, and it is with the view of working to a uniform plan that the new Association has been organised.

Marine Engine Builders Wanted.—It is announced in the Press that the Shipping Controller would be glad to hear from any engineering firms in the United Kingdom not usually engaged in building marine engines, who would undertake this class of work. They should state their possibilities. Further, the Controller would be glad to know of any schemes for establishing new shipbuilding yards in any parts of the country. Letters should be addressed to the Shipping Controller, St. James's Park, S.W.

A Bonus System at Work.—A telephone operator passed on to a foreman the message: "Tell Fritz S. that his wife has been found dead in bed." On receiving the message, and being told that his work might be dropped right where it was, Fritz replied: "Vot's de use. I don't can do her no goot now, undt, pesides, I vill lose mine bonus!"—*Industrial Management.*

Institution and Lecture Notes.—Diesel Engine Users' Association.—At the March meeting of the Association, a set of rules was discussed, and, after a few amendments had been agreed to, they were unanimously adopted by the Association.

Mr. John Milton gave some particulars concerning a curious case of failure of the high-pressure air delivery, which occurred in a compressor attached to a Diesel engine at High Wycombe. Apparently the trouble was caused by the introduction of a new high-pressure delivery valve, but the actual fault could not be discovered, and it was found necessary to replace the high-pressure delivery valve formerly in use before the air compressor could be got to work again satisfactorily.

Some particulars were given to the meeting concerning a tar oil which was being introduced on the market as suitable for use in Diesel engines.

Mr. R. W. Lyle drew attention to a blast regulator which could be fitted between the compressor and the engine, and which rendered the use of a blast bottle unnecessary.

Royal Society of Arts.—On Wednesday last, Mr. H. M. Thornton read a paper on "The Application of Coal Gas to Industry in War-Time: its National Importance." Prof. W. G. Fearnsides is to deliver two lectures (April 30th and May 7th) on "The National Shortage of Iron Ore Supplies." On May 9th, Prof. W. Ripper will deal with "Works Organisation and Efficiency."

Institution of Electrical Engineers.—At a meeting of the Newcastle Local Section on Monday last, the chairman (Mr. H. W. Clothier) announced with regret that one of their members, Second-Lieut. H. Algar, who joined the Forces about three months ago, had died in hospital. The Committee had had under consideration a report as to the training that was being given to disabled soldiers and sailors at the Cowen Home to fit them to take employment in the electrical industry. The Committee had decided, in accordance with the practice followed since the war began, that there should be no Local Section dinner this year, and suggested to the members that the money which they would in times of peace have paid for the dinner should be, instead, sent to the secretary of the Cowen Home as a subscription; those who felt they were able to subscribe more would give according to their conscience.

Mr. C. Vernier then read his paper on "Wayleaves."

Greenock Electrical Society.—At the annual general meeting, the reports of the secretary and treasurer were adopted, and office-bearers were elected: Hon. president, Mr. H. Ferrier; president, Mr. S. James; vice-presidents, Messrs. D. Angus, G. Macdonald, and W. B. Smith; hon. treasurer, Mr. W. M'Gibbon; hon. secretary, Mr. W. Love.

Decimal Coinage and the Metric System.—At a meeting of merchants of the City of London, on Wednesday last, a resolution was passed to the effect that, in view of the great advantages which would accrue to British commerce with foreign countries from the use of the decimal system, it was desirable that steps should be taken to secure its immediate adoption.

A meeting of the Castle Baynard Ward Club was held, on the same day, to discuss the metric system of weights and measures. Sir Vansittart Bowater, who presided, mentioned that not only had the City made great headway with the adoption of the system in the past few years, but every Chamber of Commerce of which he was aware had passed a resolution in its favour, while many trades and professions had similarly expressed their approval. A resolution was passed to the effect that steps should be taken to secure the immediate adoption of the decimal system, so that it might be in operation at the conclusion of the war.

Prohibited Exports from Countries Abroad.—The Supplement to the *Board of Trade Journal* of April 19th contains a complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported to various destinations from British India, Canada, New Zealand, South Africa, Newfoundland, Egypt, Malta, Cyprus, Mauritius and Ceylon.

Volunteer Notes.—First London Engineer Volunteers.—Headquarters: Balderton Street, Oxford Street, W.

Orders for the Week, by Lieut.-Colonel Clay, V.D., Commanding:—

Monday, April 23rd.—Technical for Platoon No. 9 at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30—8.

Wednesday, April 25th.—Instructional Class, 6 15. Platoon Drill, Platoon No. 2.

Thursday, April 26th.—Platoon Drill, Platoon Nos. 5 and 6. Ambulance Class by M.O., 6.30. Signalling Class.

Friday, April 27th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Recruits' Drill, 6.30—8.30.

Saturday, April 28th.—N.C.O.'s Class, 2.45, under Captain Bentley and the Instructor of Musketry.

Sunday, April 29th.—Special work at Bombing School. Parade, Clapham Junction Station (City and S.L. Railway), Tube, 9.45 a.m.

(By order), Macleod Yearsley, *Captain and Adjutant.*

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Mr. John Senior, acting electrical engineer to the Ilkley U.C., has been appointed engineer and manager, at £250 per annum.

The Wolverhampton T.C. has increased the salary of Mr. C. Bellhouse, boiler-house superintendent at the electricity works, from £180 to £230 per annum.

Mr. H. A. Greaves, assistant mains engineer at the Sheffield electric supply department, was presented with a roll-top desk by his colleagues upon leaving to take up a position with Messrs. T. H. Watson & Co. The presentation was made by Mr. S. E. Fedden.

The Dundee Corporation Electricity Committee has decided that Mr. Bishop, Mr. Lamb, and Mr. Reid receive a bonus of £50 a year for the extra work done while the engineer (Mr. Richardson) was with the Forces. The department has saved £300 on the engineer's salary by his Army pay, so that the bonus will not cost the department anything.

General.—Mr. John C. McLennan, Professor of Physics at the University of Toronto, has accepted a seat on the British Board of Inventions.

Dr. Alexander Graham Bell, inventor of the telephone, was presented with the Civic Forum Medal of Honour for distinguished public service, at a meeting of the Civic Forum, New York, on March 21st.

At Wellingborough Parish Church, on April 12th, the marriage took place of Mr. Hugo Stephens, of Northampton, of the Premier Accumulator Co., and Miss Mary Elizabeth Pendered. From the employés of the Premier Accumulator Co., Mr. Stephens received a silver inkstand and brasses.

At an informal gathering on March 6th, Mr. G. M. Sichel was the recipient of a chronometer presented by members of the London erection department of the British Westinghouse Electric & Manufacturing Co., Ltd., as a token of their regard and esteem, on the occasion of his leaving to take charge of the erection work in Scotland.

Roll of Honour.—Sergeant Leslie Smith, of the Australian Force, who is reported killed in action, went to Sydney some five years ago to take up an appointment as electrician. He had been three times in hospital. He served his apprenticeship as an electrician with Messrs. Thompson Bros., of Blackburn.

Corporal W. H. Townley, King's Own Scottish Borderers, of Wilmslow, Manchester, who has been killed in action, was formerly engaged as an electrician at Stockport and Wilmslow. At the Battle of Loos he gained the Croix de Guerre of France.

The *Times* reports that Captain Stanley J. Snowden, Middlesex Regiment, reported killed on March 26th, aged 25, was educated at Heddon Court and at Harrow. On leaving Harrow he trained as an electrical engineer at Faraday House, and later obtained an appointment on the L. & N.-W. Railway.

Corporal John McKenzie, Essex Regiment, on the works staff of the Western Electric Co., has fallen in action. Last year he gained the Military Medal.

Second-Lieutenant Arthur Annan Johnston, R.F.A., formerly in the G.O. Department of the India Rubber, Gutta-Percha & Telegraph Works Co., Ltd., Silvertown, died of wounds on April 16th.

Obituary.—Mr. Robert Young.—The death has occurred of Mr. Robert Young, electrician, of Oldham, at the age of 63.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lancashire Electrical Engineering Co., Ltd.—Equitable charge on Volt Works, Ashton-under-Lyne, dated March 20th, 1917, to secure all moneys due or to become due from company to Union Bank of Manchester.

Cambridge Electric Supply Co., Ltd. (36,457).—Capital, £100,000 in £10 shares. Return dated March 14th, 1917. 9,911 shares taken up, £89,199 paid. Mortgages and charges £30 000 first mortgage debentures and one debenture with bankers to cover £15 000.

Crampton & Co., Ltd. (109,328).—Registered April 29th, 1910. Capital, £2,500 in £1 shares. Return dated March 22nd, 1917. All shares taken up; £2,500 considered as paid. Mortgages and charges: Nil. Registered office: 73, Queen Victoria Street, E.C.

Cross & Cross, Ltd. (105,754).—Capital, £5,000 in £1 shares. Return dated December 31st, 1916 (filed April 3rd, 1917). All shares taken up; £155 paid; £4,845 considered as paid. Mortgages and charges £600.

S. Bornett & Co., Ltd. (89,565).—Capital, £2,000 in £1 shares (1,000 pref.). Return dated March 5th, 1917. 757 pref. and 950 ord. shares taken up; £1 per share called up on 757 pref. and (5s. premium) £1 5s. per share on 200 ord.; £1,007 paid; £750 considered as paid on 750 ord. Mortgages and charges: Nil.

City of Buenos Aires Tramway Co. (1904), Ltd. (82,214).—Capital, £1,240,000 in £5 shares. Return dated March 1st, 1917. All shares taken up; £1,240,000 considered as paid. Mortgages and charges: £74,000.

Fred Danks, Ltd. (122,376).—Capital, £30,000 in £1 shares. Return dated March 28th, 1917. All shares taken up; £30,000 paid. Mortgages and charges: Nil.

Dynamic Electrical Co., Ltd. (104,436).—Capital, £100,000 in £1 shares. Return dated December 31st, 1916 Seven shares taken up; £7 paid. Mortgages and charges Nil

Crossley Bros., Ltd. (51,970).—Capital, £973,700 in £1 shares (403,390 pref. and 570,310 ord.). Return dated March 13th; 1917. All shares taken up; £278,200 paid on 278,200 ord, £695,500 considered as paid on 125,190 pref. and 570,310 ord. Mortgages and charges: Nil.

Electrical Industries Development Co., Ltd. (89,461).—Capital, £25,000 in £1 shares (20,000 pref and 5,000 ord.). Return dated December 31st, 1916. 9,007 pref. and 5,000 ord. shares taken up; £4,007 paid on 4,007 ord.; £10,000 considered as paid on 5,000 pref. and 5,000 ord. Mortgages and charges: Nil.

W. E. Dove & Co., Ltd. (72,630).—Capital, £3,500 in £10 shares. Return dated March 12th, 1917. 320 shares taken up; £2,000 paid; £1,200 considered as paid. Mortgages and charges: £800.

Charing Cross, West End & City Electricity Supply Co., Ltd. (29,122).—Capital, £2,100,000 in 130,000 pref., 130,000 ord., 80,000 City Undertaking pref., and 80,000 City Undertaking ord. shares of £5 each. Return dated March 29th, 1917. 80,000 pref., 80,000 ord., 80,000 City Undertaking pref., and 70,000 City Undertaking ord. shares taken up; £1,200,000 paid on the pref., ord., and City Undertaking pref.; £350,000 considered as paid on the City Undertaking ord. Mortgages and charges: £1,087,178.

CITY NOTES.

Swiss Electrical Companies. The directors of the *Accumulatoren Fabrik Oerlikon* recommend the payment for 1916 of a dividend at the rate of 20 per cent., as in 1915, and propose an increase in the share capital from £48,000 to £66,000.

The directors of the *Gotthardwerke A.G. fur Elektrotechnische Industrie, of Bodio*, in which German as well as Swiss firms are interested, recommend the payment of a dividend of 15 per cent. for 1916, as contrasted with 10 per cent. in the preceding year.

The Elektrizitats Gesellschaft Alioth, of Basle, which belongs to the Brown-Boveri group, and is now solely an investment company, reports gross profits of £22,000 for 1916, as contrasted with £19,000 in the preceding year. The net profits are £13,800, as in 1915, and the dividend on the ordinary share capital of £240,000 is at the rate of 5 per cent., as in the previous year.

The Schweizerische Ges. fur Elektrische Industrie, of Basle, which is an investment company having interests also in undertakings situated in belligerent countries, reports gross profits of £124,000 for 1916, as contrasted with £173,000 in the preceding year, on an ordinary share capital of £800,000. After defraying the interest on the loan capital of £2,400,000, the balance is absorbed by general expenses and taxes, whereas in 1915 the net profits of £49,000 permitted of the distribution of a dividend at the rate of 5 per cent.

The accounts of the *Aluminium Industrie, A.G., of Neuhausen*, indicate net profits, including the balance brought forward, amounting to £682,000 for 1916, as compared with £379,000 in the preceding year. It is intended to pay a dividend at the rate of 20 per cent. on the paid-up capital of £1,050,000, as compared with the same rate on £840,000 in 1915, and to transfer £346,000 to the fund for fully paying up the shares, as against £140,000 devoted to this purpose in 1915, there thus remaining to be made only a further appropriation of £4,000 in order to pay the shares up in full.

Willans and Robinson, Ltd. The accounts for 1916 show, after payment of debenture interest, provision for depreciation of plant and machinery, and re-valuation of stocks, and allowances to employés on active service, a net profit of £20,090. As in the previous year, special provision has been made on account of new outlays, and the exceptional wear and tear arising from conditions connected with war output. After paying the dividends on "A" and "B" preference stocks, and annual interest on funding certificates outstanding, a dividend of 10 per cent. is recommended on the ordinary shares, leaving £12,140, of which £10,463 is to be put to reserve fund, and the balance of £1,677 is to be distributed amongst the holders of "B" stock and ordinary shares in manner provided by the Articles. The business has largely increased during the year, and its resources have been fully employed on important work Major P. M. Peters has retired from the board. The loss of Mr. Leslie Robertson (for five years a director) in the *Hampshire*, is also recorded in the report.

Clyde Valley Electrical Power Co.

The profit for the half-year ended December, 1916, was £59,162, plus £15,456 brought forward. After adjusting interest, and transferring £25,000 to contingency fund for depreciation, &c., bringing it up to £192,500, transferring to special reserve £6,920, paying the preference dividend (£9,000), and a dividend of 1¼ per cent. on the ordinary shares (free of income-tax) £7,500, there is to be carried forward, subject to Excess Profits Duty, £25,797. The plant and mains have been maintained in efficient repair out of revenue. The new power station at Clyde's Mill, near Cambuslang, has been in operation since November last, and it has now been found necessary to order a duplicate of the plant already installed there in order to meet the demand for power next winter. Col. C. M. King has retired from the board, and Mr. R. Robertson (Strain and Robertson, consulting engineers to the company) has been elected in his place.

German Electrical Companies.

The Lloyd Dynamo Werke, A.G., of Bremen, which undertaking was formed at the end of 1915 with an ordinary share capital of £50,000, reports net profits of £2,400 for 1916, most of which amount has been carried forward.

The financial statement of the *Deutsche Kabelwerke, A.G., of Berlin-Lichtenberg*, indicates gross profits of £65,000 for 1916, as compared with £35,000 in the previous year. Including the balance forward, the net profits are returned at £31,000, as against £35,000, and the directors propose a dividend at the rate of 8 per cent. on the ordinary share capital of £262,000, this contrasting with 6 per cent. in 1915.

The directors of the *Elektrochemische Werke, Bitterfeld*, whose shares are almost entirely in the hands of the A.E.G. group, propose to raise the rate of distribution on the old shares for £275,000 from 10 per cent. in 1915 to 12 per cent. in 1916, whilst 7 per cent. is to be paid on the new shares for £75,000. The operation of the company's works continues to be leased to the Griesheim-Elektron Chemical Works.

The accounts of the *A.G. Mix und Genest, Telephon und Telegraphenwerken, of Berlin-Schoneberg*, show that £39,000 has been placed to depreciation in 1916, as against £40,000 in the preceding year, leaving net profits of £86,000 and £132,000 in the two years respectively. The directors recommend the payment of a dividend at the rate of 18 per cent., being the same as in 1915.

The Ver. Isolatoren Werke, A.G., of Berlin-Pankow, in which the Berlin Electrical Undertakings Co. is largely interested, reports an increase in the gross profits of £12,000 in 1915 to £79,000 last year, of which £3,900 and £37,000 have been applied to depreciation in the two years respectively. The net profits have risen from £600 to £15,000, and the dividend for 1916 is at the rate of 20 per cent. on share capital of £50,000, as compared with no distribution in 1915.

The report of the *Ges. fur Elektrische Hoch und Untergrund Bahnen, of Berlin*, states that the number of passengers carried increased from 69,542,000 in 1915 to 78,700,000 last year, at the end of which the traffic had reached approximately the normal level of the last year of peace. It is explained that the principal reason for the augmentation was to be found in the progressive restriction in the omnibus and motor-cab services, thus causing a diversion to the elevated and underground railway. The former overcrowding of the trains was now to be avoided as far as possible by accelerating the services. The growth in the traffic was accompanied by a considerable expansion in the working expenses for wages and raw materials, and this fact and other burdens caused by the war brought about a further decrease in the net profits. An improvement in this respect was not to be expected in 1917, especially as the cost of labour and materials had again increased, and would presumably continue to a large extent also after the war, and the only remedy lay in an advance in the fares. The net profits amount to £124,000, as compared with £168,000 in 1915, and the dividend on the ordinary capital of £3,000,000 is at the rate of 3 per cent., as compared with 4 per cent. in 1915, 4½ per cent. in 1914, and 6 per cent. in 1913.

Northern General Transport Co., Ltd.

During 1916 labour conditions were increasingly difficult, owing to the need of men for the Forces, and the omnibus services had to be further curtailed, although the demands made upon the company for travelling facilities were heavier than ever. Owing to increasing costs of operation, fares were increased. Shares held by the company in the Gateshead, Tynemouth, and Jarrow Companies stand in the books at a cost of £392,226, and the dividends for 1915 were £23,726. For the year the above three companies set aside for reserves and renewals £25,219, and their total funds amount to £169,860. The company's revenue for 1916 was £35,756 (plus £5,777 brought forward), and after providing for administration expenses, deducting £4,274 for loan and debenture interest, providing £5,515 for renewals, £1,410 is put to sinking fund for debenture redemption, 6 per cent. is paid on the preference shares, and 6 per cent. on the ordinary, leaving to be carried forward £5,689.

Canadian General Electric Co., Ltd.—The report for 1916 shows that a gross profit of $2,225,912 was earned, which is in excess of any previous year in the history of the company. $408,887 has been reserved for depreciation of buildings, machinery and patterns, and in addition $631,603 has been reserved for the amortisation of munitions plants and equipment, leaving a net profit of $1,185,426. From this amount $779,843 has been paid in dividends, leaving a surplus for the year of $405,577. This surplus, added to last year's balance, makes a total of $1,112,696, from which $500,000 has been transferred to reserve, bringing the amount to the credit of reserve account to $3,500,000, and leaving $612,696 to the credit of profit and loss. During the year the mortgage indebtedness on properties purchased has been reduced from $1,367,751 to the sum of $413,813.

Midland Electric Corpn. for Power Distribution, Ltd.—The trading revenue for 1916 was £112,856, and the profit £63,646. The balance to the credit of the net revenue account, after payment of debenture interest, is £33,182, plus £8,932 brought forward. There is put to depreciation of plant and machinery £9,773, writing off of commission and expenses of issues of debentures and shares, and expenses during construction £8,615, transfer to debenture premium redemption account £500; balance £23,226. After paying 6 per cent. on the preference shares and 5 per cent. on the ordinary, there is carried forward, subject to provision for Excess Profits Tax, £11,802. The net capital expenditure for the year in respect of plant, mains, transformers, &c., was £36,916. To provide for this outlay, debenture stock to a total nominal value of £45,600 was sold.

British Westinghouse Electric & Manufacturing Co., Ltd.—Net profit for 1916, £199,346, plus £44,632 brought forward. There is written off patents, goodwill, &c., £25,000; special depreciation of plant, machinery, &c., £44,243; additional reserve for employers' liability, £10,000; 7½ per cent. pref. dividend, £75,000; carry forward, £89,735. There have been charged against revenue the usual expenses for maintenance of works, plant, &c., and in addition there has been applied to depreciation of the same items an amount of £91,144, which includes the special sum above referred to of £44,234 to cover abnormal wear and tear of plant due to war conditions. The position under the Finance and Munitions of War Acts being still uncertain, the amount carried forward is larger. Meeting: April 26th.

Woking Electric Supply Co., Ltd.—The revenue for 1916 was £21,185 (against £20,331 for 1915), less expenses £11,609. Including the amount brought forward and income-tax accumulations, the balance is £10,342. Out of this, debenture and loan interest absorb £2,883, 6 per cent. pref. dividend £3,000, there is put to depreciation and renewals £2,000, to reserve £500, 5 per cent. dividend is to be paid on the ordinary shares, and £638 carried forward. Consumers, 2,101, against 2,131; lamps connected, 119,237, against 106,360. Owing to continuous growth of the business, the directors are still looking towards issuing further debenture stock and ordinary shares. Units generated 1,499,106, against 1,285,940 in 1915; units sold, 1,165,975, against 971,541.

Marconi Wireless Telegraph Co. of America.—The report states that the operations show, before allowing for reserves, a net income of $336,040, as compared with $288,994. Receipts for message traffic with ships show an increase for the year of 9 per cent. over the previous year. The income from investment of surplus funds, amounting to $98,107, decreased $6,824. After setting aside all reserves, the net profit amounted to $259,888, an increase of 46.56 per cent. This amount has been added to the surplus, increasing that account to $801,776 at December 31st last, and the reserve set aside at that date against depreciation amounts to $439,716.—*Financial Times.*

Oldham, Ashton & Hyde Electric Tramways, Ltd.—The revenue for 1916 was £37,008 (compared with £34,822 in 1915), and the expenditure (including £1,504 for debenture interest and £1,500 placed to provision for renewals account) was £25,504 (compared with £25,062), leaving a net profit of £11;503 (compared with £9,760). There is to be placed to reserve £5,502; 5 per cent. is paid on the cum. pref. shares; a dividend on the ordinary shares of 6 per cent. is to be paid, carrying forward £2,782.

W. T. Glover & Co., Ltd.—The directors recommend dividends for 1916 at the rate of 5 per cent. on the cum. pref. shares, and 6 per cent. on the ord. shares. After allocating £6,500 to debenture redemption funds and transferring £15,000 to reserve funds, a balance of £22,025 remains to carry forward, subject to Excess Profits Duty, the amount of which is not yet ascertained.

Yorkshire (Woollen District) Electric Tramways.—The report for 1916 states that the revenue amounted to £76,140, an increase of £4,547. After deducting all expenses chargeable to revenue and setting aside £5,100 to renewals fund, a dividend at the rate of 5 per cent per annum on the ordinary shares is recommended, carrying forward £3,487.

Aldersley & Wilmslow Electric Supply, Ltd.—During 1916 the total lamp connections increased from 1,092 KW. to 1,133 KW. The profit was £2,815, against £3,064 in 1915. £1,242 was brought forward. Interest on debentures and loans absorbs £1,691, £1,200 is to be put to reserve fund, and £1,166 is to be carried forward.

Melbourne Electric Supply Co., Ltd.—At an extraordinary general meeting called for April 23rd, a resolution will be submitted issuing 70,000 preference shares of £5 each at present unissued as 7 per cent. first cum. pref. shares, ranking *pari passu* with the 30,000 7 per cent. first cum. pref. shares of £5 each already issued.

Monte Video Telephone Co., Ltd.—Interim dividend for the half-year to January 31st at the rate of 5 per cent per annum on the preference shares, and 6 per cent. per annum on the ordinary shares.

Fairbairn Lawson Combe Barbour, Ltd.—Net profit of £7,807, as compared with a loss for 1915 of £4,241. The directors do not see their way to recommend any dividend on the ordinary shares.

La Plata Electric Tramways Co., Ltd.—After placing £3,000 to the reserve fund, there is a credit balance of £10,048 to be carried forward.

Greenock & Port Glasgow Tramways Co., Ltd.—Dividend of 8 per cent. (16s. per share) on ordinary shares for 1916, £1,200 to reserve, £4,000 to renewals fund, £1,778 to sinking fund for loan redemption, leaving £3,201 to carry forward.

Kalgoorlie Electric Power & Lighting Corpn., Ltd.—Dividend on the preference shares at the rate of 4 per cent. per annum for the six months ended March 31st.

Direct United States Cable Co., Ltd.—Final dividend of 2s. per share, less tax at 5s. in the £, making a total distribution of 4 per cent. for the year ended March last.

STOCKS AND SHARES.

Tuesday Evening.

Continuance of the strength of markets as a whole is the principal Stock Exchange feature. There is considerable buying of all the investment securities, while in speculative markets, rubber shares command the principal attention. Home Railway stocks have maintained their rises, and the expected entry into the theatre of war of the South American States has contributed to the stiffening of the Brazilian exchange and an improvement in bonds, shares, and stocks of that country. Oddly enough, Brazilian Tractions have given way a point or so; but, on the other hand, Anglo-Argentine Tramways are a more robust market than they have been for some time past.

Electricity supply shares are now mostly quoted ex dividend. Bromptons are 6½, and Chelseas 2⅞, both ex dividend last week. Charing Cross ordinary rose ⅛ to 3⅜, and Metropolitans stiffened to 2 7/16, showing an advance of the same amount. Metropolitans are regarded by some as being a cheap speculative investment, inasmuch as the company should now have recovered from its internal troubles; and, with a strong, united board, the outlook should be much clearer, upon any return of normal days, for the rapidly increasing prosperity of the company.

One of the features in the Home Railway market is the strength of Underground Electric income bonds. These have recovered from their recent lowest price of 77½ to their present level of 81½ under the pressure of quiet buying; and the effect has now worn off of the slight scare produced by the suspension of various omnibus services. That the bonds will in due course receive their full 6 per cent. again is considered in the market to be only a matter of time—and not a very long time at that—though it has to be remembered that the interest is not cumulative, but dependent from one half-year to another upon the receipts.

Metropolitans are easier; Districts remain steady, while amongst the lists for prior-charge stocks there are still many more buyers than sellers. The opening this week of the new line from the Elephant and Castle to Watford has quickened interest in the Underground group; and great curiosity is felt as to what result the new feeder is likely to have upon the receipts of the holding company.

The telegraph market once more shows a list of unbroken rises. Anglo-American preferred at 94½ ex dividend is 1½ to the good, though actually this is reduced to 1⅛ when the income-tax is taken off the dividend. Eastern Extension and Eastern ordinary are both better. Indo-Europeans again rose £1. Globe Telegraph ordinary at 12 is 5s. higher.

There is not much doing in Marconis, the speculative interest in miscellaneous shares being so largely absorbed for the time being by the rubber animation. American Marconis fell away to 15s. 6d. on the appearance of a report which disappointed a good many by the non-declaration of a dividend. The company, however, is gradually strengthening its position; and although the progress made has not been as much as the optimists expected, the company seems to be moving in the right direction.

Brazilian Tractions, as already mentioned, have given way, the price at 47½ showing a fall of 2½ points. This is difficult of explanation, because all the other Brazilian issues are good, and the exchange is moving in favour of the country. Anglo-Argentine Tramway first preference are 5s. up, and the 5 per cent. debenture at 66½ is 2 points to the good.

The Canadian General Electric Co. publishes a report showing a flourishing state of affairs. But Canadian utilities are quiet for the time being; and America, which can be counted upon as a rule to provide support, is too much occupied with the war for stocks and shares to receive much attention in Wall Street.

The Mexican group is irregular, Mexico Tramways being easier, while the Mexican Light and Power issues show useful rises. The Mexican Railway announces that the Mexican Government has again acquired control of its property, and this is held to be a disquieting factor, in view of the uncertainty as to which side the Mexican Government is likely to take in the world struggle. British Columbia Electric stocks are disposed to improve, but there is not much change in prices. The 4¼ per cent. debenture is ½ up.

Manufacturing shares remain very firm. Callenders are 5s. better. Henleys recovered half their dividend and bonus of £1. Edison Swan 4 per cent. debenture stock is 2 points higher. The most animated part of the miscellaneous market, however, is that devoted to rubber shares, where business continues to be extraordinarily brisk, with prices rising, on balance, day after day. Iron and Steel shares are also better; and the armament issues are bracing up again.

The Stock Exchange has just issued its own annual balance sheet and accounts for the year ended March 25th last. In the latter occurs the item "Electric power, working expenses and maintenance," which is put down at £1,442, against £1,680 in the previous 12 months. This does not include salaries and wages. The Stock Exchange runs its own electric light plant, the machinery being used for illumination in the darker days and for pumping cooled air into the House during the weather which the last six months have made it so impossible to believe we ever get.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price April 17, 1917.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	9	6½xd	—	£6 18 6
Charing Cross Ordinary	5	5	3⅜	+ ⅛	7 8 2
do. do. do. 4½ Pref.	4½	4½	3 3/16	—	7 1 2
Chelsea	4	3	2⅞xd	—	5 4 4
City of London	8	8	11⅜	+ ⅛	7 0 8
do. do. 6 per cent. Pref.	6	6	9¾	—	6 3 1
County of London	7	7	10⅛	—	6 18 3
do. 6 per cent. Pref.	6	6	9¾	—	6 3 1
Kensington Ordinary	7	10	5¼	—	5 11 7
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	3¾	—	5 6 8
Metropolitan	3	3	2 7/16	+ ⅛	6 3 1
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 4 0
St. James' and Pall Mall	8	8	6⅛	—	6 10 8
South London	5	5	2¾	—	7 5 6
South Metropolitan Pref.	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	5⅝	—	6 5 9
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	94½xd	+1½	6 7 2
do. Def.	33/6	1½	22	—	6 16 4
Chile Telephone	8	8	7	—	5 14 4
Cuba Sub. Ord.	5	5	7¾	—	6 9 0
Eastern Extension	8	8	13⅛	+ ⅛	*5 15 4
Eastern Tel. Ord.	8	8	141	+1	*5 13 4
Globe Tel. and T. Ord.	7	7	12	+ ¼	*5 16 8
do. Pref.	6	6	9¾	—	6 3 1
Great Northern Tel.	22	22	37	—	5 19 0
Indo-European	13	13	48¼	+1	6 14 0
Marconi	10	10	2⅞	—	3 9 7
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord.	10	10	2⅛	—	4 14 1
United R. Plate Tel.	8	8	6⅝	—	*6 0 9
West India and Pan.	6d.	6d.	⅞	—	2 12 6
Western Telegraph	8	8	13⅞	+ ⅛	*5 15 4
Home Rails.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	24¾	— ¼	4 0 10
do. District	Nil	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A"	Nil	Nil	5/-	—	Nil
do. do. Income	6	5	81½	+2	*6 2 8
Foreign Trams, &c.	Dividend 1914.	Dividend 1915.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	3⅛	+ ¼	8 16 0
do. 2nd Pref.	5½	5½	2⅝	—	—
do. 5 Deb.	5	5	66½	+2	7 10 5
Brazil Tractions	4	4	47½	—2½	8 8 5
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	61	—	8 4 0
do. do. Preferred	—	Nil	46	—	Nil
do. do. Deferred	—	Nil	39½	—	Nil
do. do. Deb.	4¼	4¼	63½	+ ½	6 13 10
Mexico Trams 5 per cent. Bonds	—	Nil	2 ½	—1	Nil
do. 6 per cent. Bonds	—	Nil	26	—	Nil
Mexican Light Common	Nil	Nil	9½	+2	Nil
do. Pref.	Nil	Nil	17½	+3	Nil
do. 1st Bonds	Nil	Nil	27½	+5	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	2⅞	—	5 4 4
British Aluminium Ord.	5	7	27/3xd	—	7 6 10
British Insulated Ord.	15	17½	12¾	—	6 17 3
British Westinghouse Pref.	7½	7½	2½	—	6 0 0
Callenders	15	20	13	+ ¼	7 13 10
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	3 3/16	—	6 18 0
Edison & Swan, £3 paid	Nil	—	7/16	—	Nil
do. do. fully paid	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	69½	+2	5 15 2
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9⅝	+ ⅛	6 4 8
do. Ord.	10	10	14½	—	6 18 0
Henley	20	25	15½xd	+ ½	8 1 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11⅞	—	*8 8 4
Telegraph Con	20	20	37	—	*6 9 10

* Dividends paid free of income-tax.

WAYLEAVES.

By C. VERNIER, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

Although between 1,000 and 2,000 route miles of overhead electric mains have already been erected under the difficult conditions at present obtaining in this country, the time has come to consider seriously whether the important services which public suppliers of electrical power, light, and heat, must continue to afford—and certainly in a greater measure than ever before—to our industries, manufacturers, railways, and the practically untouched field of agriculture, in the strenuous and difficult times which will follow the present European conflict, do not call for prompt legislative assistance in removing certain difficulties that at present hamper their fullest development.

The need for efficiency and economy will be so seriously accentuated, both in regard to a more efficient utilisation of our seriously depleted capital and also in regard to the conservation of our natural resources, of which in this country coal is unquestionably the most important, that there is every reason to expect that electrical services which can so eminently achieve both these objects will be sought for to an unprecedented extent after the war.

The advantages and economies which can be derived from the generation of electrical energy on a large scale, or from the centralisation or linking-up of existing electricity supply undertakings, are now generally recognised. The present paper is more closely concerned with securing to the fullest possible extent the advantage of the economies in capital cost which can be effected by the use of overhead wires for interconnecting, transmitting, and distributing mains across open country, and the no less important economies which can be obtained by laying underground mains wholly or partly on private property whenever the use of such mains is found desirable. On 20,000-volt mains the saving in capital cost which can be effected over an equal length of route by the use of overhead wires as against the use of underground cables is in the neighbourhood of 50 per cent., excluding the cost of wayleaves in each case. At higher voltages it is yet greater; while by using cross-country routes for underground mains, instead of keeping strictly to public roads, a saving in capital cost of 30 per cent. is not uncommon on routes of several miles, and even more on shorter lengths, as the result of shortened routes and cheaper reinstatement of the ground. It must further be borne in mind that although the Board of Trade are willing to allow extra-high-pressure overhead lines on public roads, subject to strict requirements regarding public safety, practical considerations usually render this, if not quite impracticable, at least extremely undesirable, and therefore all such lines must ordinarily be placed on private property. We have also to face the probability that, in the near future, much higher transmission pressures will be employed, and this cannot in the present state of the art be satisfactorily dealt with (if at all) by underground cables.

The difficulties already referred to in the use of overhead wires for extra-high-pressure transmission, fall conveniently under two heads, viz., "Consents" and "Wayleaves."

Consents.

The Electric Lighting Acts contain clauses to the effect that (1882) the undertakers shall not be authorised to place any electric line above ground, along, over, or across any street without the express consent of the local authority, and (1899) shall not, without the express consent of the Board of Trade, and of the local authority also, place any electric line above ground except within premises in the sole occupation or control of the undertakers.

There can be no appeal from the decision of a local authority in this matter, which may refuse its consent without assigning any reason or may attach unreasonable and onerous conditions thereto, or cause unreasonable and vexatious delays. There is only one usual exception to this procedure, *i.e.*, in the case of the Power Acts, where an appeal to the Board of Trade is allowed in the event of a consent by a rural district council being unreasonably withheld.

The anomaly of the position will be better appreciated when it is pointed out that any private individual or company who cares to undertake the transmission or distribution of electricity without statutory powers—which can be and is commonly done, for example, by colliery and quarry owners and others, as there is no restriction placed upon it so long as electricity supply to consumers is not the chief business of the undertaker—is perfectly free to erect overhead wires over private land without the consent of the local authority, and can quite well carry such wires across public roads and footpaths, provided the local authority are not the owners of the land on either side of the road, and that care is taken not to contravene any by-laws which the local authority may have adopted, and further, in the absence of special by-laws, that the highway is not itself interfered with or broken up, and that its ordinary use is not restricted in any way.

As an example of the difficulties and delays imposed upon statutory company undertakings by these restrictions, in one case seven and a half months elapsed before a commencement could be made with the work, and nine months before the consent was finally given.

In another instance, consent was given only provided that where the line crossed any road, street, or footpath, it must be placed underground at a minimum cover of 3 ft., and that if any new road or street were laid out on the land where the line was situated, the line should be placed underground.

In another case, application was made to a rural district council for consent to the erection of overhead wires wholly over private land, except where roads and footpaths were met with. This consent was granted on condition that the line be placed underground where it crossed any road, bridlepath or footpath. Fortunately, in this case, the local authority being a rural district council, there was a right of appeal to the Board of Trade. Such an appeal was therefore entered, and subsequently allowed by the Board of Trade. The total time taken to obtain this consent was over nine months.

These examples may serve to illustrate how many of these local authorities have but the haziest idea of why they stand possessed of the powers conferred in the clauses of the Acts already quoted. Some, and fortunately a good proportion of these local authorities, treat the matter as a mere formality to be complied with by the undertaker and consent readily; others, in the absence of proper enlightenment, usurp functions which properly belong to the Board of Trade; while in other cases it is difficult to discern the existence of that public spirit which one might look for in the representatives of an important community.

I am strongly of the opinion that it is essential that a right of appeal to the Board of Trade should be allowed in all cases, and that while the local authority should have the right to be heard, it should have no absolute veto on such questions, and that all powers of interference in technical questions, such as design, and questions of the public safety, without a reference to the Board of Trade, should be absolutely taken from them.

A time limit should further be determined, say, one month, as in the case of works on public roads, during which a local authority must either signify or refuse its consent, failing which such consent will be deemed to have been given, as the unreasonable delays which are at present possible in some cases should not be tolerated.

Wayleaves.

Electricity supply, gas, and in some cases water, undertakers are precluded by law from laying their mains in private lands without special consent, and this is only possible by a complete agreement for an easement or wayleave with the owner and occupier, and upon such terms and conditions as he or they may in their entire discretion impose upon the undertakers.

The above restrictions have been found to be a source of serious inconvenience and unnecessary expense, and a hampering obstacle in the development of electric power supply on a large scale, and in the full achievement of the economies resulting therefrom.

Cases of absolute refusal to grant an easement or wayleave have been in my experience fortunately of rare occurrence, but it is otherwise with the imposition by landowners of unnecessarily oppressive conditions, chiefly the exacting of outrageously exorbitant rents, having regard to the use which is made of the land and its value to the owner,* and with some exceptions in their exercise of procrastination and utter indifference to industrial needs in dealing with such matters.

Only a very few cases need be cited, as doubtless the ensuing discussion will bring to light many others:—

1. A landowner (an eccentric old lady), without assigning any reason, refused to allow any cables, pipes, or poles whatever on her land.

2. The agent to a large landowner, when first approached, was inclined to grant a wayleave on reasonable terms. Subsequently, owing to a claim for damage having been served upon a firm in which this agent was interested (unknown at the time to the applicant) he plainly intimated that he would set one case against the other. He was subsequently induced to moderate his views, but the claim for damage had eventually to be abandoned.

3. A landowner, after leading the applicant to believe that a certain wayleave over his land would be granted, kept delaying his final consent on some pretext or other. After nine months of this sort of thing, when pressed more than usual, he took offence, and definitely refused to consider the matter any further. It was, therefore, necessary to incur additional expense in laying this section underground.

4. A charity trust, whose meetings were only held quarterly, was applied to for a wayleave. After repeated delays, a reply was received that the wayleave would be granted, provided the applicants would undertake to give a supply of electricity to one of the trust's institutions in another part of the district, which necessitated a special main. It was fully 18 months before the permission could be obtained to start work. The line was nearly 20 miles long, and all other wayleaves had been granted some nine months before this last consent could be obtained.

5. A colliery company owning land in various parts of the district held up wayleaves in two places on overhead lines

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* Rents for agricultural farm land vary from 5s. to 60s. per acre, with probably 25s. to 30s. per acre as a fair average.

some 30 miles long, taking advantage of the opportunity offered to negotiate favourable terms for a supply of electricity to a colliery.

As a rule, where a landowner employs a full-time agent to look after his property, delays are seldom so serious as in the case of smaller owners who have to deal with the matter themselves or through a solicitor.

A frequent cause of prolonged delay is that one or more owners, after the usual initial delay in replying, which varies according to the individual, make objection to the route selected over their land. Negotiations must then be reopened with other owners, who probably have already given their consent, to allow of a diversion of the route on their estate, and in consequence they not infrequently come to the conclusion that the applicant does not know his own mind, which is not usually conducive to a speedy settlement. If, in addition, a local authority should call for a diversion of the route when negotiations with landowners are well advanced, it is readily perceived how delays become cumulative.

I purposely refrain from quoting some of the onerous conditions which landowners have sought to impose, in some cases with success, as in the existing condition of things such information might adversely affect future negotiations.

Cost of Wayleaves.—Compensation for an easement or wayleave is almost invariably given in the form of an agreed annual rent, based either on a fixed sum per pole or per yard of route, or an annual lump sum payment to cover a particular stretch of route between fixed points.

Rents have steadily risen during the past seven years, and especially since the war began.* This is partly because landowners who at first treated wayleave rents merely as a convenient addition to the rents which they already received for the ordinary use of their land, have more and more come to regard wayleave rents as quite a useful source of additional revenue, and, especially since the war scale of taxation came into force, have made the most of their opportunities.

Moreover, as it is usually quite impossible to bring the slightest pressure to bear in negotiations for wayleaves, it has in unavoidable cases been necessary to pay some recalcitrant landowner a heavier rent than usual in order to complete wayleaves for a route. Other landowners have come to hear of this rent, and have asked for the same terms.

The following examples may serve to indicate the measure of the extortionate demands which are exacted :—

1. At the present time it would be more advantageous, on financial grounds alone, to electrical undertakers in some parts of the country to rent a strip of land wide enough for many a London street for the whole length of an overhead line at the same rents per acre as landowners secure from their tenants for some of the very best of the agricultural land in this country, and such that even if this strip of land were put to no other use the landowner would suffer no pecuniary loss.

2. Alternatively, and subject to the same assumption, it would in many cases be a satisfactory business proposition from the point of view of the undertakers to rent the whole area of specified fields along the route, on agricultural tenant's terms, provided the right to sub-let for agricultural purposes were allowed.

The iniquity of these charges can be further appreciated when it is mentioned that only approximately one-half of 1 per cent., on a liberal estimate, of the land mentioned in paragraph 1 is actually diverted from its ordinary use in connection with an overhead line on arable land, and less than one-quarter of 1 per cent. on grazing land.

If these charges may fairly be termed iniquitous in the case of overhead lines, what should be said of the same rents which are now frequently asked for wayleaves for underground cables? Underground cables when once laid generally require no further attention for many years, and do not obstruct or interfere in any way whatever with the ordinary use of the land; in fact, their very existence is usually forgotten by everyone except the undertaker and the grantor of the wayleave when he receives his rent.

Additional compensation has to be paid for all damage to crops, drains, fences, &c., occasioned in the laying down or erection of the work, or its subsequent repair and maintenance, while invariably there is a clause in the agreement for the diversion of the main at short notice at the sole cost of the undertaker.

Hitherto I have only discussed the landowner's rent, but the tenant or occupier (if any) has also an interest in the land, for which he should receive compensation. There are alternative methods of dealing with the occupier. The first is to agree upon terms with the landowner on the understanding that he settles with his own tenant. This is the basis on which the cost of wayleaves discussed above has been considered. As a rule, landowners prefer this procedure. The second method is to agree upon a rent with the landowner based on the applicant agreeing to make terms with the tenant. This is not a method to be recommended.

Compulsory Powers for Expropriation.—There are two points of view from which the question of electricity supply undertakers being granted compulsory powers for carrying their mains over or through private land may be regarded. These are briefly, on the one hand, that such undertakings afford a valuable public service, and that any source of unnecessary expense in furnishing such service is ultimately a serious handicap to industry and production, and consequently contrary to the national interest. The other is that these undertakings—I here refer to company undertakings—are a source of private profit, and any saving of expenditure merely increases profits to shareholders.

The latter is undoubtedly the view that weighs chiefly in the minds of the majority of individuals and private and public bodies when they have the power, as in this case, to exercise their absolute discretion in granting or refusing a concession. Although it is evident that Parliament has already afforded some measure of recognition to the public service character of electricity supply undertakings, especially power company undertakings, by the grant of special privileges, such as the right to break up streets and roads, the compulsory acquisition of land for their works, and, on the other hand, the imposition of specified duties under penalties. and of control, including the regulation of maximum charges and dividends, it does not appear hitherto to have fully recognised the not unimportant part which electricity supply has played in the national economy during the past 10 years, or which it is destined to play in a much larger, and even perhaps an extraordinary, degree in the near future, provided encouraging facilities are afforded for its development.

Compulsory power for expropriation for works of public utility, or, as is better known in the United States, the power of eminent domain, *i.e.*, the sovereign right of a State to appropriate private property to public uses, whether the owner consents or not, exists in most European States, including Italy, Switzerland, France, Norway, Spain, Holland, Belgium, and possibly other countries, and also in the United States.

In Italy, Switzerland, and France further enactments on expropriation have been applied to the carrying of electric mains (either overhead or underground) over or through private land, while in Norway the general law on expropriation is available for this purpose.

In every case it is necessary to satisfy the authorities, *i.e.*, either the Crown, the Legislature, or a Government Department, that (*a*) the undertaking or (*b*) the proposed main is one of public utility, before these powers can be applied.

In the United States, under a recent law easements for rights of way over public and national lands can be granted by the State, but I am not aware that otherwise the ordinary procedure is in any way different from ours, *i.e.*, by negotiation and agreement with the owners. Owing to the comparatively low cost of land in many parts, however, it is quite a common practice for electric light and power undertakings to purchase a strip of land for at least their most important lines, and elsewhere to use the public roads as far as possible, even for extra-high-pressure overhead lines.

The United Kingdom and Germany are the only two large European States which, having reached a high state of industrial development (perhaps in some measure because of this), have not yet adopted compulsory powers for expropriation for electric mains on private property.

In this country, with a few exceptions, the only statutory powers which are at all analogous to the right of expropriation or of eminent domain, are the compulsory powers for the purchase of land under the procedure laid down in the Lands Clauses Acts.

We are not here, however, concerned with the purchase of land for routes for our mains, nor should this be at all necessary. The present procedure for the compulsory purchase of land is altogether too clumsy and costly to render its adoption practicable for such a purpose.

There are, however, interesting precedents in our own legislation which afford to certain authorities the right to secure compulsory easements over private land.

(*a*) A local authority under the Public Health Act, 1875, may carry sewers and water mains through any private land whatsoever without taking the land or purchasing an easement, but only subject to compensation.

(*b*) Under a short Act passed last year—Telegraph (Construction) Act, 1916—the Postmaster-General is empowered to erect or lay down overhead or underground telegraphic lines on private land by serving a notice upon the owners, lessees, or occupiers of the same, and any difference between the parties is to be referred to a stipendiary magistrate, a judge of a County Court, or in Scotland a sheriff, with a right of appeal to the Railway Commissioners.

In the Act of 1916 there is no restriction as to motive, so long as the proposed line *is in the public interest.* So far as I am aware, there is not a single case in which the powers conferred by the Telegraph Acts of 1892 and 1908 have been exercised, and the working of the more recent Act of last year will be watched with great interest.

(*c*) In India under powers conferred by the Indian Telegraph Act, 1885, the telegraph authority is entitled to place telegraph lines and posts in or upon any immovable property.

Our special interest in these clauses lies in the fact that they have been extended to electricity supply undertakers in certain cases, and also in regard to the diversion clause contained in the Act.

The Land Inquiry Committee's Report.—In 1912 the then Chancellor of the Exchequer (Mr. Lloyd George) appointed a small private committee to inquire, amongst other matters, into the "nature and workings of the existing systems of ownership, tenancy and taxation and rating of land and buildings in urban districts and the surrounding neighbourhoods, and their effect on industry and the conditions of life." The report of this committee refers to the question of wayleaves in the following terms:—

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* These rents have in my experience approximately doubled since the war, and more than trebled during the past seven years.

"Public bodies are often called upon to pay large sums for such easements, and private firms are affected similarly when they are unable to get consent to the laying of pipes for the service of necessary water or electrical power. . . . Modern developments of the use of electricity to supply power at a distance from the spot where it is generated have given increased importance to this question. Wires have to be carried across country, and here, too, each owner whose land it is proposed to traverse is enabled to hold the scheme up by demanding an excessive price for permission to carry the wire across his land. In some cases he is enabled to prevent it altogether. . . . We believe that the State should exercise the power of compelling the grant of easements and wayleaves of all kinds.

"Therefore we recommend:—

"1. That the Government Department authorised to give such sanction should have the power to make an order for the compulsory acquisition of easements or wayleaves for any purpose.

"2. That in all cases where any such order is made the terms should be fixed by the Judicial Land Commissions.

"3. That in all cases: (*a*) The local authority and the landowner should both be enabled to appear before the Government Department and the landowner before the Commissioners.

"(*b*) The amenities of the neighbourhood and the interests of the landowner should be considered, and injured as little as possible.

"(*c*) The term 'landowner' should include all who have substantial interests in the property."

On the question of the present procedure for assessing compensation under the Lands Clauses Acts, the Committee state:—

"We are of opinion that a permanent tribunal cheap and easy of access, with wide powers in respect of limiting evidence and disallowing costs, should be substituted for the present procedure. Such a tribunal would take the form of a court or a commission combining a strong judicial element with expert members. The latter should be professional men not in private practice who would be retained in the service of the court or commissioners, thus adding independence of judgment to their professional skill. We had intended to recommend a court, but the proposals of the Government to constitute a body of Judicial Land Commissioners for dealing with questions of tenure and compensation fully meet our views.

"Therefore we make the following recommendations with regard to the tribunal for assessing compensation, its procedure and costs:—

"(*a*) That in all cases where land is acquired under compulsory powers, the final determination of the purchase price, the assessment of the compensation for severance and disturbance due to the claimant, and the apportionment of the compensation as between several claimants, should be determined by the Judicial Land Commissioners.

"(*b*) That the procedure for determining the amount of compensation for the land taken should be as follows:—

"1. At the time of applying for compulsory powers the promoters should serve a notice on the district valuer and all interested persons, as to the lands to be acquired.

"2. If and when the compulsory powers are obtained, the district valuer should assess the market value of the property to be acquired, as at the time of the application for compulsory powers provided that where the owners or persons interested are unable to agree to the valuation they should have the right to appeal to the Land Commissioners against the valuation of the district valuer.

"As to costs, we recommend that:—

"(*a*) A scale of costs and fees in compensation cases should be prepared by the commissioners.

"(*b*) It should be in the discretion of the commissioners to award the whole costs of arbitration in any proportion as between the promoters and the claimants provided that when the finding of the commissioners is less than the offer made by the promoters, the costs should be paid by the claimant, unless otherwise ordered by the commissioners.

"(*c*) The commissioners should have discretion to limit the number of witnesses and to exclude counsel."

I have freely quoted from the above report, as, in my opinion, not only would the adoption of the Committee's recommendations go far to overcome satisfactorily most of the present difficulties in connection with obtaining wayleaves, but, further, any action which might be taken in order to secure legislative assistance would, if on these lines, be more likely to meet with Government support.

The report formed the basis of the Land Reform proposals outlined on behalf of the Government by Mr. Lloyd George at Bedford and Swindon in October, 1913, which included the formation of a Ministry of Lands and the appointment of Judicial Land Commissioners. Owing to the war, these proposals have had to be abandoned, but I believe that the war will have facilitated the adoption of these or similar measures to an extent unthinkable in pre-war times.

The drastic powers exercised by the State during the war under the Defence of the Realm Acts will have accustomed everyone, legislators and the public alike, to the idea of State interference with private rights in anything that concerns the public interest, and the vital importance of rendering the nation as self-supporting as possible in the future, both industrially and in regard to agriculture, will call for much more intelligent State aid and oversight than in the past, and in many previously neglected directions.

It is obvious that no new legislation of this nature can be considered by Parliament during the period of the war and for some time after, but I suggest that the Council of the Institution would do well to formulate proposals and consider without delay the best means of securing their adoption.

The Land Committee's recommendations have, however, one serious defect, in that no definite period of time is appointed during which consents must either be given or an order be made by the Government Department concerned. Time is all-important in industrial matters.

It appears inconceivable that the present procedure in connection with the acquisition of land for general public purposes, including electricity supply, can for long remain unchanged after the war, but in the event of the Government showing no intention of proceeding within a reasonable period after the declaration of peace with the former proposals, I submit the following for discussion, which utilise existing machinery and are not inconsistent with precedents in our present legislation.

(*a*) That, failing agreement between a statutory electricity supply undertaker and a landowner or occupier for a wayleave for electric mains on private property, or if a landowner or occupier refuses to give a consent or fails to give a reply in writing within one month from the date of application, the Board of Trade be authorised, after inquiry, to make an Order for a compulsory wayleave within a further period not exceeding two months. In all cases the undertakers would have to satisfy the Board of Trade as to the commercial and other considerations which render this course necessary.

(*b*) That, failing agreement between the parties as to the annual rent to be paid by way of compensation, this be determined by one of the following methods:—

1. By a single arbitrator (who should be an expert) appointed by the Board of Trade, counsel and expert witnesses being excluded from the arbitration proceedings. The Board of Trade with the concurrence of the Lord Chancellor to be authorised to fix a scale of costs and disallow costs unnecessarily incurred.

2. By the valuation of two surveyors, one of whom shall be appointed by one side and one by the other side, and in the event of their not being able to come to an agreement, by a third surveyor appointed by two justices or a stipendiary magistrate.

In fixing the wayleave rent, regard should be had to the average annual rent (if any) received from the land under consideration during the previous seven years, and a reasonable percentage should be added to cover permanent damage, disturbance, or inconvenience which may arise from the proposed works, and for the right of entry upon the land. This percentage would obviously be greater for overhead wires than for underground cables. The arbitrator or valuer should not be allowed to take into consideration any saving in expenditure which is afforded to the undertakers by the grant of wayleave, but should apportion the rent equitably between landowners, tenants, and occupiers, and all who have a beneficial interest in the land.

Any of the parties, failing agreement, should have the right to apply for a revision of the rent once in every seven years. Damage to crops, &c., caused in the execution of the work, should be settled separately and in the usual manner.

(*c*) That in cases of urgency, the undertakers be authorised to enter upon the land and commence the execution of the work as soon as an Order has been made by the Board of Trade, and before the assessment of the compensation, upon serving a notice, making a satisfactory deposit, and giving bond.

(*d*) That a right of appeal to the Board of Trade be allowed in all cases where a landowner or occupier demands the removal or diversion of a main at the cost of the undertakers which in the opinion of the undertaker is unreasonable or unnecessary.

The success or failure of any proposals such as these would obviously depend upon the degree of "public utility" which might be attached by the Government Department concerned to the various kinds of electrical services, but even if compulsory powers were only granted in important and difficult cases, the mere existence of such powers and the possibility of the grantor of a wayleave having to justify his demands would, I believe, exercise such a moral effect that in many cases an agreement would be possible without putting into operation the machinery created. It would materially assist in this very desirable consummation if undertakers were enabled to secure a declaration from the Board of Trade of the public utility of a proposed main for which wayleaves are required before negotiation is entered into with landowners and others, in all cases where the Board is satisfied that the public interest justifies such a declaration.

Discussion.

Mr. C. H. Wordingham, in opening the discussion, said the paper was intimately connected with the success of the electrical industry, and was eminently fair from beginning to end. It was essential that we should be able to run overhead and underground mains by a direct route, and also true that existing rights should be respected. He considered that Mr. Vernier's proposal for appeal to a tribunal with compulsory powers was a good one.

Col. Ogilvie thought the tendency would be for Parliament to be much more willing to consider new legislation now than at any previous period, as evidenced by the grant of powers to the Post Office last year. The existing statutory powers for lines over private property were not satisfactory; the private individual was in a better position as regarded freedom of action than the statutory authority. The Postal authorities, in the past, had suffered a great deal in obtaining wayleaves from local authorities, and it was extraordinary what a great number of road authorities there were, whose powers applied equally to power lines and postal lines. The Post Office experience in dealing with stipendiary magistrates and county court judges was that most uncertain and freakish judgments were given, and he would prefer always to have the right of appeal to a regularly constituted body such as the Railway Commissioners.

Mr. W. B. Woodhouse said that legislation on the subject of wayleaves was quite antiquated, and they must make out a strong case if it was to be altered. Additional reasons could be advanced for greater wayleave facilities, as in many districts it was better to run mains overhead than underground on account of the danger from subsidence; also they had to consider in the future the transmission of very large powers, which would require a wide strip of land to enable many lines to get away from the power station. The question of agricultural and railway supply also called for further wayleave facilities. It was not claiming too much to say that electric power requirements were quite as important as those of the telegraph and telephone in the matter of obtaining wayleaves. He saw no reason to distinguish between county boroughs and urban councils as regarded powers, as the former often embraced equally rural country. A difficulty was encountered under the Settled Lands Act, in that a wayleave could only be given for 21 years; again, when dealing with trustees, &c., legal expenses mounted up, and they were in general very heavy. He recently secured an agreement, terminable at six months' notice, for six poles, which cost £9. As showing the difficulties encountered, he cited a case of a local authority which, while quite willing for a 10,000-volt overhead line to pass through its area, asked that the wires should be continuously insulated. He thought it would help matters if they said they supported in principle all the recommendations made by Mr. Vernier.

Mr. D. A. Starr said he was glad that in the Scottish area with which he was connected, they had less difficulties to contend with than in England; they had many miles of line on private land, and a special department had been formed for negotiating wayleaves. He thought the question of lines over private roads open to the public, and on roads passing over or under railway bridges, was as important as that of lines passing over agricultural lands. In some cases the farming community welcomed their lines, and took a supply through pole transformers. The projected "Supply of Electricity Bill" contained a clause dealing with wayleaves which, if passed, would cover the author's recommendations.

Mr. A. J. Stubbs, with regard to legislation, said the Post Office would no doubt find it necessary to secure the Postmaster-General's rights in the matter of wayleaves, but, apart from this, they were brothers in arms. He thought it would be agreed that the Post Office had priority in the use of roads, and ventured to suggest as an alternative to the proposals in the paper that it would be easier to draft a small Bill conferring on power engineers the same privileges as already held by the Post Office authorities. He suggested, as regarded the proposed reference to the Board of Trade, that that body was rather a controller of electric supply powers than one able to act judicially, as was the case with the Railway Commissioners.

Mr. J. C. Wigham asked why anyone should have the right to refuse permission for running lines overhead; a private supplier could not be prevented from doing it. The important part of the wayleave question was the "consents"; various suggestions had been made, and he only wished they had the same powers as the Post Office, but doubted whether Parliament would grant so much. He agreed with the proposal to refer to the Board of Trade matters of compensation, and in the draft bill of the Joint Committee a similar reference was made to the Board of Trade, with a further important stipulation that the same arbitrator should sit continuously. The question of forming a judicial electrical committee was urged before Sir Charles Parsons's Committee, and he thought that that was wanted, and was really better than having an arbitrator appointed by a Government department.

Mr. E. T. Williams urged that this was not the time to consider the matter, but the time to act. He submitted figures of costs of wayleaves, showing the great divergence in values; in many cases recently, however, powers had had to be taken under the Defence of the Realm Act to run transmission lines, which was evidence of the necessity of altering the law. He suggested that the proposed Electricity Board should be added to the Board of Trade in the author's recommendations. They must be reasonable in their requirements to avoid opposition, and he thought that a slight modification of the 1916 Telegraph Construction Act would meet the case. Electricity supply must be represented by a concrete body before its representations would meet with success. If London's water supply and dock improvements justified the creation of a public body, then surely the electric supply of Great Britain was important enough for such a body.

Mr. H. M. Sayers said he found that the Spanish wayleave law substantially followed the Italian law, and he proposed to send a translation to the *Journal*.

Mr. J. E. Kingsbury said the author concluded with certain sound proposals, and the only question was what could be done to forward the object of the paper. The proposals embodied in the 1916 Post Office Act had actually been officially put forward in 1885, and, in view of the time taken to secure them, it was very necessary to make an early move in the wayleave question. They were suffering from a lack of public appreciation of the difficulties and iniquities of the question; if the public realised that the refusal of a wayleave resulted in disadvantage to the community, the position would be better appreciated.

The President (Mr. C. P. Sparks), in the course of a few remarks, said the paper resulted from the work of the I.E.E. Committee on Electricity Supply. The question of obtaining suitable outlets from large power stations was so wrapped up with electricity supply that it was felt advisable to have a paper read on the subject. Hence, Mr. Vernier was invited to deal with the question, and the Council that day had awarded him the Paris premium for his paper, the reception of which by the meeting proved that they had selected the right man for the work. In the present state of the law, the non-statutory undertaking was immensely better off than the statutory one as regarded overhead lines. In one case with which he was concerned, the lines extended 10 miles, and it was easy to get wayleaves. No local authority could refuse permission to cross roads; moreover, the private owners and the railway companies were both interested parties, as regarded the industry in question, and could not easily refuse wayleaves. He felt that the necessity for granting greater powers would be forced on the legislature in the next year or two.

The Author, in replying, said he was glad there was general agreement on the subject; the present was the most propitious time to deal with it, and he felt that the Board of Trade Committee would be compelled to give it consideration. The Scotch undertakings were in a better position; it was only in Scotland that the County Council was the local authority. He remarked that the Newcastle-on-Tyne Co. also had a wayleave organisation of its own. Some of the difficulties met with by the smaller undertakings were due to the lack of such an organisation. The railway companies claimed wayleave rental if the construction touched the structure of a bridge; a standard charge had been fixed to meet such cases. He thought that a charge per unit was iniquitous; the railway company had nothing to do with the amount of energy transmitted. The Postmaster-General seemed to own the earth and the air, though he provided only one kind of public service; personally, he thought the Postmaster-General should not have quite so extensive powers, but he got on very well with the Post Office engineers. Parliament had not yet realised the importance of electricity supply and the economies that could be effected by its means. The Electricity Board suggested by Mr. Williams would be a very good thing, if and when appointed, and could deal with the question of compulsory wayleaves. If they got the powers, let them be *useful* powers; the French law was useless in some respects. He was sanguine that the powers desired would be secured in two years or less.

ALUMINIUM PRODUCTION BY ELECTROLYSIS.

By RICHARD SELIGMAN, Ph.Nat.D.

(*Abstract of paper read before the* Institute of Metals.)

In the course of his paper on "Electric Furnaces as Applied to Non-Ferrous Metallurgy," Prof. Stansfield describes the production of aluminium by the electrolysis of a fused mixture of cryolite and alumina, and illustrates the course of the main reaction by means of the conventional formula

$$Al_2O_3 + 3C = 3CO + Al_2.$$

In a communication on this paper Dr. G. H. Bailey points out that this formula does not truly represent the changes which take place.

As Prof. Stansfield correctly states, it has been assumed heretofore that carbon monoxide is the sole gaseous product of the electrolytic reduction of alumina.

This was the generally accepted view when the present writer approached the subject at the beginning of 1905.

A correct appreciation of the mechanism of the reaction whereby aluminium is produced in the electric furnaces is of very great practical importance, because the anode consumption is one of the main items in the cost of production of aluminium, and it is clear that if the assumption be made that for every three units of aluminium produced two units of carbon must necessarily be consumed, a downward limit is put to the possible reduction of this source of expenditure.

From observations made of the electric furnaces at work, the writer soon reached the conclusion that the accepted "theoretical carbon consumption" was a myth, and that it should be practicable to work with a far lower consumption than had up till then been considered possible. At that time, however, he found his efforts to improve the carbon ratio hampered by the assertion that it was useless to spend money on experiments with the object of reducing a consumption which already approached very nearly to the figure demanded by "theory." Nevertheless, in a series of large-scale experiments made avowedly with a different object a carbon consumption of well below the "theoretical" figure was attained early in 1907. Experiments on a larger scale and in many directions were immediately started, and by the summer of 1907 the fact that carbon monoxide was not necessarily the sole gaseous product of the reaction had been finally demonstrated. As a result of the explosion of the fetish of a "theoretical" carbon consumption of 66 per cent., the present-day consumption has, as Dr. Bailey says, been reduced to a very much lower figure, with financial benefits which are very considerable. The improvement attained has been accompanied by a number of subsidiary advantages.

Some further experiments were carried out by the writer with the late Mr. H. B. Phillimore. Owing to the difficulties experienced in eliminating atmospheric contamination in a commercial furnace, these experiments were made on a laboratory scale in the electrical department of University College, Gower Street, where Prof. Fleming kindly gave facilities for the work to be done.

Experiments so far published upon the production of aluminium on a laboratory scale have, in their efforts to simulate practical conditions, always overlooked one of the most important, namely, current density. It is well known that in the aluminium furnace the heating is done by the electrolysing current, no external source of heat being required. Experimenters have been anxious to reproduce this condition, but have overlooked the fact that the loss of heat from a laboratory furnace is far greater, proportionately, than that from a full-size commercial unit. In order to make up for this loss of heat, current densities have been applied which are far in excess of those used in practice, and consequently the conditions obtaining in these laboratory furnaces have been totally different from those found in practice.

Mr. Phillimore and the writer considered that the question of the source of heat was entirely irrelevant, and that in order to construct a laboratory furnace which would truly represent the practical conditions, external heating would have to be applied so as to neutralise the excessive loss of heat to which these diminutive furnaces are subject. By constructing such a furnace, the external source of heat being either gas or electricity, it was found possible to produce aluminium under normal conditions in a bath having a capacity of about 150 grm. of electrolyte only. So far as the experiments went they indicated that all the phenomena of a large furnace could be reproduced "in parvo" by this simple device.

In order to prevent the infiltration of oxygen the electrolysis was carried out in a slow stream of nitrogen. Under these conditions gases containing more than 3 vols. of CO_2 to 1 vol. of CO were obtained before the experiments were interrupted, temporarily it was then thought, but in fact permanently.

Dr. Bailey in his communication rightly demolishes the old accepted formula, but replaces it by another, namely—

$$2Al_2O_3 + 3C = 2Al_2 + 3CO_2.$$

The view of the writer at the time was that the primary product of the electrolysis was oxygen, and that whether oxygen, carbon dioxide, or carbon monoxide resulted was dependent upon such factors as temperature, current density, physical properties of the carbon anode, rapidity with which the gases were removed from contact with the anode, and similar factors. The experiments designed to prove the correctness or otherwise of this view had to be abandoned before any decision had been reached.

SUBSTITUTION IN ELECTRICITY WORKS.

The following is a copy of a circular-letter issued under date April 16th, 1917, to members of the Incorporated Municipal Electrical Association by the Hon. Secretary, Mr. C. Faraday Proctor :—

Substitution in Reserved Occupations.

Dear Sir,—I beg to enclose a questionnaire which I shall be obliged if you will kindly fill in and return to me at the earliest possible moment.

I have to inform you that a deputation consisting of representatives of the

I.E.E.,
I.M.E.A.,
I.A.E.P.C.,
Conference of Chief Officials of the London Electric Supply Companies, and the
Association of Provincial Electric Supply Undertakings of Great Britain

was received by the Reserved Occupations Committee at their offices, St. Ermin's Hotel, on Wednesday, March 28th, at 3.30 p.m., under the chairmanship of Mr. Graves.

The various speakers on behalf of the deputation drew attention to the following, amongst other matters :—

The great importance of the electricity supply industry, both from the public utility and the munitions standpoint.

The very large number of employés affected and amount of machinery dependent upon electricity supply, and the comparatively small number of employés engaged in electricity works in relation thereto.

The danger of too severe cutting down of the staff and employés in electricity works.

The necessity for considering the employés in electricity departments from the standpoints of technical capability, experience and physical fitness.

The difficulties, dangers and limitations of "substitution."

The employment of disabled soldiers and sailors and women and girl labour.

The shortage of labour in the neighbourhood of some large undertakings.

The difficulty, and, in some cases, the impossibility of making even slight reductions in staff of small undertakings.

The necessity for each case to be considered on its merits by expert advisers.

The fact that woman labour is employed in some instances to the extent of 25 per cent. or more, but that the extent necessarily depends upon the local, climatic, and social conditions.

The chairman stated that the recent de-badging was carried out upon the order of the Cabinet direct, and Tribunals should appreciate the fact that it was not, and is not, intended to be a mandate that all de-badged men are to go into the Army, but that it is still for the Tribunals to consider the circumstances of each case, and that a reasonable time should be given for the provision of substitutes.

The chairman stated that the Committee were fully alive to the position and importance of the electricity supply industry. It was not their intention to interfere with skilled men.

It was agreed that a circular letter be issued by the respective Associations to their members, particularly impressing upon them the necessity of closely following up the suggestions made in the letter and memorandum addressed to the I.M.E.A. by the Reserved Occupations Committee on February 5th, 1917,[*] and that statistics of the staff and employés of electricity works be obtained now, and further statistics in two or three months' time, to show what further substitution had taken place, and when a further conference would be held.

SCHEDULE 1.

Statistics for March 31st, 1917.

(a) Number of employés, July, 1914 .. ..
(b) Number of employés released for service with Colours to March 31st, 1917 .. . .
(c) Number of employés, March 31st, 1917 .. ..

Analysis of (c).

(1) Number under Military age (18) .. ..
(2) Number over Military age (41) .. ..
(3) Number of Military age (18–41) .. ..
(4) Number of Women .. ..

Total as above (c) at March 31st, 1917 .. ..

Analysis of (c) (3). (Men of Military Age (18–41).

Number of Discharged Soldiers and Sailors .. ..
Number of Rejected Men .. ..
Number of Badged Men .. ..
Number of other grades .. ..

Total number of men of Military age as above (c) (3) ..

Names of undertakings to which the above returns apply :

....

....

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

Canada.—The following reduced Customs duties are to be levied as from January 19th, in virtue of regulations made by Order in Council under Section 286 of the Customs Act, viz.—On battery jars of glass and articles of hard rubber when imported by manufacturers for use only in their own factories in the manufacture of electric storage batteries :—Under the British Preferential Tariff 12 per cent. *ad val.*, under the Intermediate Tariff 20 per cent. *ad val.*, and under the General Tariff 20 per cent. *ad val.*

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[*] Electrical Review, February 23rd, 1917, page 212.

UNITED KINGDOM AND CERTAIN FOREIGN COUNTRIES.—A Supplement (Part I) to the *Board of Trade Journal* of March 1st contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported from Denmark, France (including Algeria), Italy, Japan, and the Netherlands. This Supplement also contains the list of articles, complete to March 1st, which are prohibited to be exported from the United Kingdom. A further Supplement (Part II), issued on March 8th, contains similar lists for Norway, Portugal, Russia, Spain, Sweden, and Switzerland, and this Part contains also a copy of the United Kingdom Contraband List complete to date of publication. The information given in these two Supplements supersedes that given in the Supplements published on November 23rd and 30th last. Copies of the Supplements may be obtained, price 3d. each (post free 3½d.), from H.M. Stationery Office, Imperial House, Kingsway, W.C. 2.

SOUTH AFRICA.—In consequence of representations made to the High Commissioner for South Africa, the Union Government have extended to two months the time limit within which suppliers' invoices of goods shipped to South Africa must be dated previous to the date on which the vessel sails which carries the goods.

The High Commissioner for the Union draws attention to the provisions of Section 7 of Act 26 of 1914, and points out that the declaration of home consumption value must show prices current *at date of invoice*, and not that current when the order was accepted or contract entered into.

JOHORE.—A revised list of export-duties came into operation on January 1st last. Wolfram and scheelite are free, but all other metals and metalliferous ores (except tin and gold) pay 10 per cent. *ad valorem*.

PERU.—A tax of 2 centavos on every kilogramme of rubber exported through the port of Iquitos is levied under a law dated October 11th last.

SEYCHELLES.—A recent Ordinance provides for the levy on all goods imported of a surtax not exceeding 10 per cent. on the amount of Customs duties now payable under Ordinance 3 of 1913, with the exception of wines and articles de mode. Under the existing Tariff the duty on all kinds of wire and on electrical apparatus is 12½ per cent. *ad valorem*, to which the above-mentioned surtax must now be added.

FRANCE AND ALGERIA.—The importation into France and Algeria of all goods produced in or coming from foreign countries is prohibited, by a Decree published on March 24th, with the exception of (a) goods imported on account of the State; (b) goods which are proved to have been dispatched direct to France or Algeria prior to March 24th; (c) goods declared for warehousing in those countries by the same date. Other exceptions may be allowed by the Minister of Finance, either of a general character, or within the limits of the contingents to be fixed by a new Committee ("Comité des derogations aux prohibitions d'entrée") which is to be set up in the Ministry of Commerce. In addition to fixing the quarterly contingents of imports for specified products, the Committee is to draw up and submit for approval proposals for general licences in respect of certain goods, and for each contingent a scheme for dividing the goods among the various industrial and commercial groups in proportion to their essential needs.

It is understood that the prohibition will not be brought into force until the contingents above referred to have been fixed.

SWITZERLAND.—A notification issued by the Swiss Customs Department provides that packing materials (sacks, wooden packing cases, glass receptacles, ropes and cords, &c.), which have been imported as containers of merchandise may be re-exported empty on production of documentary proof that the articles are in fact returned empties. [It should be remembered that an import licence will be necessary in the case of such returned packing materials as are covered by the British "Prohibition of Import" Proclamation.]

BRAZIL.—Among the requirements of the new Consular invoice regulations, laid down by the Brazilian Budget Law for 1917 (see the ELECTRICAL REVIEW of April 6th), was one that packages entered on an invoice must be numbered consecutively. Cabled instructions have now been received by the Brazilian Consul-General in London from the Ministry of Foreign Affairs suspending this requirement, but the requirements that each invoice must cover a shipment of goods bearing the same mark (thereby ensuring that the goods are destined for one consignee only) holds good. Shippers are also reminded that the old requirement that Bills of Lading and Consular Invoices should agree in every respect is still in force.

CANADA.—A recent Memorandum issued by the Department of Customs calls attention to the existing Regulation providing that the words "fair market value as sold for home consumption *at time shipped*" in the heading of one of the columns of the prescribed invoice form should be strictly adhered to. If importers desire to make an entry on invoice forms without this proper heading, but containing the usual certificate, entry may be accepted upon addition of 10 per cent. to invoice value pending delivery of proper invoices.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & CO., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

4,720. "Automatic device for wireless signalling." J. MORRISON & W. A. MORRISON. April 2nd.

4,738. "Electrical instruments for transmission and/or reproduction of sound." D. F. MCQUIRE & F. W. MCQUIRE. April 2nd.

4,739. "Protective gear for dynamo-electric generators." H. PEARCE. April 2nd.

4,758. "Telegraph systems." A. DAVIDSON, J. A. L. DEARLOVE & N. J. PERRYMAN. April 2nd.

4,773. "Magnetos." N. P. RAWLINS. April 3rd.

4,808. "Manufacture of electric cables." C. J. BEAVER & E. A. CLAREMONT. April 3rd.

4,839. "Electric switches." C. C. GARRARD & A. H. RAILING. April 4th.

4,860. "Sparking plug." BLUEMEL BROS., AND F. H. BLUEMEL & F. A. SAXELBY. April 4th.

4,865. "Plug connections for electric circuits." H. LUCAS & W. H. EDWARDS. April 4th.

4,866. "Electric arc lamps." H. B. GRYLLS & W. HEAPE. April 4th.

4,882. "Individual electric driving of machine tools, cranes, &c." H. SCHOLEY. April 4th.

4,885. "Manufacture of plates for storage batteries." H. WADE (Flanders). April 4th.

4,886. "Manufacture of storage-battery plates, and paste therefor." H. WADE (Flanders). April 4th.

4,901. "Attachment for electric torches." J. F. BARR. April 5th.

4,923. "Electric welding device." F. B. DEHN (Electric Railway Improvement Co.). April 5th.

4,937. "Telephone appliance." F. MAYER. April 5th.

4,946. "Circuit interrupters." BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO. (Westinghouse Electric & Manufacturing Co., U.S.A.). April 5th.

4,948. "Electric pocket lamps." S. BIHELLER. April 5th.

4,950. "Electrical instruments." H. A. EWEN & MARCONI'S WIRELESS TELEGRAPH CO. April 5th.

4,957. "Electric interrupters for induction coils, &c." D. MCLENNAN. April 5th.

4,963. "Electric switches." O. V. FORBES & J. GELL. April 5th.

PUBLISHED SPECIFICATIONS.

1915.

13,788 DYNAMO-ELECTRIC MACHINES. D. Suchostawer. (March 27th, 1916.) September 28th.

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

6,869. POWER TRANSMISSION SYSTEMS. W. Morrison. June 8th, 1915. (100,639.)

7,731. STARTING INTERNAL-COMBUSTION ENGINES. Bosch Magneto Co. June 12th, 1915. (100,682.)

9,588. HAULING OR WINDING MACHINERY. Siemens-Schuckertwerke Ges. September 4th, 1915. (101,407.)

146. PROJECTION OF A LIGHT BEAM. H. R. Evans. January 4th, 1916. (104,517.)

3,204. AUTOMATIC NIGHT TIDAL SEMAPHORES AND TIDE RECORDERS. W. M. Greer (H. G. Reaks). March 3rd, 1916. (104,527.)

3,323. INCANDESCENT-LIKE FIRE OR IMITATION FIRE, OR LUMINOUS BODY FOR DOMESTIC FIREPLACES, STOVES, GRATES, OR THE LIKE. C. O. Bastian & H. H. Berry. March 6th, 1916. (104,533.)

4,182. METHODS OF AND APPARATUS FOR SHAPING WIRE. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 21st, 1916. (104,561.)

7,376. APPARATUS AND APPLIANCES FOR PREVENTING THE OVERWINDING AND UNDERWINDING OF CRANES, HOISTS, LIFTS, WINDING DRUMS, AND THE LIKE. E. Allen & Co. and E. H. Furnival. May 24th, 1916. (104,591.)

14,250. SOUND PRODUCING OR TRANSMITTING APPARATUS. R. A. Fessenden. June 27th, 1916. (104,643.)

2,176. ELECTRIC COUPLINGS. R. W. L. Phillips. February 14th, 1916. (104,702.)

3,637. TRANSFORMER AND OIL SWITCH VESSELS OR COOLING TANKS OR OIL CONTAINERS AND THE LIKE, AND THE METHOD OF MANUFACTURING THE SAME. J. H. Davies. March 11th, 1916. (Cognate application, 11,647/16.) (104,717.)

3,657. IMPULSE CONTROL SYSTEMS FOR AUTOMATIC TELEPHONE EXCHANGES. Western Electric Co. & F. R. McBerty. March 11th, 1916. (Addition to 3,360/14.) (104,719.)

3,736. SEMI-AUTOMATIC TELEPHONE SYSTEMS. Relay Automatic Telephone Co. & H. J. Herink. March 13th, 1916. (104,726.)

3,859. DYNAMO-ELECTRIC MACHINERY. J. H. St. H. Mawdsley & H. F. Joel. March 15th, 1916. (104,731.)

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3,896. MAGNETO-ELECTRIC MACHINES FOR IGNITION IN INTERNAL-COMBUSTION ENGINES. M. S. Conner & A. R. Kahl. March 16th, 1916. (104,736.)

4,006. APPARATUS FOR TESTING ELECTRIC CIRCUITS. F. Proksch. March 22nd, 1915. (100,201.)

4,348. ARC PROJECTOR LAMPS. J. Brockie and Johnson & Phillips. September 25th, 1916. (104,753.)

4,453. ELECTRIC CONDUCTORS SUITABLE FOR SEALING INTO VITREOUS MATERIAL. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 25th, 1916. (104,758.)

4,532. DEVICES FOR HOLDING THE SHADES, LIGHT REFLECTORS, OR DIFFUSERS FOR LAMPS, SUCH AS ELECTRIC INCANDESCENCE LAMPS. J. B. Mitchell, A. B. Shaw & W. Taylor. March 27th, 1916. March 27th, 1916. (104,759.)

4,639. APPARATUS FOR ADJUSTING THE IGNITION IN INTERNAL-COMBUSTION ENGINES. E. Marazzi. March 29th, 1916. (104,762.)

4,865. SPARKING PLUGS FOR USE ON INTERNAL-COMBUSTION ENGINES. J. J. Creasey. April 3rd, 1916. (104,770.)

4,941. AUTOMATIC VOLTAGE REGULATORS AS APPLIED TO INTERNAL-COMBUSTION ENGINES DRIVING MOTOR VEHICLES. P. F. Smith & V. S. Robinson. April 4th, 1916. (104,772.)

5,464. ELECTRIC SIGNALLING OR TELEGRAPHING SYSTEMS. T. McLeod. April 13th, 1916. (Cognate applications, 7,156/16. and 9,750/16.) (104,777.)

7,328. MULTICORE ELECTRIC CABLES. J. O. Callender and Callender's Cable & Construction Co. May 23rd, 1916. (104,793.)

8,831. ELECTRICALLY-WELDED WIRE FABRIC OR THE LIKE. British Reinforced Concrete Engineering Co. & E. B. Hall. June 23rd, 1916. (104,807.)

9,137. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. F. A. L. Johnson. June 29th, 1916. (104,808.)

10,361 MEANS OF CONTROL FOR PETROL ELECTRIC VEHICLES. Tilling-Stevens, Ltd., & P. F. Smith. July 22nd, 1916. (104,819.)

12,410. MEANS FOR THE CONTROL ELECTRICALLY OF THE SIGNAL INDICATORS USED IN CONNECTION WITH MINE HAULING ENGINES, WINDING ENGINES, AND THE LIKE. J. P. Forster. September 1st, 1916. (104,828.)

12,420. ARRANGEMENT OF REGULATOR AND CIRCUIT INTERRUPTER FIXED UPON ELECTRIC GENERATORS HAVING A VARIABLE SPEED. Soc. Anon. pour l'Eclairage Electrique des Vehicules. November 29th, 1916. (102,483.)

17,074. ELECTRIC BATTERY LAMP. J. E. Hamilton. July 25th, 1916. (Divided application on 3,029/16.) (104,847.)

THE

ELECTRICAL REVIEW.

VOL. LXXX. APRIL 27, 1917. No. 2,057.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: April 27, 1917. [No. 2,057.

Page
Reasonable Imagination 449
Electric Power on Canals 450
Wiring with Tough Rubber Compound Cables, by W. Ellerd-Styles (*illus.*) 451
Wayleaves 454
Machine-Switching Telephone Gear, by F. R. McBerty ... 454
The Telegraphic Communications of the Empire 457
The American Electrical Industry in Time of War 458
Correspondence—
Fault Localisation 458
Electric Fires 458
Municipal Electrical Publicity 458
The I.E.E. Nominations 458
New Electrical Devices, Fittings and Plant (*illus.*) 459
The Training of Disabled Sailors and Soldiers for Electrical Sub-station Work 460
Legal 460
War Items 460
Business Notes 461
Notes 465
City Notes 467
Stocks and Shares 469
Market Quotations 470
The Importance of Canal Development to the Electrical Man, by W. T. Wardale 471
Voltage Regulation of Rotary Converters (*illus.*) 472
First London Engineer Volunteers 474
Novel Features in D.C. Watt-Hour-Meter Construction (*illus.*) 474
The Wiring Rules of the Institution of Electrical Engineers, by W. R. Rawlings 475
New Patents Applied for, 1917 476
Abstracts of Published Specifications 476
Contractors' Column ... ... Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

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OFFICE :—4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 6d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.
AUCKLAND N.Z: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.
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TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.
WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

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(THE RED BOOK),
1917 EDITION
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REASONABLE IMAGINATION.

STATESMEN at Home, Colonial Premiers, lesser politicians, and hard-headed business men, are all appealing to us to exercise in these momentous times the gift of imagination. The quartette sounds well, is faultless in execution, is rendered at the psychological moment, therefore is most effective and quite rightly evokes thunderous applause. But what is this great gift that we are all urged to exercise? Are we all possessed of it? Do we know how to use it well? Unless we use it with discretion, may it not "run riot" and degenerate, as some writer of the past has said, into unrestrained enthusiasm which may be likened to a "runaway horse"? Suitably used, at a period of national emergency, it saw the dread possibilities of the prolonged war with Central Europe, and put under properly organised control, it led to the establishment of munitions manufacturing and ordering on such an immense scale that the cause for which Free Peoples are fighting to-day has been saved. This was real Statesmanship—the man for the hour was found in the person of the present Premier—a man of imagination and foresight *par excellence*. We organised our industries, our engineering and other resources, to secure the one great end. The appeal of the Colonial Premiers who are amongst us to-day summons us to bring our minds to bear upon other problems, less immediate perhaps, but problems supremely momentous for the days that may not be very far away. Sir Robert Borden weightily voiced the appeal at Manchester on Monday last. The British Empire is a vast heritage, free in certain respects to all of us—ours! But, says Sir Robert, and so we needs must recognise, it imposes corresponding responsibilities which we cannot fulfil unless we possess "the vision and the imagination to grasp its immense possibilities."

Then we come to the lesser politicians and the social reformers, and we find them all bowing in adoration before the same great power for good or evil, and urging that in our preparations for the strange ways of after-war along which our own and other nations will eventually have to pass—the stage of reconstruction—we be men of vision, of foresight, quick to read the signs even before they can take definite shape. They may be critical days for most of the world, and the appeal is not by any means unneeded. But now we turn to the last-mentioned of our quartette the "hard-headed business man," as we have termed him, as represented by Mr. Dudley Docker, founder of the British Industries' Federation. Writing in an evening newspaper, he discusses that problem which soon may be second to none in importance, though interconnected with the problems of the Colonial Premier, the lesser politician, and the social reformer—the new relationship of Capital and Labour. Mr. Docker says that our difficulties in the past were in a large measure attributable to "lack of imagination." Imagination is a quality essential to the success of any undertaking, "undertaking" including, of course, trade. "Lack of imagination renders one blind to the possibilities of a situation. It prevents an appreciation of another person's point of view, and it militates against any negotiations through want of understanding." Now, if there is anything we need to perceive to-day it is the possibilities of the situation. Events come tumbling so thickly and so fast that we have hardly recovered from one great transformation before we are in the midst of another. It is difficult enough to understand, sometimes, even the situation itself, if we take the near view, let alone its possibilities. Still, we have to face the situation, changing as it may be, with the utmost care, forethought, and, if we can, imagination. We may be on the verge of democracy's greatest plunge for liberty and freedom. Events in Russia, the incoming of the United States, the signs of socialistic struggling to cast off the yoke of militarism in Germany, may all be portents of immense efforts from the workers of the world for securing the future consideration of their interests. The workers of the British Empire have in millions paid their price to liberate the world from its oppressors. The time of their return will come. They, as well as statesmen, politicians, and hard-headed business men, will have the gift of imagination, and they will want to exercise it, too. Here, then, assuredly is a matter calling for men of imagination in industry to exercise their foresight in such a way that the imagination of Capital and Labour may not come into collision in the pursuit of their ideals. Compared with the pre-war conditions, it is something great to have arrived to-day at that stage toward industrial harmony where, as Mr. Dudley Docker says, "representative employers and trade unionists have agreed *to look at* each other without the intervention of Government or politician," and have founded the National Alliance of Employers and Employed. They have *looked at* each other in the past—with drawn daggers, but the employer who will grind all that he can out of his workpeople, and will not consider their "welfare" along the lines that have proved humane and successful during war, can have no self-respecting *rôle* to fill in our future industrial economy. We doubt whether many of his cult remain to-day. Nor will there be self-respect or peace for any of us if Labour utters again its pre-war threats and hates, and throttles progress by its short-sighted obstructiveness and limitation. Imagination, discreetly guided, counselled by experience, not imagination run riot and degenerating into the enthusiasm for ideals which will liken it to a "runaway horse," will be as necessary a quality for Labour as for Capital, and any step that will lead us into that spirit of industrial peace, that co-partnership in industry which will enable us to live in prosperity and real freedom and happiness for years to come is to be most cordially welcomed. The new National Alliance is undoubtedly a move in the right direction. As Mr. Docker says: "Many old shibboleths have disappeared, and all that is wanted is the exercise of *reasonable* imagination and human sympathy." He holds that the success of the new Alliance will be assured if each member will endeavour to understand the point of view of his neighbour. That is no easy matter, but the way to arrive at it is to look a little beyond our own immediate personal fads and fancies, predilections and objections; and imagination and a far-off look are more essential than the immediate counting of our individual rights and possessions, and than the refusal to consider the claims of others to be entitled to a share therein. It will be useless talking Industrial Peace, Industrial Harmony, and so on, unless men find that such conditions are going to clothe and feed those who depend upon them. Prosperity and good wages, considerate treatment and humane environment, are the only way to Industrial Harmony which will last. It ought not to require much imagination to *see* that, but a great deal of it will be required in the formulation of measures and the forming of an atmosphere by and in which that end is to be secured. The statesmen, the Colonial resources, the social reformer, and the hard-headed man of business, are the great co-operating means or forces or mediums through which we shall succeed. Appealing, as our leaders are, to others for the exercise of the gift of imagination, they will surely not neglect to exercise that gift themselves.

Electric Power on Canals.

An article which appears elsewhere in this issue directs attention once more to the immediate bearing of the canal question in this country upon the future of the electrical industry. As the author points out, the subject is intimately connected not only with the utilisation of electrical power on the canals themselves, but also with the supply and distribution of electricity in the districts traversed by the canals. As in the case of the electrification of the railways, the consumption of energy for haulage would provide a steady load from the commencement, and would thus remove one of the greatest obstacles to the wide extension of electric mains; the subsidiary demands for electricity could then be cultivated at leisure, and the advantages of electric power could readily be demonstrated to farmers and other prospective consumers in the neighbourhood of the waterways, while factories on the route could be supplied with lighting, power, and shipping facilities at one stroke.

In this connection, it is interesting to note that Germany is contemplating the construction of a great new waterway from Aschaffenburg to the Austrian frontier. Some details were given in the *Times* of March 1st, which states that the work involves the connection of the Main and the Danube, which rivers will also form part of the waterway; the total length of route will be 460 miles, and the aggregate cost is estimated at 32½ millions sterling, requiring an annual traffic of 10 million tons to cover the expenditure. A Bill authorising the outlay of £50,000 has been passed by the Bavarian Diet, this being the first instalment of a sum of £250,000 required to complete the plans for the new waterway. The canal is intended to accommodate ships of 1,200 tons, and will provide a connection between the North Sea and the Black Sea. A canal joining the Main and the Danube already exists, but can carry barges of not more than 125 tons, and is found to be wholly inadequate to meet the present demands. The scheme is only one of several projects of similar type, which illustrate the importance attached to the provision of internal water transit by Germany. Granting that the conditions there are far more favourable to canal development than in this country, the facts nevertheless indicate the economic value of such waterways, and warrant us in urging that the question should not be lost sight of.

WIRING WITH TOUGH RUBBER COMPOUND CABLES.

By W. ELLERD-STYLES, A.M.I.E.E., Member Electrical Contractors' Association (Incor.)

The following article has been written for the benefit of contractors and others interested in electrical installation work who may desire to erect tough rubber compound cables (popularly known as C.T.S.) in place of conduit, capping and casing, Stannos, Henley, or other system of wiring, several of which are restricted in application by the I.E.E. Rules issued in March, 1916. These Rules permit the use of tough rubber compound cables (C.T.S.), and, in view of this fact, the experience of the writer in the use of this class of cable in various situations may be of assistance.

Several contractors have doubted the claims of manufacturers of this class of cable as to its being suitable for users in all situations, and with a view to dispelling these doubts it can be stated that the covering possesses a remarkable degree of durability, there is no creeping of moisture into the insulation, it is immune from the usual chemical actions met with in practice, it possesses high resiliency, great tensile strength, and is difficult to injure by mechanical means. It is most easily installed, economical as regards labour costs and amount of material used, and entirely removes the trouble of earths, always ensuring a good insulation test. For surface wiring it easily scores over the metallic systems, being more flexible and unkinkable (a word adopted to convey the absence of kinks in the sheathing during the handling and erecting). An important detail is that it is popular with workmen who have made its acquaintance.

Dealing with tough rubber compound protection in his paper, "Wiring Rules of the Institution of Electrical Engineers," read before the Association of Supervising Electricians, Mr. W. R. Rawlings says: "It has been thought by many that the Institution should not allow this material to be used without protection." Why not? It has a protective sheathing. Several individuals have asked: If this class of cable is permitted, why should not vulcanised rubber cable of standard manufacture be used? The question is the outcome of inability to grasp the details of relative construction, and also the result of want of experience with C.T.S.

To begin with, the cables are insulated exactly in the same way up to the vulcanised layer. The ordinary v.r. cable is then finished with tape and braiding, both very hygroscopic, both very inflammable, and the red braiding in particular being appetising for mice and similar vermin. C.T.S., on the other hand, is finished with a protective coating of tough rubber compound (not, as some folk state, with ordinary rubber). This compound is non-hygroscopic, is not easily ignited, and vermin ignore it.

As to the question of fire risk, this should be sufficiently answered by mentioning the extensive use of C.T.S. cable for trailing cables, &c., in mines, and those individuals who hesitate to become converts to the use of this class of cable, and who lament the fact that it is permitted by the Rules, should attempt to gain some experience in mines and the severe conditions existing therein, and they would then see the cable question in its broadest aspect.

Metal-sheathed systems as a whole have the serious drawback of being subject to damage during erecting. The workmen have to use extreme caution in handling the material, an accidental blow with a hammer is fatal, and earth risks are to be considered. The open ends of the cable do not receive proper attention as regards sealing, with resultant trouble.

The question of lowering wiring costs is ever recurring, and many engineers are in favour of the Continental system, or the cleat system, as being within the region of cheapness; their opinion is that the appearance does not count. Perhaps not in factories, workshops, sheds, &c.; but what of the house, showroom, and better-finished establishments? It is easy to appreciate such disregard of artistic effects where the Huns are concerned, but it is not—British. Even in the poor man's cottage we find humble ornaments and decorations; do not let us abuse such places with what are apparently considered "improvements," but really constitute a "clumsy abuse."

Such a method of wiring as herein described could be classed as being the cheapest to install if the cable makers (a big "IF," please) would condescend to reduce their prices for this C.T.S. cable. A prominent cable-maker informed the writer that they *could* afford to lower prices. The labour costs are extremely low, and with the co-operation of the cable makers we should obtain a very cheap and reliable method of wiring which would rapidly popularise the use of electricity in directions at present monopolised by "penny slot meters."

To begin with it may be necessary to educate the supply authorities' representatives, also the prospective client, in the virtues and merits of this particular cable, as three following incidents demonstrate:—

1. On the completion of the electrical equipment of a large suburban residence, the supply authority's representative called to test and connect up. After the test, an inspection was carried out, and we were instructed to *earth* the sheathing. Of course, explanations followed.

2. Some large garage premises were being wired, consisting of several detached buildings, when the inspector observed that at several points the cable rested on girders and other ironwork. He gave instructions for insulating material to be placed between the cable and the metal work so as to avoid the risk of the sheathing being *earthed at these points.*

3. An incident of a different nature occurred at a residence during the wiring of the same for lighting and heating. The owner paid a visit, and observed that cables were being laid under the floors. He promptly 'phoned the supply authorities, stating that the electricians were using a *very funny stuff* for the electrical work. A representative called, cut off a sample to test, and, after looking up the Rules, approved of its use. On the same job we arrived one morning to find notices chalked over the floors and walls, "Do not proceed—this must be in conduit." The sinking of the cable in the plaster disturbed the proprietor, so we explained that experiments had been carried out to determine the effects of "serapite plaster" on the covering; after a lengthy period, there was no adhesion of the plaster, and when the cable was chiselled out an insulation test proved it to be quite unaffected.

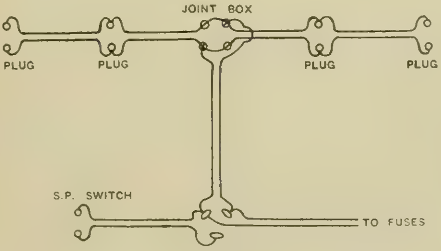

Fig. 1.

The above incident closed with a satisfied client, who is very pleased with his equipment.

It is not necessary to describe the corrosion-proof fittings (White's patents) manufactured by the St. Helens Cable & Rubber Co., of Warrington, for use with C.T.S. cables, as many booklets and pamphlets exist to assist in the erection of the system,* but we may show how to wire installations with ordinary accessories as used for house lighting and similar situations, including standard pattern distribution boards, wood blocks, ceiling roses, &c.

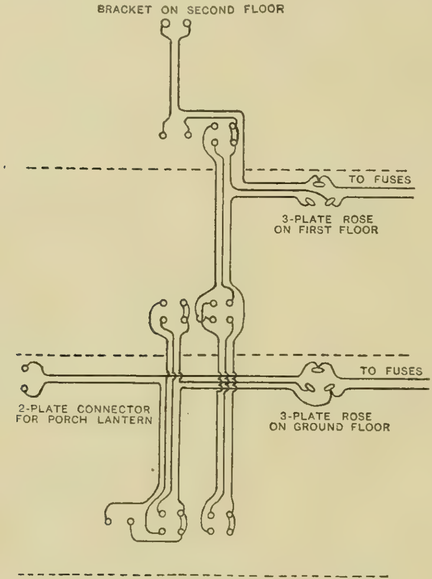
BRACKET ON SECOND FLOOR
TO FUSES
3-PLATE ROSE ON FIRST FLOOR
TO FUSES
2-PLATE CONNECTOR FOR PORCH LANTERN
3-PLATE ROSE ON GROUND FLOOR

Fig. 2.—Vertical Wiring Diagram for Porch, Hall, and Stairs.

For wiring simply, the accessories, apart from the cable, are clips with suitable fixing pins.

The writer favours the use of flat section cable where the system is not required to be watertight, as it gives a better appearance than the circular core cable when used for surface wiring. The twin and three-core is useful for most runs, but for some situations it is advisable to use the single core, this being a matter for the individual to decide who is responsible for the work. An advantage to be gained by using twin cable to the distribution board is that the time taken to sort out the circuits is reduced to a minimum.

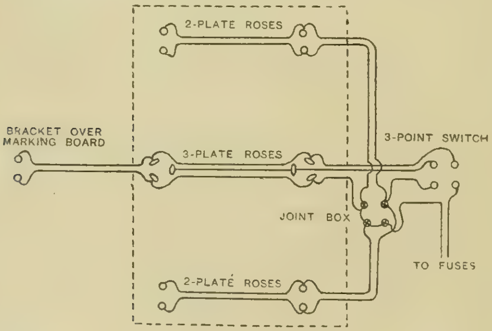

Fig. 3.

A waterproof system is obtainable by using ordinary screwed surface boxes and outlets, as made for ½-in. conduit, adapted by the employment of externally screwed grip nipples. The circular section multicore cable is used, and stout rubber rings effectively bind the cable in the nipples.

When commencing an installation it is advisable to plot out the runs on a rough plan, and then arrange the circuits so as to make all runs as short as possible. Endeavour to arrange for suitable ceiling-plate connectors, and, if convenient, use C.T.S. junction boxes.

If concealed wiring is specified, it is necessary with walls of brick faced with plaster to chase out a narrow channel in the plaster to receive the cables, which will terminate in sunk boxes for the switches, using "serapite plaster" for making good. If the walls are of lath and plaster the wiring becomes extremely simple, a "fish wire" or "mouse" being employed to get the cable to the switch points.

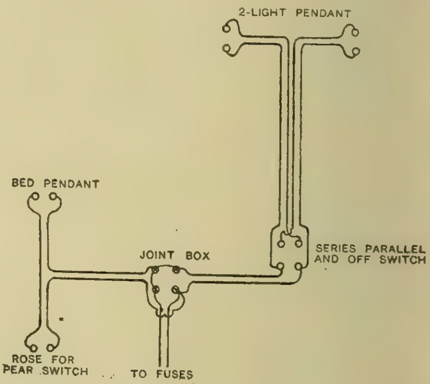

Fig. 4.

The diagrams given show where multiplate ceiling roses and junction boxes can be used with advantage, and will assist in deciding what is advantageous when plotting out the work with a view to economising both material and labour, the ceiling roses serving as junctions for the cables, in addition to carrying the pendants. Looping-in is dispensed with to a considerable extent, resulting in a great saving of cable, &c.

Mr. D. S. Munro in his book, "The Practice of Electric Wiring," mentions that "Within recent years he has been in charge of a number of installations in which looping has been insisted on throughout. On the average house, with eight circuits feeding the usual 5, 3, 2, and single-light positions, he has found that quite 50 per cent. (in some cases 70 per cent.) additional cable is required for looping."

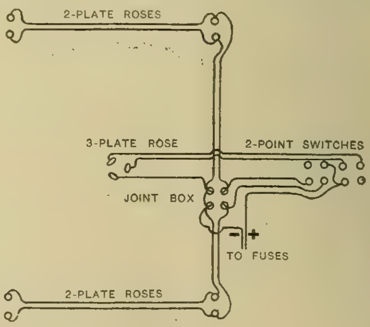

Fig. 5.

This adds unnecessarily to the cost; in addition, we have to remember that every unnecessary yard of wire fitted is a disadvantage to the installation, one reason being that the best of cables have an average characteristic leakage per yard, and, therefore, increase in length must increase the total leakage, other things remaining equal.

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* See also Electrical Review, February 5th, 12th, and 19th, 1915; November 19th, 1915; and February 2nd, 1917. —Eds.

The diagrams and controls given are those employed on a large suburban house recently completed. It is not claimed that the general arrangement of lighting, &c., is ideal, as, in common with this class of work, the client was guided partly by his architect and partly by his personal fads; nevertheless, this installation when completed possessed many advantages over the "cut and dried" method of wiring usually employed. To use a group of single-pole tumbler switches for controlling a cluster of lamps may look imposing to some folks, but it is really clumsy and unsightly, and a sign of ignorance, if not of present-day capabilities, at least of modern switches.*

Regarding the switch controls, it is necessary to mention that the switches used were partly of Messrs. A. P. Lundberg & Sons' manufacture, and the remainder were "Diamond H" switches. Flush patterns were specified in most situations, and in the less important rooms the surface pattern.

At both the South-Western Polytechnic Institute and the East Ham Technical College the students (ages 16-60) are given every facility for studying improved switch controls as part of the course of "Electrical Installation Work," and contractors generally would soon discover that they had a lot to learn in this direction if they cared to take the trouble.

It is not intended to give diagrams of the whole installation, as a good deal of repetition would occur; nevertheless, it is hoped that a study of those given will enable the prospective user of the C.T.S. cables to proceed in an economical manner. Only the terminals of the accessories are shown.

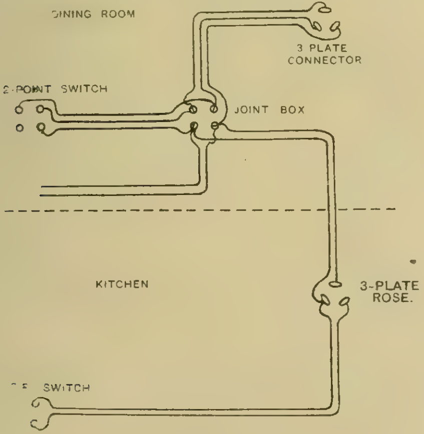

Fig. 6.

Fig. 1 is extremely simple, and is intended to convey to the reader how easily a few switch plugs can be wired, and also the method of using a three-plate ceiling rose to avoid a loop into the switch, which may save several yards of cable. Twin cable is used for all the wiring shown.

Fig. 2 shows the controls for porch, hall, and landings, the pendants on the landings illuminating the staircase. In the hall are three sunk switches with an ornamental switch plate, namely, one single-pole and two two-way switches. On the first landing two sunk switches are fitted, a two-way and a two-way intermediate, while on the top landing there are a two-way and a single-pole switch. The hall pendant is controlled both from the hall and the first landing. The pendant on the first floor is controlled from three positions: hall, first landing, and second landing. The single-pole switch in the hall controls the porch lamp, and the single-pole switch on the second landing is for a bracket on that landing. Twin and single cables are employed for these circuits.

The billiard room circuit is shown in fig. 3. The switch is a "Diamond H" flush type three-point switch. The table pendants are wired in two sections; the centre pair are taken to one switch point, and the remaining four to another switch point. The bracket over the marking board is wired to the remaining switch point. We then have the following variety of controls: marking board alone, marking board with two table lights, marking board with six table lights, "off"; mostly twin cable used, with one length of triple and two lengths of single.

The diagram shown in fig. 4 is for a bedroom having a pendant over the bed controlled by a pear switch, and a two-light rise and fall pendant over the dressing table controlled by a "Lundberg" series-parallel and off switch. We therefore obtain three degrees of light: One lamp alone "full on" or off, two lamps "full on," two lamps in series "dim" and off; mostly twin cable, bedlight with single cable.

Fig. 5 is a diagram of the drawing-room controlled by "Diamond H" two-point flush pattern switches. The two pairs of corner lights are on one switch, and the centre three-light pendant is on the other switch. One switch gives 2—4—2 and off, the other switch gives 1—3—2 and off, this latter being the same as in the morning room. It will be seen that with the two drawing-room switches any number of lamps may be switched on from one to seven in steps of one.

Fig. 6 illustrates the wiring for dining-room and kitchen, and again demonstrates where a three-plate ceiling rose saves a long loop wire to the switch. The runs are exceptionally easy. A twin cable feeds the joint box from the distribution board. Another twin cable is taken from the joint box to the three-plate rose, looped-in to the terminals, and is then continued to the switch. For the dining-room a triple cable is taken from switch to joint box, then away to three-plate fixture block.

A Few Points in Conclusion.

Always continue the sheathing well inside of distribution boards, switch blocks, &c.

For surface runs, mark out the lines with chalk or pencil so as to assure symmetry, and space the clips at regular intervals.

Remember that cable is heavy, and it is easier to work the runs in a downward direction.

For surface work use uniform cable; for instance, if five wires are needed, do not run a triple and a twin, or two twins and a single, but five singles.

If a number of cables run side by side, do not use a number of clips side by side on each of the cables, but span them with a suitable saddle.

There is no braiding to bother with or to cause surface leakage, and no earthing troubles. There is no threading of conduit or capping and casing between partition walls.

You may continue your cables into exposed situations without fear of troublesome after-effects.

You are able to run cables in positions that would be impossible with other systems of wiring.

The extra cost of cable is more than compensated for by the saving in labour costs and shorter runs.

The writer has no interest in the above cable other than that of a satisfied user.

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* For a good guide to switching see the booklet, entitled "Lektrik Lighting Connections," published by Messrs. A. P. Lundberg & Sons.

WAYLEAVES.

Mr. C. Vernier's paper was read and discussed at a meeting of the Newcastle Local Section of the Institution of Electrical Engineers on April 16th.

The Chairman (Mr. H. W. Clothier) said the present was an excellent time to tackle such a matter; these were times when they should get their troubles straightened out. Electricity in the past had been too much dominated by persons who did not understand it. The war had afforded a great opportunity to show its worth, and it had shown what it could do. When the nation realised its importance from a national standpoint, some of their difficulties would begin to disappear. Municipal representatives did not appreciate the public interests involved in electricity as they might do, and there was undoubtedly a tendency to look at any industrial concern that was pushing on as something that ought not to have the support of the general community. This difficulty, which was largely due to ignorance, could be removed by putting the proper men in the right place.

Mr. W. S. Burton (a local solicitor interested in electrical concerns) said that the opposition of some landowners to wayleaves was the real trouble; a landowner might say he would have nothing to do with wayleaves, and he was quite within his rights in saying so. The way in which this difficulty had been got over in that district was remarkable; of course, there had been delay, but the marvel was that there had been so few refusals. Mr. Vernier had restricted himself to agricultural and open lands; in dealing with such lands as parks they must admit that overhead wires and poles were not beautiful, and if they got such a system across a park, it did detract from the letting value of the mansion house. Instances of that kind were few, but the company would have to pay more for such depreciation. He thought the time had come when compulsory powers for the acquisition of wayleaves for electrical purposes were really necessary. He referred at length to the costliness of arbitration, and suggested that probably the best persons to act might be the local valuers appointed under the Land Valuation Department.

Mr. Crisp said the difficulty in negotiating wayleaves in that district was the question of delay, and it seemed iniquitous that one person should have it in his power to hold up some operations for, perhaps, 18 months. In regard to rental, it was not usually the large landowner who was difficult to deal with, but the small one. If some such measure as was suggested was not put into force, the working of many undertakings would be seriously affected.

Mr. Baldwin was not quite sure that compulsion would remove all the difficulties, but there was no doubt that great advantages would accrue from a measure such as that mentioned by Mr. Vernier. As to unreasonable terms demanded for wayleaves, he mentioned one case in which the owner stipulated that the poles should be painted red, white, and blue, with a pulley at the top so that the owner might raise the national ensign when he desired. Those terms were agreed to, and carried into effect. The landowner was perfectly satisfied; but in a few weeks' time he was certified as a lunatic.

Mr. Laws thought that seeing that wayleaves were essential they ought to be put on some ground of logic and equity. It was a matter in which there should not be any haggling. There were few men who would say that the rights of the individual should not give way to the interests of the community.

Messrs. Marshall, Turnbull, Elder, and Hunt also took part in the discussion.

MACHINE-SWITCHING TELEPHONE GEAR.

By F. R. McBERTY, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

(*Concluded from page* 400.)

The formulas for computing chances permit the calculation of a switching capacity at the various trunk links and switching machines which will be adequate for all but a certain peak of load, consisting in calls delayed, or blocked, by a busy-back signal. The cost of accommodating the peak may be considerable.

In a switching system in which the testing of trunks at a given group is not prolonged or repeated, an advancing connection which encounters all trunks busy is blocked and lost. When registers are employed for recording the number wanted and governing the selection and the testing of trunks, the test of engaged trunks may be prolonged or repeated until a trunk becomes available; the call is then merely subjected to a delay which is negligible in the time of total completion. The table below shows for a system constructed for the repeated testing of busy trunk groups, and for the switching machines of a single group employed at four different percentage efficiencies, the percentage of busy hour calls which would wait longer than 12 seconds. In a machine-switching equipment with such registers, it was found by test that the number of final switches could be reduced to the extent of 25 per cent. before the delays imposed upon connections in progress because of repeated testing to obtain an idle line switch became perceptible to the users.

Percentage of Calls Lost or Delayed.

Efficiency p.c.	Calls lost on test p.c.	Calls waiting longer than 12 secs. p.c.
0.55	3.4	0.45
0.65	8.3	1.4
0.70	12.2	3.8
0.80	23.4	9.0

Since the switching capacity of the system affects the cost of the equipment to a very considerable degree, it would seem highly desirable that a standard method of computing the switching machines in an equipment should be agreed upon as a basis of "rating" or comparing systems of different types.

Controlling the Switches.

The manner of controlling the movements of the two types of switches with ratchet and power motors are characteristically different; the ratchet motor impulses of current are produced by the controlling means which operate the motor magnets of the switches successively step-by-step, advancing the moving member to an extent corresponding to the number of impulses; in the power-driven switch, the switch is set in motion, and in its motion transmits back to the controlling means impulses of current which measure the progress of the switch and enable the controlling means to stop it when the desired displacement has been produced.

The control of the switching machines may be exercised either by the subscriber himself, furnished with a number-transmitting dial, or by an operator acting under the subscriber's direction by telephone.

When the manual switch-controlling mechanism is located at the central office it takes the form of keys corresponding to the numbers like those of a typewriter, which can be manipulated with great facility and accuracy. To transmit a five-digit number by means of a dial sender requires about six seconds; to set up a like number on keys requires no more than one second. In several semi-automatic switching systems the keys directly govern the impulses distributed to the switching machines. Since the operator can dispose of connections more rapidly than the switching machines can perform the numerical and junction selections, two or more sets of keys are furnished for each operator which she may use in succession. In the system of the offices G, I, J, and K, and others later referred to, a single set of keys placed before the operator is associated with several sets of numerical registers, any of which may be set to position corresponding with the numbers of the keys depressed; and the registers free themselves when set from the keys and remain associated with the machines until they have guided the latter to the indicated connections.

These registers are of the same general nature and govern the switching machines in the same way whether they are set to position by means of the keys of the operator, or by means of the number-transmitting dial at the subscriber's station.

Operating the registers or switching machines directly from the subscriber's station very little affects the nature of the central office switching mechanism; the control of the machines by operators, however, considerably modifies both the machine-switching equipment and the work of operators in comparison with manual switching.

Call Distribution to Semi-automatic Operators.

The use of seeking machines, whether pre-selectors or finders, for concentrating the incoming calls upon the group-choosing switches, in semi-automatic operating, permits at the same time a concentration of the work of answering, establishing, and supervising connections upon a minimum number of operators, and the equable distribution of the work amongst them. In machine switching, the same mechanism collects the calls from a large number of lines, concentrates them upon a limited number of trunk circuits, and brings them before a limited number of operators in charge of those trunk circuits. The trunks ending in seeking switches are occupied for the full holding time of a connection, and hence must be available in a relatively large proportion to the calling lines.

It is profitable to concentrate the incoming calls upon an operator up to her full capacity, which may be about five or six hundred connections per hour. A condition limiting the load is the delay imposed upon the individual subscriber's call before it receives attention, which can be kept down only by reducing the load on the operator and so increasing the wage cost per connection, or by distributing calls to a larger number of operators and thereby increasing the quantity of distributing machinery. The aim of good manual practice is to answer the calling subscriber in an average time of 3¼ seconds, with no more than 5 per cent. of the calls delayed more than 10 seconds.

The operator's delay in answering a call on a manual switchboard is composed of two factors, of which the first is a nearly fixed minimum time of rather more than two seconds for observing the call signals, plugging into the calling line, and connecting her telephone; while the other is the wait imposed while the operator serves other calls, which increases with increasing load.

A high grade of service can be attained consistently with a high load upon each operator, by providing for connecting any call originating amongst two or three thousand lines with any of six or more operators. To perform such a distribution requires seeking switches of large switching capacity.

The results of the foregoing studies and conclusions have been embodied in a number of machine-switching plants, of which one—a semi-automatic equipment for an exchange area in France—is described in some detail in the paper.

The office in question is the centre of an important toll traffic which is provided for in the usual manual toll and recording positions. The switching of calls from lines demanding toll connections and of calls for lines of the automatic equipment is performed by machine switches.

The exchange equipment is in the single large office of the area; conversion of the area to automatic working takes place completely with the cutting over of the office. When the machine-switching equipment is in one office of a multi-office area, special provision is required for passing calls from the manual to the automatic equipment, and from the automatic to manual equipments, without impairing the telephonic service or reducing the efficiency of operation of the automatic equipment.

For receiving traffic from a manual office to lines in a machine-switching equipment, semi-automatic positions are furnished in which the junctions terminate from the manual office. The operator, upon receiving an order for a wanted party in the automatic office, selects an idle junction in her position, designates it by number to the ordering operator (who plugs into it at the outgoing end) and depresses the keys of the number called for. The registers take the positions corresponding with the number ordered, release the numerical keys, and perform the mechanical selection of the wanted line. Supervision remains in the manual board as usual. Disconnection takes place automatically when the plug is withdrawn at the outgoing terminal of the junction in the manual board.

The service at the incoming semi-automatic terminal of the junction is surprisingly accurate and prompt; the calls are disposed of with such swiftness as to reduce the drag of the "B" operator upon the "A" operator while permitting the carrying of a substantially increased load by the "B" operator.

Passing traffic from a machine-switching office (whether semi-automatic or full-automatic) to a manual office is performed with the aid of a number-indicating device before the incoming junction operator in the manual office, which reproduces before the operator visually the number stored in the registers by the semi-automatic operator or by the subscriber.

Telephone Service in Machine-switching Systems.

The benefits derivable from the substitution of machines for operators and manual-switching apparatus are of three principal sorts: improvements in service, economies, and freedom in development.

The user of the telephone is interested in the accuracy and promptness with which switching is performed, and in the constant availability of his individual equipment, and he obtains, from machine switching, gains in these particulars which are definite and substantial. In manual switchboards, the errors in switching may range from a minimum of about 2.5 per cent. to above 5 per cent., dependent on whether junction-working is involved. In machine-switching systems they may be brought readily to a daily average of 1 per cent., and in certain equipments have ranged about 0.25 per cent. and as low as 0.1 per cent. In semi-automatic operating, the operator easily attains the same skill in manipulating keys as in typing, and her errors become negligible. A mechanical equipment in good order will perform thousands of selections without error. Both sources of error are independent of junction working.

The promptness of switching in the full automatic system leaves little to be desired by the user. The ringing of the bell at the wanted station begins practically as soon as the calling party completes dialling the number. In systems with operators, the delay which ordinarily impresses the subscriber is that in reaching the operator to give his number, and the quality of service is judged by the percentage of occasional long delays, as well as by the average time of response. The standard for service in manual exchanges generally accepted has already been referred to—the average response for the number is 3.5 seconds after the subscriber takes the telephone, with no more than 5 per cent. delays exceeding 10 seconds.

The table shows the times for answers measured from taking the telephone (or calling) to the answering operator's response:—

Answering Time, Average.

	Seconds.
Manual central battery, standard	3.5
Manual central battery, heavy load, "M"	4.5
Semi-automatic system, "I"	2.1
Semi-automatic system, "J"	2.2

Another measure is the time from initiating the call to the beginning of ringing the bell at the wanted station. Within this period there is no delay which is not directly dependent upon the operator and the apparatus except the drag of the subscriber in giving his order, which ordinarily is not a large factor.

Time from Initiating Call to Ringing Bell of called Station.

	Secs. (aver.)
Manual C.B. exchange, "M," best performance ...	10.3
Manual C.B. exchange, "M," heavy load	12
Manual C.B., 100 per cent. junction calls	18.5
Semi-automatic, "I"	10.3
Semi-automatic, "J"	10.5
Full automatic, "H"	8.5

Data for direct comparison of the time of connecting for the same subscribers' lines by manual and by machine switches are at hand for only one office, "I," located in France. The replaced equipment was a magneto board; the replacing equipment a Western Electric semi-automatic machine system. The measured times run from the moment of the operator's answer—the insertion of the plug in the one case, the passing of the call to the telephone in the other—to the beginning of ringing. In the machine equipment, the average time is about half that formerly experienced, and 95 per cent. of the connections are made in one-fourth the former time, the maximum time being only one-fifth of the former maximum.

The shorter time noted in the above table for the full automatic system is due to the omission of the time waiting for the operator. Otherwise the time for getting connection in a self-contained office is not largely different in manual and in machine-switching systems. In multi-office areas, however, with a considerable percentage of junction calls, working through second operators adds largely to the time occupied in manual switching, but adds nothing to that in machine switching.

The "cut-offs" in manual boards are well known to be due to the accidental withdrawing of plugs; no corresponding interference takes place in the mechanical equipments. Connections to wrong lines are common in large multiples by reason of indistinct or effaced numbering, or of error in choosing the jack at arm's reach. Double connections result from simultaneous plugging in or from defect in or failure to recognise the busy test. Neither of these faults has developed in any of the exchanges of types "I" and "J"—some tens of thousands of tests have failed to produce double connections. Connections made by the "B" operator to the wrong lines are in part due to errors in passing the number. Errors and faults corresponding to those of the "B" operator are not found in machine-switching equipments.

A third improvement in service of marked value, but obscure origin, is that before referred to as an increase in the availability of the subscribers' lines. The duration of a connection is noticeably less in machine-switching systems.

The more obvious economies offered by machine switching are in operating and supervising forces and in plant. The possible net savings in operating are still subjects of controversy, which, however, is in a fair way to settlement by reason of the increasing volume of reliable data; while the savings in plant which might be made are still somewhat speculative, no complete development plan having been carried out wholly on the most promising arrangements permitted by the use of machine switches and distant control.

The range of variation in wages, loads, and relief forces for operators, and in first costs, maintenance costs, and depreciation of machines, is such that a judicious choice of factors permits a demonstration of either gain or loss in replacing manual by mechanical switching. As the range is narrowed by reasonable assumption and practical experience, however, the case seems to be made out with increasing margin for the machine switch.

The handling time of the operator per connection is a very significant, though not an entirely satisfactory, measure of probable operator's loads and costs of operating, for the reason that it is definitely measurable and comparable in different systems.

An operator at a manual central-battery board with no trunking can give fairly prompt service without undue fatigue under a load of 230 calls per busy hour, and can carry a load of 400 calls with exceptional fatigue and a notable impairment of service. Such an operator can give more prompt service with ease through a mechanical switching system under a load of 450 or more busy hour calls of like average character, and can carry 600 or even 700 calls in exceptional cases without noticeable impairment of service or troublesome fatigue. Junction calls reduce the load materially in manual systems, but not at all in mechanical switching.

Maintenance of Machine Switches.

As in the earlier history of the conversion of central office equipment from the magneto to the central-battery system, so in the conversion of central battery to machine-switching systems, the difficulties and expenditures actually experienced turn out to be less important than anticipated, and show a substantial diminution as the result of progressive improvement in manufacture and in practice. The early automatic exchanges required the attention of men in such numbers and of such skill to keep the equipments in good working order that their wages largely or quite counter-balanced the savings in operators. Experience with modern equipments demonstrates that the maintenance force need be hardly more numerous or more skilful than that required for manual equipments of equal size; while the faults requiring maintenance are of such a nature as to warrant the expectation of still further reductions in staff.

The expenditure in wages constitutes the main item of maintenance expenditure; those for materials and replacing parts are practically negligible.

In offices of relatively small size the amount and cost of labour is largely affected by the need or preference for continuous attendance.

A special study was made at office "G" to determine the effect of reducing the hours of attendance. For a period of 11 days, during which 83,000 connections were recorded, all maintenance of the equipment was withheld, with the single exception of removing a fuse from one switch to put it out of operation. The equipment gave satisfactory service throughout the period. For an equal number of connections just prior to the test the percentage of errors (failures to obtain proper connections) was 0.27 per cent.; at the end of the test the percentage of error had risen to 0.57 per cent. In a later test the maintenance and repair of the equipment was suspended for a period of six weeks; attention was confined to recording the errors and removing the fuses from switches marked as frequently producing errors. During this test the percentage of error did not change substantially, but at the end of the period 12 per cent. of the selectors had been temporarily withdrawn from operation for cleaning or repair. The switching service was satisfactory throughout.

These instances indicate that with apparatus of good construction the quantity of labour can be largely reduced by withdrawing attendance during slack hours, nights, and Sundays.

A minimum attendance probably can be reached by employing one man in a single shift of eight hours during the busy portion of the day. For a 1,000-line exchange this would result in 2.5 man-hours per line per year. Studies made in exchanges "G" to "K" indicate that the time of the attendant would be occupied to only a very small extent in inspecting, testing, and repairing the switching machines. For example, in exchange "G" the average time for discovering and correcting a fault or defect was three minutes; and all such work occupied about one hour per day. A study in exchange "J" shows for a month a total of 6.5 hours in discovering and eliminating faults (averaging 12 minutes for each case), 19.5 hours for routine testing, 45 hours for inspection, and 57 hours for cleaning. The extent to which the spare time of the attendant can be utilised for maintaining the power plant, distributing frames, and manual equipments has not been determined.

The difficulty of obtaining men of sufficient skill and training for maintaining an automatic equipment often has been unduly emphasised. No doubt upon first examination a machine-switching system produces the impression of being complex beyond the grasp of many minds; these complexities, however, are readily resolved by a moderate amount of steady and continuous thinking into quite simple mechanical operations which make an unusual demand on the mind only in respect of the number of associated parts and of operations in sequence.

A machine-switching equipment of either of the available types, of modern construction, and of moderate or large size, can be kept in good operating condition with an expenditure of labour not exceeding 5 or 6 man-hours per line per year, and the expectation may be entertained of reducing the labour in fairly large equipments to one-half that amount or less. Such a high quality of mechanical performance has already been reached that the number of man-hours per line per year is determined by the necessity or desire to have men present in the exchange during a part or all of the day, rather than upon the amount of skilled repair or interference in the equipment.

Depreciation of Machine-switching Apparatus.

The actual depreciation—wear, breakage, and deterioration—in a machine-switching equipment is not heavy, and eventually may be found to be less even for the present types than the rate of depreciation commonly assumed for manual equipments. In the case of machine-switching equipments of the type described, rather more than one-half of the value of the plant (as an average of 60 offices) consists of the apparatus familiar in manual equipments—distributing frames, meters, cabling, relays, and power plant; the remainder consists of automatic switching machinery, and power apparatus for it. The customary rate of depreciation would naturally be applied for the sorts of apparatus well known in manual practice. As to the switching machinery, sufficient experience has accrued to warrant the expectation of a rate of actual deterioration in no case greater, but possibly less. Office "G" of the motor-driven type described, after operating six years, was examined in detail with great care. The motors and clutches showed wear so slight as to warrant the expectation of useful life several times the period of service. The bronze terminals and brushes showed little more than glazed markings upon their surfaces, and were deemed suitable for 50 years' life. The sequence switches showed very slight wear. A few pivots exhibited wear, while about 100 of the small interrupter levers had required replacement. On the whole it would appear that the replacement or improvement of the interrupter levers would put the equipment in condition for certainly six, and perhaps 12, years of further service.

The expenditure for replacing parts in four machine-switching equipments during nine months fell within £5.

Although exact comparative data are not available, it would appear that the repairs in machine-switching systems will be fewer and less expensive than the repairs to cords alone in manual equipments. In view of these facts it is the opinion of the author that an actual rate of deterioration for a machine-switching equipment may be assumed conservatively to be equal to that of a manual central-battery equipment.

An element which is important in estimating depreciation as a factor in studies of annual charge is the probability of displacement by improved apparatus. This is always a difficult factor to evaluate, but in the present circumstances a partisan of machine switching might find warrant for assigning to it a larger value for manual than for automatic switches.

Discussion.

In the discussion in London, Mr. Frank Gill said this was an engineering, and not merely a mechanician's, paper. The author appeared to regard lost and delayed calls as the same, but one could tolerate a much greater error if the call was merely delayed than if it were lost. The paper showed the great variation in the number of switches required according to the system of computation adopted; it was important not to put in too many switches. The number of calls delayed was not nearly so important as the number of seconds delay. The author really gave no help in the matter of first cost, and they could not move until they knew what it was. Had any of the cases referred to been put in on the basis of economic selection, or merely as being the proper thing to do? If the manual cost were taken at 100, then the automatic first cost would, he suggested, be something like 140 to 145.

Mr. Laidlaw drew attention to the increasing annual cost of operators' wages in manual installations. There were over 3,000 exchanges in the United Kingdom; about half the subscribers were on exchanges of less than 1,000 lines, and for such, the step-by-step mechanism was probably better than the motor-driven, and the 100-line switch was probably the most suitable for the small exchange. It had been shown that the manual operator's efficiency rapidly fell off if more than one station was taken. The figures for manual operation given by the author showed a high order of service, and did not favour automatic working.

Col. C. B. Clay, after mentioning that it had been desired that someone should speak on behalf of the relay system, said he could not help wondering whether a system requiring so much mechanical and electrical mechanism could in the end compete with a pure relay system. The latter would work with greater variation in voltage, and with greater variation in speed of the calling device. It appeared that the maintenance cost of the relay system was very small, and he hoped to get valuable data on this point from the 1,000-line exchange at Stockholm. Experience showed no case of dirty contacts so far. Relay apparatus would, he thought, be more easily dealt with by telephone men than mechanical plant, and as a manufacturing problem, "nothing but relays" was ideal.

Mr. A. J. Stubbs said the Post Office had five systems of automatic switches under trial, with a view to securing the combination of trunk working with local service. He thought standardisation was a matter for the future, but the Post Office had introduced a similar dial system in all cases.

Mr. Dane Sinclair congratulated the author on the cleverness with which he had got over many difficulties. As far back as 1883 he (the speaker) had patented an automatic telephone, but it gave place to the manual system, though he never lost faith in it. He regretted that the author had chosen new names for many parts.

Mr. Aitken said he presumed the author was as much in favour of the "full" as the "semi" automatic system referred to in his paper. The automatic system was now in use in every progressive country in the world; there were really only two systems, the Strowger and Mr. McBerty's, both of which were excellent, but not final. There was also the relay system, which scored in some respects; it was instantaneous in action, whereas machine switching required a time interval between contacts; it also involved only fractional movement, and practically avoided wear and tear. As regarded maintenance, it was interesting to see how the author confirmed the figures he (the speaker) had given in a paper in 1911 on the Strowger system; these figures were much doubted at the time, but apparently maintenance was a very small matter indeed.

Mr. Anson discussed the author's traffic curves. Manual working was a different problem to automatic working; in the latter it was a question of minutes, while in the former it was "calls," on which the tariff system was built up. The Post Office obtained their own empirical curve, and only connected 75 per cent. of the estimated number of subscribers. To design an automatic installation on manual statistics, without due allowance, would lead to errors.

Mr. Petithory said the first automatic telephone patent was taken out in 1879, and the basic patent was the Strowger, which was the first system to prove successful. He considered that a storing device was very useful for semi-automatic working.

Mr. **Ward** thought the tendency was in favour of replacing mechanical devices by electrical ones, and that the relay system would supersede other methods. The power required by a relay was so small that destructive arcing was absent; machine switching also required mechanical as well as electrical knowledge, while relay working was a natural development of present methods.

Mr. **Grinstead** agreed with the author's deductions from data, &c., and as to their value in the design of automatic exchanges.

Mr. **John Lee** asked where the exchange was in which the operators worked at 600 calls an hour, as machine work could not much better this.

Mr. H. H. **Harrison** said he could show the author a switch which would make hundreds of contacts per second, and yet stop with certainty when it came to an idle trunk or line.

The **Author** decided, owing to the late hour, to communicate his reply to the *Journal*.

THE TELEGRAPHIC COMMUNICATIONS OF THE EMPIRE.

In the Final Report of the Royal Commission on the Natural Resources, Trade, and Legislation of the Dominions, an important section is devoted to the subject of telegraphic communication between the various portions of the British Empire. As stated in the Second Interim Report, the Commission is convinced that the feeling of devotion to the Empire and of loyalty to the Mother Country will be strengthened in proportion as increased facilities are offered for keeping in close personal touch with friends and relatives overseas. While this is especially true of the Australasian Dominions, which are the most distant from the capital of the Empire, it applies also to Canada, Newfoundland, and South Africa.

At present cable communication, apart from its commercial use, is practically a luxury; the full charges for messages are as follows: Australia, 3s. per word; New Zealand, 2s. 8d.; South Africa, 2s. 6d.; Canada 1s. 0½d. to 1s. 6½d.; Newfoundland, 1s. 0½d. per word, with reductions for deferred, week-end, Government, and Press messages. The full charge for wireless service to Canada and Newfoundland is 8d. per word. The popularisation of the cable service can only come with a simplification of the charges and their radical reduction, and the Commission would like to see some bold reform in the direction of lower rates analogous to the adoption of penny postage. A charge of 6d. per word for messages in plain language to and from the remotest parts of the Empire is mentioned as a possibility, which would attract an immense amount of traffic, but any drastic reduction of rates by private cable companies is regarded as out of the question, though credit is given them for their efforts to foster communication within the Empire during the war, resulting in utilisation of the cables to a far greater proportion of their full capacity than ever before. The necessity for the cable companies periodically to renew their landing licences does not afford effective control or lead to the cheapening of the services, the power possessed by Government in this respect being used mainly to prevent unreasonable rates; in point of fact, landing licences which expired in 1911 and 1915 have not yet been renewed, owing to the refusal of the companies to accept a clause providing for the control of rates. However, the Commission regards it as urgently necessary to require all companies to supply periodical returns of their traffic, and of the distribution of the traffic throughout the 24 hours, on which points no recent information is available, though such particulars are essential to enable the Governments of the Empire to deal with the subject with adequate knowledge.

The most direct method of securing reductions of rates is that of providing State-controlled telegraphic communication between the United Kingdom and Australasia by way of Canada. In the three Dominions concerned there is a strong feeling in favour of the project, and there is already a through service under State control from Montreal to Vancouver Island, over a leased telegraph wire, and thence to Australia and New Zealand by the Pacific Cable. To complete British control, a cable across the Atlantic and a land line from Nova Scotia to Montreal are needed. There are 17 Atlantic cables, stated in 1911 to have an average capacity of five to five and a half million words per annum, and an actual traffic of two and a half millions; owing to technical improvements, the average capacity of each cable, working duplex, is now estimated at 10 million words per annum at least, while the utilisation factor is believed to be not more than 40 per cent. of the maximum capacity. With an unused capacity on existing lines of six million words per cable per annum, or a total of 102 millions, there is no need to increase the number of cables. The Commission holds, therefore, that one of the existing Atlantic cables should be leased, or otherwise secured for Imperial purposes, and that a land line to Montreal from the landing point of the cable in Canada should be erected or brought under State control, the whole being placed under the administration of the Pacific Cable Board.

In 1915-16 the Pacific Cable carried a load of paying traffic amounting to eight million words; the receipts were nearly £300,000, and the cable paid its way, the average rate for paying traffic of all classes being 8½d. per word. Allowing an average of 9d. a word from Montreal to Australia and New Zealand, and calculating on the basis of the pre-war traffic distribution, with the reduced rates for deferred messages, &c., the Commission estimates that the full ordinary charge should be 1s. 4d. a word, to which must be added 10s. for transmission between the United Kingdom and Montreal, making an ordinary full rate of 2s. 2d. per word between this country and Australasia; the deferred rate would be 1s. 1d. and the week-end rate 6½d. per word.

This calculation is based on the assumption that the traffic will be divided as follows:—Ordinary 38 per cent., deferred 19 per cent., Government 6 per cent., Press 13 per cent., deferred Press 12 per cent., week-end 12 per cent. It has also been assumed that the ordinary Press rates will be one-sixth instead of 5/24 of the full rate.

These rates could be further reduced if the charge of 10d. paid to the Atlantic cable companies, which appears unduly high, could be brought lower. Assuming that an income of £100,000 per annum at the outside would cover the costs to Montreal, five million words at a full rate of 8d. per word, or 4.8d. per word on the average, would suffice. The full rate between the United Kingdom and Australia and New Zealand could then be reduced to 2s., the deferred rate to 1s., and the week-end rate to 6d. It has been taken for granted that the present terminal charge of 5d. per word on full-rate messages made by the Commonwealth Government would be largely reduced, and that the proposed reduction of rates would attract sufficient traffic to maintain a full load on the Pacific cable. The reductions are put forward as the minimum required in the interests of the Empire.

The acquisition of an Atlantic cable would also enable Canadian business to be handled, as the Pacific cable traffic would not adequately load the Atlantic cable and land line. A difficulty is met with here, as unrouted messages to North America have to be handed to the Western Union Co. as representing the Anglo-American Telegraph Co. But this arrangement ceases in 1920, and traffic could be attracted to the State-controlled cable by the lowering of rates and the opening of offices by the Pacific Cable Board in the larger centres of the United Kingdom and Canada. Lastly, by the State control of an Atlantic cable the distribution of Press news to Canada and the Empire—which the Commission regards as a very urgent necessity—would be facilitated, the lowest possible rates being charged.

The State-controlled cable should land in Newfoundland and be laid thence to Nova Scotia, to increase the speed of working and give the Colony the advantages of the cheaper services; if this is not practicable, a land-line should be erected from the landing-place of the cable in Canada to the terminus of the Newfoundland Government cable at Canso.

As regards South Africa, while the rate of 2s. 6d. per word is high compared with 2s. 8d. to New Zealand, the traffic receipts have been so small that the private companies providing the service have been entitled to receive the full subsidy of £13,500 from the Governments concerned and the British South Africa Co., which is payable until 1919. The Commission advocates the encouragement of social and non-urgent messages by a reduction of rates, and advises the Governments to pay temporarily a larger subsidy.

The Commission believes that the nationalisation of the cable service will soon become one of the most urgent problems for statesmanship. It appears difficult, if not impossible, to attain the desired cheapness of cable communication throughout the Empire without interfering with the rights of private companies, who have done much in the past to facilitate development of the Oversea Dominions and to maintain the United Kingdom as the greatest world market; the Commission pays a tribute to their achievements, and deprecates any action which would deprive them of the reward of their enterprise. On the other hand, the urgency of making cable communication available to all classes is described as manifest and imperative. Some propose to await the probable developments in wireless telegraphy before considering the acquisition of private cable lines or Government guarantees, and the Commission recognises the assistance afforded by wireless communication in causing the reduction of rates and multiplication of services, but it is pointed out that on the grounds of speed, certainty, and secrecy in time of war, the cable will long continue to hold the field as the most reliable means of telegraphic communication overseas. There has been no slackening in the pace of cable construction since the advent of wireless.

The British Trade Corporation.—His Majesty's approval was given on April 14th to the draft of a Charter of Incorporation for the above corporation.

THE AMERICAN ELECTRICAL INDUSTRY IN TIME OF WAR.*

The present critical situation in regard to our international affairs finds the electrical industry ready and willing to do its share. Already many organisations of electrical men and a great many individual companies have pledged their support to the administration, and it is very gratifying to note the large number of prominent electrical men who have been called upon, either in an industrial or an engineering capacity, to help direct the preparedness programme now actively under way. An indication of the times is the action taken by the copper producers in voluntarily agreeing to supply the Government with all of the copper required for the army and navy at a price of about 17 cents per pound, which, at the time of writing, is just one-half of present market prices. Approximately 50,000,000 pounds of copper will be supplied at this price during the next twelve months. Figured conservatively, this represents a saving equal to the annual interest on a bond issue of $200,000,000. Equal patriotism has been shown by many of the largest and most prominent electrical manufacturers, who have offered to turn over for Government use, *without profit*, their entire organisations. The central-station industry has been prepared. Already mobilised, ready to serve the individual, the community and the nation, whether for peace or war, solidly and surely founded, it stands, not the creation of a moment's hasty, frenzied action, but the evolution of wise, far-sighted policy, careful and painstaking development and judicious fostering. Long since have intensive co-operation and unified effort been the key note for the cheap and reliable generation, transmission and utilisation of electrical energy. Increased outputs, overloads, long hours and overtime are the order of the day. The solution is to resort to central-station service in the vicinity of arsenals, fortifications, army posts, navy yards, &c. It is available without costly delays and without the necessity of finding extensive capital which in any case can be better utilised in other ways.

While industrial preparedness is, without doubt, of vital importance, the country is sorely in need of men for active service. The President has recently issued orders for the recruiting of the United States Navy to its present authorised war strength of 87,000 men, which will require immediate enlistment of about 25,000 recruits. The idea is to bring the first line of national defence up to condition of immediate maximum efficiency. In this work also can the electrical industry be of inestimable service to the country. Employers are undoubtedly sorely taxed to keep the number of employés abreast of the demands in their factories; nevertheless it would be a wise and far-sighted policy on their part to encourage enlistment for the younger men, such as apprentices, since aside from patriotic considerations, the training is a very good one, and the men return much better able to take their places in the electrical industry.

Another phase of the preparedness programme is open to electrical dealers, namely, that of maintaining window displays designed to encourage enlistments. The cause is a worthy one, and the dealer who so participates gains prestige in his community, and must necessarily gain satisfaction from the knowledge that he is doing his part.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Fault Localisation.

With reference to my letter, published in to-day's issue of your journal, will you kindly correct a printer's error in the last equation, which should be—

$$\text{Distance of fault from A} = \frac{\text{AFK} \times \text{length of AB}}{\text{AFK} + \text{BFL}}.$$

not $\text{AFK} \times \text{length of AB} (\text{AFK} + \text{BFL})$ as printed.

H. E. Blake.

Eastbourne Electricity Works,
April 20th, 1917.

[The expression should have appeared $\text{AFK} \times \text{length of AB}(\text{AFK} + \text{BFL})$: unfortunately, the slant line was omitted.—Eds. Elec. Rev.]

Electric Fires.

The articles by "Experiment" and "Hot Air" appearing in your issues of March 2nd and March 16th respectively, touch on a matter open to much controversy.

There is something to be said in favour of the "convector" or "low temperature" form of electric heater, and much for the "radiant heat" type. For distinction, one can classify them respectively as "air warmers" and "fires." They both have their peculiar scope of usefulness. The salesman can, of course, more easily create a favourable impression in the mind of a visitor to his showroom with the aid of a cheerful-looking electric fire; and it is also certain that the quicker that cheerful appearance manifests itself after switching on, the sooner he will effect a sale. There is no necessity to have a highly concentrated and intense or built-up heat to give this desired effect.

So far as high-temperature apparatus is applicable, an ample area of hot glow, combined with a free ventilation of the heating medium, seems to be the ideal arrangement, and the one that gives most general satisfaction. For although the test usually employed in the showroom is the heating effect on the hands of the lady buyer, or the posterior of the male visitor, the ultimate opinion is founded on the general heating effect in the room at home, or office, in addition to the cheerful appearance.

Most people do not spend their day warming themselves by the fire, and there is no need to, if the fire fulfils it prime duty of raising the general air temperature of the room to a comfortable degree; and this is most quickly done by a circulation of the air through the fire. That warm air is of some practical use, is made pretty certain by the fact that very many buildings are heated entirely by steam or hot-water radiators.

Those in doubt should try the effect on the person on entering a room in which a boxed-up and most intensely radiant-heat fire has been working for, say, 20 minutes, as compared with a radiant-heat fire that also promotes air circulation—starting from similar conditions. We think the result will be pretty conclusively in favour of the latter. In passing, might we add that this useful combination of a good radiant heat with warm air circulation obtainable in an electric fire constitutes a big advantage over the gas fire. The air passing through a gas fire *has* to go up the flue pipe, and it is for this reason that gas-fire makers are so keen upon getting the maximum possible percentage of radiant heat.

We, unlike the firm referred to by "Experiment," welcome criticism as the sure road to perfection. We don't care a cent what sort of good fire we make. We are unbiassed. Our chief point is: "Is this fire going to sell?" And if it sells—and *continues* to sell—we know it to be good.

The speakers at the N.E.L.A., in their reference to electric water-heating, had evidently come fresh from a study of the comparative heat units in a pennyworth of coal and a pennyworth of electricity at market prices. Such a comparison, although giving one furiously to think, causes no despondency in the stout-hearted, because it has been amply shown in practice that with units at a halfpenny (*i.e.*, where the market price of British thermal units is at the rate of 6,800 a penny), and with suitable apparatus, electric water-heating is not only feasible, but will, in due course, become highly popular, because it is a service at a reasonable cost, and embodies enormous advantages over other forms of heating.

Belling & Co.

London, N., *April 24th*, 1917.

Municipal Electrical Publicity.

The suggestions of Mr. E. P. Hollis for organising a publicity department are very interesting, and consist essentially of a combined publicity and selling department controlled by one head.

The publicity engineer, under this scheme, would require to devote most of his time and energies to duties which properly belong to the selling engineer.

The work of collecting, analysing, indexing, and collating technical data, and reproducing them in an interesting and readable form, would, in practice, require the whole time and attention of a properly organised publicity department.

To obtain successful results, two departments would require to be organised—viz., a publicity department and a selling department, each under the direction of a qualified engineer. The publicity engineer with literary ability and experience in systems of dealing with technical data as mentioned above, and the selling engineer with commercial experience in addition to his technical training.

The publicity department would not only publish interesting literature for public consumption, but would also keep the selling department, and other sections of the electricity supply undertaking, constantly supplied with up-to-date information, including prices and useful technical data systematically arranged for easy reference.

The most successful selling departments are built on the foundation of well-organised and systematic publicity departments, and successfully to carry out such a campaign as outlined by Mr. Hollis, a selling department, with an efficient publicity department behind it, would be necessary.

D. Ross Kennedy.

April 21st, 1917.

The I.E.E. Nominations.

I am instructed to inform you that at a meeting of this Association the following resolution was passed:—

"That the members of the Association of Municipal Electrical Engineers of Lancashire and Cheshire congratulate Mr. Wordingham on being nominated as President of the Institution of Electrical Engineers, and desire to place on record their high appreciation of the services rendered by him to the profession over a long period of years.

"The Association regrets to note that opposition to the nomination of Mr. Wordingham has arisen in certain directions, apparently because he has at times offered candid criticism on various matters which have been the subject of debate at engineering meetings. The Association feels that, instead of criticism being the ground for objection to Mr. Wordingham's nomination for this office, it should rather be considered a qualification, as honest criticism must at all times act beneficially in regard to any subject of a debateable nature.

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* American *Electrical Review and Western Electrician*, March 31st.

"The Association enters its strong protest against the unfair attacks which have been made against Mr. Wordingham's nomination, as, by reason of his official position, he is obviously unable to reply thereto."

The following members were present and signed the resolution :—
S. L. Pearce, J. A. Robertson, R. Blackmore, H. Dickinson, S. J. Watson, P. P. Wheelwright, H. Wilkinson, C. L. Stewart, A. T. Smith, W. J. H. Wood, A. W. Clegg, C. J. Wood, W. Chamberlain, J. E. Starkie, D. H. Davies.

W. J. H. Wood,
Hon. Secretary, Association of Municipal Electrical Engineers, Lancashire and Cheshire.

Manchester, *April 24th*, 1917.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Reel for Use in Pulling Wires into Conduit.

When wires are being pulled into conduit, unless they can be cut off before they are pulled in, they are inclined to tangle badly. To overcome this trouble, Mr. F. Boone made a reel that solves the problem very well.

Two wheels are first made from about 1-in. board, and turned to about 10 in. in diameter. A 1·125-in. hole is bored through the centre of each, and slats are nailed on the edges of the wheels about 2 in. apart, so as to form a sort of squirrel-cage cylinder. These slats should project over the edge of one wheel 1 in., and be flush with the edge of the other wheel. On the face of the latter, six or eight radial slats or spokes are nailed to keep the wire from slipping off. Another wheel is made like the two already mentioned, but not necessarily as thick, and on one face of this are nailed radial slats, to correspond with those on the flush end of the squirrel cage. A frame is made with heavy base blocks to weight the whole reel properly and keep it from tipping over when the wires are pulled. The accompanying sketch shows the general arrangement, one end being partly broken away to show the detail. A piece of conduit will serve as axle, and a block or thick washer should be nailed inside the frame.

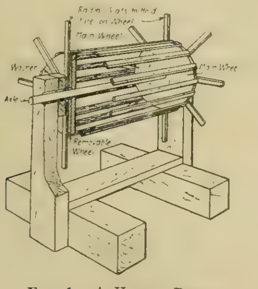

Fig. 1.—A Handy Reel.

In using the reel, it is bodily taken from the frame, and the removable wheel slipped off. The bundle of wire to be used is split, and half of it is turned round ; then the whole bundle is slipped over the reel at the end where there are no spokes. If more than two wires are to be pulled in, other bundles are put on the reel as may be necessary. The removable wheel is again put on, its spokes closing the free end and the projecting longitudinal slats fitting in between these spokes to keep the wire from getting between the two adjoining wheels. The reel is then put back in the frame, and the wires are ready to be pulled. By turning half of each wire bundle round before putting it on the reel, it is possible to pull wire in the same direction from each half of the bundle without tangling.—*Electrical Review and Western Electrician.*

Electric Heaters Used in Making Bank Notes.

In the Bureau of Engraving and Printing, Washington, D.C., there are 600 electrically heated industrial stoves in use for the heating of engraved plates from which bank notes are printed. These units (made by the Cutler-Hammer Manufacturing Co., Milwaukee, Wis.) are spring-mounted in a cradle, so that there is a pressure upward against the under side of the plate. The construction is diagrammatically shown in fig. 2. The heater units are united to the top plate of the stove by electric welding, and the top plate and heating units therefore become virtually one piece. There is perfect and permanent contact, and the heat is generated right where it is needed. The upper plate is of steel.

Electric stoves of this construction can be made in sizes and shapes to suit various applications, such as for velouring in hat factories, for sweating on machines used in mounting electrotype metal blocks to the copper shell ; for embossing work ; for laboratories ; and for many industrial purposes. The heat is uniform, can be easily controlled, and is not affected by draughts of air. The 600 stoves in the Bureau of Engraving referred to above, if heated by gas or other agent, would vitiate the air and foul the walls and ceiling. As a central-station load the electric industrial stove is very favourable, because of its many possible applications.—*Electrical Review and Western Electrician.*

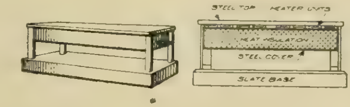

Fig. 2.—Electric Heaters used in Engraving.

A Petrol Engine with Electrically-Operated Valves.

Not content with the important part that electricity plays in the running of the petrol engines of motor-cars—such as ignition, starting, &c.—Mr. Jos. C. Youngblood, of the Youngblood Automobile Co., of Atwood, Kan., U.S.A., has gone a stage further by designing and constructing an engine, the valves of which are opened and closed electrically instead of mechanically.

Aiming at a form of construction that will, it is claimed, at the same time reduce the cost of manufacture, facilitate the operation of valve setting, and result in an extremely quiet-running engine, the valve mechanism of the new engine is different in every detail from the conventional type. Across the top of the cylinder, or cylinders, is a cylindrical valve chamber, into which open ports, two of which communicate with the combustion chamber, and two others with the inlet branch and the exhaust manifold respectively. Sliding in the chamber is a piston valve, the centre of which is cut away, so that by a suitable sliding of the valve direct communication can be established between one of the cylinder ports and the inlet branch and between the other cylinder port and the exhaust manifold. With the valve in a central position both ports are closed ; the cylinder ports, however, register with recesses cut in the valve to serve as pockets for any carbon that may be formed.

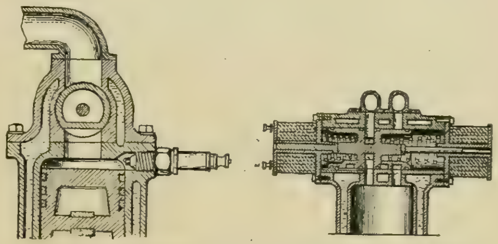

Fig. 3.—Sectional Elevations of the Youngblood Valve-gear.

The piston movement of the piston valves is operated by means of solenoids. From the outer ends of the valve extend axial arms of soft iron, which enter the hollow cores of electromagnets mounted on the end caps of the valve chamber. Between the ends of the valve and the caps are helical springs, which tend to keep the valve in a central position with both ports closed. The windings of the solenoids are energised by current from an accumulator, the current being distributed by a gear-driven timer operating on the same principle as a low-tension ignition distributor. The contacts are, of course, so arranged that the valve movements take place at the correct moment of the piston stroke, and in proper sequence.

New Method of Testing the Acid Resistance of Enamels, Paints, and Varnishes.

Messrs. Jenson & Nicholson, Ltd., of Goswell Works, Stratford, E., point out that the usual methods for testing the acid-proof qualities of enamels, paints, and varnishes which are in practical use, such as coating pieces of iron, zinc, copper, or similar suitable metals, immersing them in acid solutions, and watching the development of corrosion, are of a very primitive character, and possess the disadvantage of not affording any scientific basis of comparison which can be tabulated. A very considerable length of time is required before results of a conclusive character can be obtained. They have therefore worked out a new test with a view to affording a moderately rapid and accurate estimation of the acid-proof quality of an enamel on such lines as will enable anyone to compare the qualities of acid-resisting coatings in definite terms.

The principle of the test is that of the simple voltaic cell, where an electric current is produced as a result of chemical action. Plates or rods of dissimilar metals—say, copper and zinc—are coated with the enamel or material to be tested and immersed in dilute acid, when, if they are unable to withstand the corrosive action of the acid, a breakdown occurs, galvanic action sets in, and is recorded by suitable instruments, and its intensity forms the basis of comparison of the acid-resisting properties of the coatings.

According to their method, a number of copper rods, each 6 mm. in diameter and about 16 cm. long, are washed clean and dried, and are dipped into the liquid enamel or paint; when dry, the ends are to a distance of 2-3 cm. coated with paraffin wax.

A zinc rod, amalgamated with mercury, is immersed in a vessel containing a solution of 25 per cent. H_2SO_4. prepared with distilled water; the copper rods are spaced round the zinc at a radius of 5 cm. The zinc is connected to one terminal of a millivoltmeter, while each of the copper rods is successively connected up and the potential difference noted. No difference of potential should be indicated at the commencement; should any occur, the rod should be rejected and a fresh one put in its place. The rods should be tested every hour at first, to study the effect, but later at intervals of 6, 12, or 24 hours. A good acid resister should give no potential difference during 24 hours. A reading of 100 millivolts might be adopted as the maximum limit.

THE TRAINING OF DISABLED SAILORS AND SOLDIERS FOR ELECTRICAL SUB-STATION WORK.

Since June, 1916, an important experiment has been in progress, which was first conceived in February, 1916, by the Institution of Electrical Engineers, who approached, and obtained the sympathetic help of, the Education Committee of the London County Council. It was held that a preliminary period of technical training under capable instructors in an institution having up-to-date electrical laboratory equipment might enable men of various grades of education to qualify as sub-station attendants in a much shorter period than otherwise would have been needed, and might give them an enhanced value during the period of station training. The experiment was projected to test the the possibility of such preliminary training.

The Northampton Polytechnic Institute was selected as a suitable training centre in London, and the experiment was entrusted to the Electrical Engineering Department of that Institute. The training, which is intensive, lasts only three weeks, a new course being held each month, and the number of students in each course is limited to 20. The seventh course of the series ended in March, 1917, and the eighth is now in progress. Statistics of these courses are as follows :—

	Course 1.	Course 2.	Course 3.	Course 4.	Course 5.	Course 6.	Course 7.
	June-July, 1916.	July-Aug., 1916.	16/10—10/11/16.	20/11 - 15/12/16.	15/1—2/2/17.	12/2—2/3/17.	12/3—30/3/17.
Number of Applications for Admission.	22	21	22	23	30	22	24
Number Actually Commencing the Course.	13	20	18	23	19	18	19
Number Approved for Employment.	15	14	16	20	18	13	18
Number Actually Placed.	13	12	15	20	18	13	17
Number of Applications from Employers.	16	12	Over 50	Over 40	Over 45	Over 35	Over 35

Totals for Seven Courses.

Number of applications for admission ...	164
Number actually commencing the course ...	130
Number approved for employment	114
Number actually placed	108*
Number of applications from employers, over	205

* A few of those approved for employment obtained work privately; one or two had to return to hospital.

The disablements which have been found not to disqualify for all posts of the kind at which the training aims, are total disablement of one arm or one leg, or a partial disablement of one limb. Disabled men suffering from shell shock, however, cannot be accepted.

Up to the present time the whole of the men who have taken sufficient advantage of the training to secure the recommendation of the Joint Committee under which the training is being managed have been placed out, and there are still many vacancies to fill, but increasing difficulty is being found in placing men with serious arm disablements. It is suggested that, in certain cases, such men might still be utilised for this work by simple modifications of parts of the switchgear, and the patriotism of station engineers throughout the country is appealed to, to consider carefully the possibility of employing men who have lost partially, or wholly, the use of one arm.

The system of instruction was described in our issue of August 4th, 1916. Particulars of the course of training, and the men available, may be had from the Principal of the Northampton Polytechnic Institute, Clerkenwell, London, E.C., 1.

LEGAL.

Pickman v. Western Electric Co., Ltd.

In the King's Bench Division, on April 20th, an action was heard before Mr. Justice Laurence and a special jury in which Mr. John Pickman, Elsden, The Chase Cottage, Southminster, sued the defendants to recover damages for personal injuries sustained, as he alleged, through the negligence of the defendants in not properly protecting an electric circular-saw used for cutting up hard woods at their saw mills at North Woolwich, at which the plaintiff was working. The defendants denied negligence.

Plaintiff said that on March 31st, 1916, while he was putting wood into the saw, a piece of wood, getting caught in the teeth, was flung forward and struck him in the right eye, the result being that he had practically lost the sight of that eye. The plaintiff said that the machine was dangerous, being not adequately protected, and he claimed damages.

The Defendants denied that there was any negligence on their part.

The Plaintiff claimed, in addition to general compensation, £55 as special damages.

The jury awarded the plaintiff £250 and the special damages, judgment being entered for the plaintiff for a total of £300 12s. and costs.

WAR ITEMS.

Municipal War Wages.—The Hackney Electricity Committee has received a further application from the employés of the electricity undertaking and the refuse destructor works asking for an increase of wages or an increased war bonus. In view of the recurring applications, and considering the whole circumstances, the Committee is of opinion that the Chief Industrial Commissioner should be asked to consider the matter in all its bearings, and give a decision which it is hoped will settle the question until the time when normal conditions will prevail. The Committee recommends that the borough electrical engineer be instructed to submit the necessary particulars to Sir George R. Askwith, and ask him to decide what salaries or wages should be paid to employés in the electricity undertaking and refuse destructor works as and from April 1st, 1917.

Exports to China.—The "London Gazette" for April 24th contains further names of persons in China to whom exports may be consigned.

Substitution.—The Director-General of National Service has appointed Mr. R. E. Graves to be Director of Substitution, to take charge of the new Substitution scheme.

National Service Department.—Mr. W. A. Appleton has tendered to Mr. Neville Chamberlain his resignation of the position of Labour Adviser to the National Service Department.

Exemption Applications.—At the Driffield Tribunal, an electrician employed at a picture palace, 33 years of age, and passed for general service, was granted an extension of his certificate from April 2nd to July 1st, his contracts in hand not having been completed. The condition was attached that applicant could not appeal again without the permission of the Tribunal.

Worcester Tribunal has granted renewed conditional exemption to Mr. R. E. H. Heenan, resident director of Messrs. Heenan & Froude, Ltd., refuse destructor makers.

Salop Appeal Court have refused a Military appeal against conditional exemption held by the manager of the Oswestry Electric Light Co., aged 25, and in Class C1, who has sole control of the undertaking.

Martley Tribunal has, after a Military review, confirmed conditional exemption held by Mr. F. Turner (37, in Class C1), electrical engineer at the Knightwick Sanatorium.

Before the Essex County Tribunal, on April 19th, the Ilford U.D.C. appealed for 11 men engaged on the tramways. The manager (Mr. L. Harvey) said that it was now impossible to release more men if the tramways were to be safe for the travelling public. A reduced service was being run, and in one case the Ministry of Munitions was complaining of the inadequate service of cars. Conditional exemption was granted to the night foreman, the armature winder and storekeeper, an overhead linesman, and six motormen; the cashier was allowed three months, and a second night foreman was directed to join up at the end of May.

At Torquay, a review was made of the case of W. J. Coleman (35), electric jointer and handyman, engaged at the

Corporation electricity works. Conditional exemption renewed.

Before the East Kent Appeal Court, the Military Representative appealed against exemption until May 19th allowed to P. F. Cotton (30), electrician with Mr. V. Hill, electrical engineer, of Broadstairs. It was urged that there was an urgent need in the Army for men with skilled knowledge of electrical engineering. The appeal was allowed, and exemption cancelled.

At Ipswich, the Corporation Electric Light Committee appealed for two men engaged at the refuse destructor, whom they had been unable to replace. Both appeals were refused, and the Military Representative undertook to find substitutes.

At Rotherham, the cases of seven men on the Corporation tramway staff were reviewed. It was mentioned that 75 out of 130 men had been lost, and that substitutes could not be obtained. During the past six months five men had been trained; two had died, and the others could not stand the weather conditions. One single, Class A, man was ordered to join up, and the others were exempted until competent substitutes satisfactory to the Tribunal were found.

Before the Somerset Appeal Court, the Military asked for the withdrawal of exemption held by the chief assistant engineer (31), and a fitter and driver (41), engaged at the electric light and tramway undertaking at Weston-super-Mare. It was urged that there would be danger to the public if the staff was further reduced. The engineer's exemption was allowed to stand, and the other case was adjourned *sine die* for substitution.

At Bexhill-on-Sea, Mr. C. A. Frost, electrical engineer, appealed for further exemption for two shift engineers, as substitutes were being found. A month was allowed to each.

Maidstone Tribunal has granted six months' exemption to J. P. Macrow (30), armature winder, and E. Weller (30), engineer's turner, engaged in the Corporation tramway department.

On the appeal of the Military, Maidstone Tribunal has withdrawn conditional exemption, with a month's grace, held by E. Styance (25), one of a gang employed in unloading coal to the municipal electricity works. The electrical engineer, Mr. E. E. Hoadley, said that the gang had been depleted from 20 to seven.

At Eccles (Lancs.), the borough electrical engineer appealed for a handy labourer at the works, aged 37, who works on the average 87 hours per week. Mr. Angus stated that the man's work was of a special nature, and he could not find a substitute. A Class A man was necessary for the heavy work he had to do. The appeal was dismissed, and the calling up fixed for the end of May.

At Burgess Hill, the Military Representative had a review of conditional exemption granted to the engineer and manager of the Electric Light Co. (39, in Class B 1), and asserted that electric light was a luxury. Respondent stated that he was not only manager of the works at Burgess Hill, but elsewhere. Mr. L. R. Burrows, chairman of the company, who was a member of the Tribunal, urged that it was an important matter for the town. The company supplied current to places of worship, banks, post offices, and some 200 private houses and shops. If the manager were taken, and they could not get another man, the works would have to be closed, which would be a public nuisance. The exemption was cancelled as from May 1st.

At Redruth, on April 14th, the Cornwall Electric Power Co. appealed for their high-tension wire foreman (22, in Class A), and for a high-tension wireman (21). The company claimed that it was in the national interest that they should retain these men; they had been badged, but the badges had been withdrawn. The Military Representative objected to the men being exempted on the ground that they were in Class A, and that it was not in the national interest that they should remain in civil life. The foreman was given six months, and the other appeal was disallowed.

The Surrey Appeal Court has dismissed an appeal for exemption for J. G. Toonjan (23), shift engineer at the Reigate municipal electricity works.

Before the Durham County Appeal Court, the Sunderland and District Electric Tramways Co. appealed against the refusal of exemption to a tramway engineer and foreman (28), and an electrical wireman and tramdriver (25), both passed for general service. It was stated that the company had released 123 employés for the Army, Navy, and munitions, and it was claimed that both men were in certified occupations. Mr. G. Stratton, the manager, said that he had applied for substitutes without success. Conditional exemption granted in both cases.

At Keighley Tribunal, reference was made to the case of an electrical engineer, aged 20, in Class C 3, who was a member of the Amalgamated Society of Engineers, and had held a trade card for the past two months. The Military Representative contended that the card was no use, as he should have had it since before August 15th, 1915. Mr. Liddermore held that that condition was not essential in the case of a man who, as in this case, was a skilled or semi-skilled engineer before that date. This fact had not been placed before the Tribunal at the hearing a few days previously, when four men had been concerned in the case, two of whom were ordered to join up at once. Mr. Liddermore suggested a reopening of the cases. Mr. Morkill (Military Representative) said a circular had been received by recruiting officers giving instructions that whatever might be a decision of a Tribunal, if within an hour of the expiration of a calling-up notice a man, through his employer, could produce evidence that on August 15th, 1915, he was registered so as to come within the skilled or semi-skilled definition entitling him to a trade card, the papers should be cancelled. It was agreed that the man concerned should be made aware of this position.

BUSINESS NOTES.

Book Notices.—"The Electrical Review's Electrical and Allied Trades Directory" (The Red Book.) London: H. Alabaster, Gatehouse & Kempe. Price 21s.—Notwithstanding all the difficulties that the war has naturally placed in the way of compilers of directories in which an important feature is made of foreign entries and corrections, the Red Book for 1917 has made its appearance looking as business-like as ever, but under a slightly altered title. It has dropped the "Universal" from its name, because certain countries, some of which shall be nameless, have no longer place within its covers—they are, for the present at least, outside the pale of Civilization, and nobody wants to know the addresses of those with whom they do not want to communicate even if they could. Attention has been concentrated in this edition, more particularly upon information which will be useful in encouraging business relations in the United Kingdom and between works and traders in the Mother Country and our Colonies and Dependencies overseas. As far as possible the entries of alien enemies in neutral countries have also been eliminated. It is believed that all the changes made will enhance the British utility of the volume. All that could be done, in exceptional times, to ensure the making of corrections to bring the contents right up to date, has been done, and we believe that the volume will be found of great service to those who are fortunate enough to secure a copy. The sections into which the Red Book are divided by the usual thumb index are:—British Alphabetical, British Classified Trades, Colonial and General Alphabetical, ditto Classified Trades, and a selected Continental Alphabetical Section of about 100 pages. The number of pages is now 1,164, as compared with 1,568 last year, but the drop of 25 per cent. in pages is amply made up for by an increase of more than 25 per cent. in its British business efficiency by reason of its special adaptation to a period of exceptional difficulty and expense.

Wiring Hints for Interphones. Bulletin No. 4,015. London: Western Electric Co., Ltd.—This is one of those brochures issued in connection with a firm's specialities which are so full of technical information, expressed in terse and lucid language, that they are of the greatest value to the user, not only of the apparatus primarily dealt with, but also of all apparatus of the same general type. It relates to the automatic replacement interphones of the Western Electric Co., Ltd., and is intended for the guidance of the contractor and his wiremen. A brief description of the equipment is given, followed by particulars regarding the cables, batteries, and accessories required, and a full account is provided as to the proper method of preparing the cable for wiring in workmanlike fashion, with ample detailed illustrations which render errors, if not impossible, at any rate inexcusable. Simple rules for connecting are also given, and methods of finding and clearing faults (in the unlikely event of their occurrence) are described. An explanation of the working of the sets, with diagrams of the circuits, completes the booklet, which is a model in style and substance. It should prove most useful to those for whom it has been written.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXVI, No. 4. April, 1917. New York: The Institute.

"Preliminary Mathematics." By Prof. F. E. Austin. London: E. & F. N. Spon. Price 5s.

Trade Announcement.—The Yorkshire Electric Wiring and Motor Co., Ltd., of Sheffield, have removed from Waingate to 4, Lady's Bridge.

Storage Batteries for New Zealand.—H.M. Trade Commissioner in New Zealand (Mr. R. W. Dalton) reports that a firm at Wellington desires to get into touch with United Kingdom manufacturers of storage batteries for power station and country house lighting, with a view to representing them in New Zealand after the war. This agency is wanted in conjunction with an agency already held, in order that the firm may be in a position to offer a complete installation of power plant. Communications should be addressed to the Department of Commercial Intelligence, 73, Basinghall Street, London, E.C., 2. (Reference 150).—*Board of Trade Journal.*

Catalogues and Lists.—In connection with the restriction Order relating to the distribution of catalogues, &c., the production of which was ordered and commenced before March 3rd, the Paper Commission has been authorised by the Board of Trade to extend by general licence until further order the period during which such distribution will be lawful.

The Telegraph Condenser Co., Ltd., Vauxhall Street, Kennington Oval, London, S.E.—The catalogue (40 pages) issued by the company contains full description and numerous illustrations of different types of artificial lines for duplex working on submarine cables, especially the Dearlove patent type with negligible temperature coefficient; condensers for submarine cables; other condensers, artificial cables for universities, colleges, and science schools, &c. A supplementary list of eight pages shows developments, including artificial cable for telephone experiments, "T.C.C." type telephone condensers, and Mansbridge condensers.

Messrs. Arnold Goodwin & Son, Ltd., Sumner Street, Southwark, London.—Illustrated list showing a number of their runways in service, also giving prices of "Beatall" lifting blocks and travelling carriages.

Messrs. Dick, Kerr & Co., Ltd., Abchurch Yard, Cannon Street, London, E.C.—Folder giving prices of Britannia drawn-wire lamps.

Western Electric Co., Ltd., North Woolwich.—*Bulletin* No. 4,015 (24 pages) contains full particulars, with wiring and other diagrams and illustrations of the company's system of automatic replacement interphones.

Messrs. Scholey & Co., Ltd., 56, Queen Victoria Street, London, S.W.—A series of small leaflets issued in connection with the Taylor stoker. They relate to the saving of labour and upkeep of boilers, the increase in capacity of boilers, and the ability to meet sudden overloads accruing through the use of this stoker, also its advantages in connection with the use of low-grade fuels.

British Thomson-Houston Co., Ltd., 77, Upper Thames Street, London, E.C.—Eight-page reprint from the "Beama Journal" of an illustrated article on "Industrial Fittings for Half-Watt Type Lamps."

The General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—Three new publications: No. V 2,088 gives illustrated particulars and prices of "Witton" moulded insulation terminal blocks; No. L 2,093 describes the G.E.C. haulage road-signalling system for use in collieries; and No. O 2,104, deals with the "Kingsway" miners' electric hand lamp.

Dissolutions and Liquidations.—British Electrical Accessories Manufacturing Co., Ltd.—Mr. E. Fisher, of 12, Cherry Street, Birmingham, has been appointed receiver as from April 4th. It is expected that there will be a dividend of about 5s. in the £.

Alphons Custodis Chimney Construction Co., Ltd.—The controller, Mr. D. H. Allen, has applied for his release.

Anglo Engineering Co., Ltd.—By an order dated March 28th, Mr. G. E. Corfield has been appointed an additional liquidator to act with Mr. A. E. Tilley.

Universal Light and Sign Co., Ltd.—A meeting is called for May 25th at 35, Coleman Street, E.C., to hear an account of the winding up from the liquidator, Mr. J. H. Anneveld.

Birmingham Belting Co., Ltd.—A meeting is called for May 24th, to hear an account of the winding up from the liquidator, Mr. E. Taylor.

Auto-Flash Sign Co., 119, High Holborn, and Rickmansworth, lately at 4 and 5, Glebe Road, Kingsland Road, Dalston, as the Patent Distributor and Times Switch Co.—Messrs. W. B. Garstin & W. R. Scott have dissolved partnership.

Climax Stopper and Ebonite Co., Ltd.—A meeting of creditors is to be held at Normandy Works, Normandy Street, Custom House, E., on May 2nd. Mr. C. A. Henderson, liquidator.

Adnil Electric Co., Ltd., London, E.C.—Second dividend of 3s. 6d. in the £, payable April 30th, at 6, Clement's Lane, E.C., 4.

Wholesale Traders' Association.—The fourteenth annual meeting of the Wholesale Traders' Association for the Protection of the Hardware, Furnishing and Metal Industries, Ltd., was held at the offices at Birmingham on April 19th. Major J. H. Cartland, J.P., who presided, stated that the operations of the Association had again been fully maintained, and that the members had made extensive use of its various departments, which had afforded them exceptional facilities and assistance in many directions under the present abnormal conditions; 138 new members had joined the Association during the year, bringing the total membership to 3,195. Notwithstanding the war, and the fact that a large number of firms were doing Government work, and, therefore, were not seeking to open new accounts, the number of status inquiries sent in during the year had reached the enormous total of 72,772, involving a credit of over £6,000,000, thereby showing that there was still a good general trade being done by the various manufacturers and merchants throughout the country, and that a large number of orders had been received from foreign and colonial markets which they were unable to execute at the present time. In the debt recovery department 22,690 cases were sent in for collection, aggregating in value £224,137, and out of this sum only 8½ per cent. proved irrecoverable or bad. In the insolvency department there had been a considerable decrease in arrangements, bankruptcies, and companies' liquidations, but a large number of cases had been reported during the year where meetings had been attended and combined action taken in the interest of members. The secretary reported concerning the Association's activities relating to the Registration of Business Names Act. No fewer than five of the Association's amendments were included, wholly or partly, in the Act. Up to date about 75,000 firms had already registered. The working of the Act had shown the importance of some amendment being made in the Companies' Acts, and the secretary was instructed to take whatever steps he thought necessary, in conjunction with others to bring about this result.

LIGHTING AND POWER NOTES.

Australia.—The report on the results of working of the Melbourne City Council's electricity undertaking for the year ended December, 1916, shows revenue amounting £197,100, an increase of £14,505; an expenditure of £94,849, leaving a gross profit of £102,250. After deducting £54,339 for capital charges and depreciation, £6,540 sinking fund, £3,654 payment to employés on Active Service, and £1,454 special expenses, there remains a net profit of £36,263, £36,000 of which the Committee proposes to allocate to the loan fund. The sinking fund now stands at £141,828.

In the discussion which followed the presentation of the report, a resolution was moved that the accounts be referred to the Finance Committee, it being claimed that the Electric Supply Committee should not arrogate to itself the right of allocating amounts to any funds. Alderman Cabena, the chairman of the Electricity Committee, said he objected to one Committee controlling another; if the Finance Committee was to control the accounts of the Committee of which he was chairman, he would resign. The resolution to refer the accounts was carried by 13 votes to 6, and Alderman Cabena intimated his resignation from the Committee.—*Melbourne Age.*

In connection with the electric lighting department of the Cottesloe (W.A.) Municipal Council, during 1916 the number of consumers increased to 1,185 and the consumption to 242,720 units. The Council is now arranging an agreement with the Fremantle Tramway Board for a 21 years' service, and, under the new system, it is proposed to spend £3,000 to make the necessary changes in existing fixtures.—*Commonwealth Engineer.*

A deputation, consisting of the representatives of the Electrical Employés' Association and the Electrical Trades Union, waited on the Lord Mayor of Sydney, N.S.W., recently, to urge the Council to reconsider its decision not to connect new consumers, pointing out that it would result in a number of men being thrown out of employment, and suggesting that the Council should apply to the Railway Commissioners to use the plant at White Bay to generate electricity to enable the electric lighting to be pushed on with. The Lord Mayor said the Council had been in communication with the Railway Commissioners since last April, and he would personally renew the request. If the Westinghouse Co. was prepared to do the work of constructing the engines required at before-the-war contract rates, there was no doubt that the Council would have no hesitation in signing a contract and procuring the machinery as rapidly as possible.

Birmingham.—A special meeting of the Electric Supply Committee has considered the report of Mr. C. P. Sparks, president of the I.E.E., which approves the Nechells site, and it was agreed to proceed with the erection of the permanent station as soon as practicable.

Blackpool.—Year's Working.—The Corporation electricity department records a loss for the past year—the first for a very long period. The income was £45,791, compared with £44,347 in the previous year, but working costs increased from £25,277 to £28,768, resulting in a loss of £887. Daylight saving and the increased cost of coal were factors. There were 13,904 tons of coal used, at a cost of £12,289. Three years ago nearly the same number of tons cost only £8,775. The total capital outlay to date is £252,191, and there is a loans sinking fund of £133,262, and a reserve fund of £5,223. Only 100 new consumers were added to the mains during the past year. The Committee is to consider a further revision of the charges for current.

Canada.—In an address before the Ontario Municipal Electric Association, on February 15th, Sir Adam Beck reviewed the work of the Ontario Hydro-Electric Power Commission, and spoke on the future of the provincial system. The Commission at present supplies 191 municipalities, and expects to supply over 200 in the course of the next two or three months. Over 200,000 h.p. is now developed by the Commission, with a total investment on the part of the Commission and municipalities of more than $40,000,000. Within five years, Sir Adam expects this amount to increase to $100,000,000. In regard to the future, Sir Adam said his opinion was that the hydro-electric power system must absorb the whole of the electric systems in the province of Ontario.

Formal protest has been made to the Canadian Government by the United States against the proposed Chippawa-Queenstown power canal, by which the Ontario Hydro-Electric Commission will divert additional water from the Canadian channel of the Niagara river for power development. The United States claims that the project would violate the treaty under which the diversion limit above the cataracts is fixed at 20,000 cb. ft. per second on the American side and 35,000 cb. ft. per second on the Canadian side. The Ontario Provincial Legislature has been advised by Attorney-General Lucas that there is no necessity for seeking the consent of the International Joint Waterways Commission to carry out the Chippawa-Queenstown power development project, and, acting under this advice, the Provincial Legislature will proceed with the plans without the permission of the International Commission. The Ontario Hydro-Electric Commission has charge of the construction, &c.—*Electrical World.*

Clayton.—The Bradford Corporation Electricity Committee, last week, considered the matter of electricity supply to Clayton, arising out of the recent controversy in that township as to whether this should be obtained from Bradford or from the

Yorkshire Electric Power Co., the latter of whom has a Bill before Parliament. It is believed that there was a view that it would not pay Bradford to supply Clayton. A Sub-Committee was appointed to make full inquiry, and report to the next meeting of the full Committee.

Haworth (Yorkshire).—An animated discussion ensued at last week's District Council meeting as to whether or not an Electricity Committee should be appointed. In open Council, a motion for the re-appointment of an Electricity Committee was defeated by a majority of one, but subsequently a Committee was appointed.

Hoole. — Workhouse Lighting. — The U.D.C. has assented to Chester T.C. supplying current to the workhouse, which is in the area of the Council.

Hull.—The Electricity Committee has received a communication from the Municipal Employés' Association, asking the Council to receive a deputation in regard to an advance of wages. It was stated that a Special Committee had been appointed to consider the wages question. The acting engineer (Mr. McGoris) was authorised to employ a further batch of women, with whose work he expressed much satisfaction.

In regard to the scheme for amalgamating the tramway and lighting generating stations, the chairman reported that an agreement had been arranged with the Tramways Department in regard to formulating a scheme.

India.—Last year's Administration Report of the Madras P. W. D. states there has been a steady increase in the use of electricity in Madras City. As many as 48 industrial concerns in Madras are now being worked with electric power, these including saw mills, oil mills, flour mills, printing presses and cement works, and if the supply company could only meet the demand, the list would include many more concerns. Works are in progress for conveying current to the suburbs of the Kilpauk Adyar and Royapuram, and the only delay in carrying out these extensions is due to non-receipt of materials from home on account of the war. Altogether, there are in Madras signs of general development, and a readiness to accept new ideas.

At the July meeting of the Bombay Legislative Council, the following resolution is to be moved :—"That this Council recommends that his Excellency the Governor-in-Council will be pleased to place on special duty, at the earliest convenient date, a capable officer of the Public Works Department to report upon the development of water power in this Presidency, both for direct use and for the establishment of hydro-electric plants, the special duty officer being instructed to give approximate costs of the proposed water power schemes, the details being left to be worked out by promoters proposing to utilise the power for industrial purposes."—*Indian Engineering.*

London.—Hammersmith.—The Electricity Committee has had under consideration proposals by the electrical engineer for increasing the ouput of the existing generating plant, by adding induced draught plant, a new boiler feed pump, mechanical stokers, &c. It is expected that another 1,000-kw. capacity can be obtained, and a detailed report is to be submitted.

Marylebone.—The Electricity Committee has received a communication from Sir Arthur Duckham, chairman of the Advisory Committee (Ministry of Munitions), asking the general manager to advise him on matters connected with a proposed scheme and experiments for the economical use of coal.

Annual Estimates.—The estimated revenue of the electricity undertaking for the year ending March, 1918, is as follows :—From sale of electricity to consumers, £187,500 ; from public lighting, £14,850 ; meter rents, £8,100 ; sale of fittings, &c., £11,280 ; rent of properties, plant on hire, and sundry charges, &c., £4,540 ; making a total of £226,270. The estimated expenditure is for generation and distribution costs, management expenses, rates, taxes, &c., £91,320 ; maintenance and repairs to public lamps and repairs to properties, £4,500 ; allowances to employés, £4,500 ; sales department, £10,250 ; repayment of loans, £47,303 ; interest, £66,576 ; making a total of £224,449, and leaving an estimated credit balance on the year's working of £1,821.

The Electricity Committee recommends that two underfeed stokers be fitted to two additional boilers, at a cost of £2,100 ; it also reports that alterations have been made at Aybrook Street sub-station, at an estimated cost of £750.

The report of the working of the electricity department for the December quarter shows that 5,341,237 units were sold, representing a net increase of 7·2 per cent. over December, 1915. The net revenue from the sale of electricity and meter rentals totalled £63,252, being an increase over December, 1915, of £2,783. The total expenditure for the quarter amounted to £23,383, an increase as compared with the December quarter of 1915 of £3,747. The total average costs per unit sold were 1·141d., as against 1·042d. The result of the quarter's working shows a net improvement of the balance available for capital charges of £895, making a total for the nine months of £75,721.

Mytholmroyd (Yorkshire).—The U.D.C., last week, agreed to the Halifax Corporation applying to the B. of T. for an Order authorising it to supply electricity to several industrial concerns at Mytholmroyd, conditional on it undertaking to discontinue the supply on written request by the Mytholmroyd Council, and on there being no liability attached for any cost or expense incurred by the Corporation.

Rochdale.—The D. R. Cotton Co., Sudden, has written to the Corporation Electricity Committee, asking if the department is in a position to give it the full supply of energy promised between 1,700 and 1,800 kw. The Committee has replied that it cannot supply more than 1,350 kw. at present.

South Africa.—The Johannesburg T.C. recently decided that no applications for electric light or power connections could be entertained after February 19th and until further power was available. The turbines ordered in England with this object cannot be delivered for a considerable time.

Swansea.—Linking-up.—The engineer has attended a meeting with regard to interconnection of electric supply undertakings ; as regards the question of funds for the preparation of plants, reports, &c., each undertaking, it is proposed, shall guarantee a maximum amount of 1½ guineas per £10,000 of gross revenue.

Tasmania.—According to *Tenders*, Mr. J. H. Butters, general manager of the Government Hydro-Electric Department, has informed the Launceston City Council that it will not be possible to complete the extensions to the Great Lake scheme for 18 months, owing to the impossibility of obtaining the material in England ; consequently, the negotiations for the supply of energy have been suspended. Mr. Butters suggests that it might be possible to limit the demand, with a view to avoiding extensions of plant in the meantime.

TRAMWAY and RAILWAY NOTES.

Accrington.—Accident.—Considerable interference was caused to traffic on April 19th through the breaking down of the overhead equipment by the trolley poles of two cars getting into contact. The fall of the equipment resulted in the breaking of three windows in a Blackburn car, but, happily, no one was injured.

Three women are learning the work of motormen, and a woman is driving a tramcar.

Atherton.—The South Lancashire Tramways Co. is now employing women in its highway repair department.

The company has granted £100 towards the equipment of Green Hall, Atherton, as a military hospital.

Belfast.—The Tramways and Electrical Committee has recommended the pushing on of the new electric station at Hamilton Road, convenient to Belfast Lough, and also recommended a suggested revision of the stages and fares over the Corporation system of tramways. Unless this is done, the tramways will soon be bankrupt, as the war has hit them so hard that they are losing at the rate of anything from £10,000 to £15,000 per annum, and stand to lose still more in the near future should the employés persist in their demand for a further increase of pay—this time 5s. per week. These matters will be considered at the next monthly meeting of the Corporation.

Blackpool.—Record Year's Receipts.—The receipts of the Corporation tramways for the past 12 months, ended March 31st, were by far the largest on record. The total was £94,368, or over £10,000 more than the next best year, which was 1913.

Bury.—Year's Working.—The Tramways Committee reports a profit on the Bury section for the past year of £3,543, and on the Radcliffe section, under the first agreement, a loss of £452, and under the second, a loss of £406. It was decided that the profit from the undertaking and a sum of £1,456 from the reserve and depreciation fund be paid to the credit of the borough rate.

The Corporation Tramways Committee has refused the application of the Tramway and Vehicle Workers' Association for an advance in wages of 10s. per week for male and female employés in the tramway department.

Dudley.—Female Drivers.—The local Trades Council has sent a resolution to the B. of T., Ministry of Munitions, and Tramway Co. against the employment of women as tramway drivers, on the ground of physical unfitness.

Halifax.—Year's Working.—The tramway statement for the year ended March 31st shows a total income of £114,684, as compared with £113,514 in the previous year. The passenger receipts were £111,370, as against £110,130 ; luggage, £108, as against £149 ; private cars, £226, against £95 ; ticket vouchers and tokens, £352, against £327 ; parcel traffic, £1,974, as against £2,134. Advertising had cost £500, as against £441. The expenditure had been £100,125, as against £94,458, and the profit was £14,559, as against the previous year's £19,055. There had been a decrease in mileage from 2,195,980 to 2,048,772, but the number of passengers carried had increased from 21,024,003 to 21,180,584.

The figures for the week, including the Easter holidays, showed receipts £1,918, as against £1,914 last year ; mileage, 35,005, as against 39,285 ; receipts per car-mile, 13·15d., as against 11·73d.

India.—The Government of Madras, in its review of the Madras Corporation's last report, writes that the proposals for the extension of the tramway lines in Madras City, so as to help in the removal of congestion, involve the widening of some of the bridges at considerable cost, and are still under examination.

The Municipal Commissioner of Bombay has forwarded to the Corporation for sanction the proposals submitted by the Bombay Electric Supply and Tramways Co. for extending the tramway system along Esplanade and Sandhurst Roads, and for doubling the present single track along Colaba Road. —*Indian Engineering.*

Keighley.—It was reported that meetings had been held, last week, between representatives of the Council, the Keighley Corporation Tramways Committee, and the Bingley U.D.C. with respect to the proposed linking-up of the Bradford tramways at Cross Flats, Bingley, and the Keighley tramways at Stockbridge, to which all parties were favourably inclined, but the stumbling-block is the bridge itself, which must be improved before any tramway can be run over it. The idea of an extension of the tramway track on the Bingley side, as far as Barhouse Lane, had not met with much favour, and railless extensions met with the same feeling.

Leeds.—Year's Working.—Actual figures of the past year's working of the Corporation tramways submitted to the Tramways Committee, last week, show that the receipts were £515,806, an increase of £40,301 on those of the previous year, and, for the first time in the history of the undertaking, exceeding the half-million sterling. The number of passengers carried was 112,151,883, an increase of 8,698,082, the car-mileage having been 9,658,595, an increase of 253,474 miles. The working expenses had increased by £25,259, from £236,227 to £261,486, thus leaving a gross profit of £254,231, an increase of £15,042. With the addition of bank interest and dividends on investments to the amount of £9,755, there is a disposable revenue of £264,076, of which £120,787 is for interest on capital and redemption fund instalments, £30.000 for permanent way renewals, £2,373 to go towards capital outlay: income-tax takes £18,594, and war allowances, £12,891. The surplus to relief of rates is £79,431, equal to an 8½d. rate. Traffic expenses during the year were £122,499, the average cost per car-mile being 3·044d., as against 2·927d.; general expenses were £39,832, including £22,592 in local rates, and the cost of general repairs and maintenance was £53,291, of which £34,373 was in car repairs. Power costs were £35,098, including £12,070 for energy purchased. War bonus to employés absorbed £10,766, the wages bill, including that bonus, being £161,899.

Under the Northern Command substitution scheme, a start has been made in Leeds with the employment of wounded and discharged soldiers as drivers, about 20 of these men being now so employed, and a batch of others being in training at the depôts.

The Glasgow scheme of sale on the cars of 1d. tickets, with War Savings Certificates as prizes and about nine-tenths of the money going to war charities' funds, has, it is understood, been approved for the Leeds tramways, and a start is expected to be made very soon.

Manchester. — Year's Working. — The Corporation Tramways Committee on Tuesday decided to reduce its contribution to the city rates from £100,000 to £50,000; the increase in the rates may be 6d. in the £. The tramway revenue last year was £978,602—being £39,000 more than a year ago; the passengers numbered 219,097,258, another increase, while reduced car-miles 18,388,302—were worked. The revenue per car-mile was 12·6d. Increased costs of material, wages, &c., are reported; war service allowances and bonuses during the year are estimated to amount to £103,800.

Morecambe. — Electrification Prospects.— At the meeting of the T.C., last week, Alderman Snowden said the town's financial position was better than ever before, and they were now contemplating many improvements, one of the first of which should be the abolition of the horse cars. But for the war, they would have got a long way towards completion of the electrification scheme. The Mayor said the abolition of the horse cars would be the first step towards real progress.

Oldham.—Year's Working.— The tramway department last year made a profit in aid of the rates of £3,837. Allowances to dependents of employés serving with the Colours amounted to £5,463, and the recent war bonus granted to drivers and conductors will mean an additional expenditure of £3,456. There was a loss on the motor-'bus service of £809.

Discussing the extraordinary application for an additional bonus of 10s. a week by Lancashire tramway workers, Councillor Cheetham said it was time the authorities put their foot down; the cars, he added, were run for the convenience of the public, and not to find occupations for a number of men and women.

Rochdale. — Year's Working. — The profit on the Corporation tramways during the past year was £1,773, as compared with £3,609 a year ago, £4,284 in the previous year, and £8,489 in 1913-14. The Committee recommends the placing of the amount to the reserve fund for renewals, which now amounts to £22,000. The total receipts were £90,812, an increase of £2,904, but working expenses totalled £50,397, £2,274 more. One item—income-tax—amounted to £6,463, an increase of £2,600. These charges in 1913-14 were £1,020. A sum of £6,192 has been spent on a new car repair shed.

Salford.—At a meeting of the Local Trades and Labour Council, held last week, it was decided to protest against the raising of tramway fares by the Corporation.

South Africa.—Electric Vehicles.—After a trial of two vehicles, lasting over several months, the Johannesburg postal authorities are now using 11 such vehicles imported from America. The charging garage has been established by the importing firm, and a sliding-scale tariff has been arranged with the municipal supply authorities. According to the *S.A. Mining Journal*, as compared with the ordinary petrol car, weight for weight, the electric vehicles are run to-day at about half the cost of the ordinary petrol vehicle.

Stockport.—At a recent meeting of the T.C. the chairman of the Tramways Committee said that the present fares could not be continued if the undertaking was to hold its own. The estimates presented showed an increased expenditure for the ensuing year of £8,893, involving an increase in the rates of 3d. in the £.

Wolverhampton.—Wages.—The local branch of the Amalgamated Association of Tramway and Vehicle Workers has passed a resolution urging the Corporation to come to a final decision as regards giving increased wages, and as an alternative intimating that permission will be asked to withdraw their labour if the demands are not granted.

TELEGRAPH and TELEPHONE NOTES.

Argentina.—The Germans are putting forward a proposal to set up immediately in the Argentine a great wireless station for the receipt of messages from Berlin.

Australia.—The annual report of the Postmaster-General for 1916 shows a loss on the telegraph service of £86,426, compared with £114,555 in 1915, and a loss on the telephone service of £271,695, compared with £390,703. In September, 1915, the telephone call fees were raised from ½d. to 1d. on subscribers' lines, and from 1d. to 2d. on public call office lines, to reduce the loss.

Automatic Telephony.—On March 17th the telephone service of the Indianapolis Telephone Co. was changed over to the automatic system, with highly satisfactory results. The order was placed with the Automatic Electric Co. nine months ago, and the time occupied in completing the installation is said to make a new record. There were about 13,000 lines equipped at the time of the change-over, and the number of subscribers is rapidly increasing.—*Telephone Engineer.*

India.—Owing to the numerous extra official demands on the telephone system in Simla, no telephones can be given to new private subscribers. The automatic system is loaded to its fullest extent, and additional connections are being made to a central battery system, which can, however, be worked in connection with the automatic. An extension of the automatic system will, it is hoped, be installed during the coming season.—*Indian Engineering.*

Morocco.—H.M. Agent and Consul-General at Tangier has forwarded an extract from the *Bulletin Officiel* of the French Zone, containing a Presidential Decree, dated December 5th, 1916, authorising the execution of certain works, at a cost of 81,000,000 fr., out of which 1,108,400 fr. are provided for telephones, and 2,293,000 fr. for telegraphs.—*Board of Trade Journal.*

Telephone Call Recorder.—An automatic recorder of effective telephone calls, invented by an Australian railway employé named Godfree, has been in use about 18 months at the Ballarat Telephone Exchange on trial, with a view to obviating the frequent complaints of overcharging. Mr. Halion, the officer in charge of the exchange, has reported that the device is giving complete satisfaction.

Wireless Installations on British Ships.—An Order in Council of April 14th gives power to the Admiralty or the Shipping Controller to require that any British ship shall forthwith be equipped with wireless telegraph apparatus, and that the crew shall be properly instructed in its use. If any ship to which such directions have been given puts to sea without complying with the Order, the owner or master will be liable to punishment, and the ship to seizure and detention.—*Board of Trade Journal.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Melbourne.—May 23rd. Victorian Railways Department. Twelve months' supply (8,250) of incandescent electric lamps as ordered.[*]

Glasgow.—May 1st. Electricity department. 12 months' supply of cables and meters. See "Official Notices" to-day.

Manchester.—May 11th. Electricity Committee. Stuart Street generating station, (*a*) one hydraulic accumulator and electrically driven ram pump, (*b*) coal conveying plant. Mr. F. E. Hughes, Secretary, Electricity Department.

Sheffield.—May 8th. Tramways and Motors Committee. Carbon-filament lamps for tramcar lighting, for 12 months. See "Official Notices" to-day.

Wigan.—May 5th. Corporation electricity works. Best quick-firing slack or washed peas, for a year. Electrical Engineer, Bradford Place.

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[*] Specifications may be seen at the Department of Commercial Intelligence, 73, Basinghall Street, London, E.C.

Wolverhampton.—May 4th. Electricity Committee. 5,000-kw. turbo-alternator, water-tube boilers, economisers, and induced-draught plant, and mechanical stokers. See "Official Notices" to-day.

CLOSED.

Dover.—T.C. Coal for the electricity works: —3,000 tons of Featherstone coal, at 26s. 5d. per ton; 2,000 tons of Snowdown nuts, at 26s. 6d. per ton.

Government Contracts.—List of new contracts placed during March, 1917:—

War Office.

Bridge meggers.—Evershed & Vignoles, Ltd.

Electric cable and wire.—British Insulated & Helsby Cables, Ltd.; Callender's Cable and Construction Co., Ltd.; Connolly Bros., Ltd.; Craig Park Electric Cable Co., Ltd; I. Frankenburg & Sons, Ltd.; General Electric Co., Ltd.; W. T. Glover & Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Hooper's Telegraph and India-Rubber Works, Ltd.; India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; Liverpool Electric Cable Co., Ltd.; C. Macintosh & Co., Ltd.; St. Helens Cable & Rubber Co., Ltd.

Telephone cords.—London Electric Wire Co. & Smith's, Ltd.; C. A. Vandervell & Co.

Insulator cups and caps—Litholite, Ltd.

Distribution boards.—Kartret Engineering Co.

Electric light fittings.—Bullers, Ltd.; Electric and Ordnance Accessories Co., Ltd.; Gutheric & Co.; W. Kent; J. Macintyre & Co., Ltd.; E. Stevens, Ltd.; J. Stevens, Ltd.

Generating sets.—A. Lyon & Wrench, Ltd.; Smart & Brown.

Electric lamps—British Thomson-Houston Co., Ltd.; Edison Swan Electric Co., Ltd.; General Electric Co., Ltd.; Siemens Bros. Dynamo Works, Ltd.

Switches.—Kerr, Stuart & Co., Ltd.; W. Sanders & Co.; Sperryn & Co., Ltd.; Wandsworth Electrical Mfg. Co., Ltd.; W. White & Co., Ltd.

Electrical terminals, &c.—Automatic Standard Screw Co., Ltd.; Davis and Timmins, Ltd.; Croggon & Co., Ltd.; F. Giles & Sons; L. Herve; Houghton-Butcher Manufacturing Co., Ltd.; Ingram & Kemp, Ltd.; Sperryn & Co., Ltd.; C. J. Thursfield & Co.

Iron and steel wire.—Dorman, Long & Co., Ltd.; Rylands Bros., Ltd.; Shropshire Iron Co., Ltd.; R. Johnson & Nephew, Ltd.

Tinned copper wire.—Liverpool Electric Cable Co., Ltd.

Works services.—Electric lighting, Cecil Cooper & Co.; installation of electric light, H. J. Cash & Co.; erection of boilers, Babcock and Wilcox, Ltd.

India Office Store Department.

Brackets.—Bullers, Ltd.

Cable.—Callender's Cable Co., Ltd.

Cells.—Siemens Bros. & Co., Ltd.

Dynamo.—Lancashire Dynamo, &c., Co.

Insulators.—Bullers, Ltd.; Taylor, Tunnicliff & Co.

Telephones.—Peel-Conner Telephone Works, Ltd.

Wire. T. Bolton & Sons; F. Smith & Co.; Dorman, Long & Co.; R. Johnson & Nephew; Rylands Bros.; Shropshire Iron Co.

Post Office.

Telephone apparatus.—British L. M. Ericsson Manufacturing Co., Ltd.; Peel-Conner Telephone Works, Ltd.; Walter's Electrical Manufacturing Co., Ltd.; Western Electric Co., Ltd.

Arm grips for poles.—Bayliss, Jones & Bayliss, Ltd.

Wood arms.—British Australian Timber Co., Ltd.; T. Gabriel & Sons and Burton; W. F. Holloway & Bros.

Bodies and covers for insulators.—Taylor, Tunnicliff & Co., Ltd.

Submarine cable.—Telegraph Construction and Maintenance Co., Ltd.

Telegraph cable.—British Insulated & Helsby Cables, Ltd.; Henley's Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; St. Helens Cable and Rubber Co., Ltd.; Telegraph Construction and Maintenance Co., Ltd.; Union Cable Co., Ltd.

Telephone cable.—Peel-Conner Telephone Works, Ltd.; Western Electric Co., Ltd.

Telephone cords.—B. I. & Helsby Cables, Ltd.; Western Electric Co., Ltd.

Wire drums.—Siemens Bros. & Co., Ltd.

Telephone mouthpieces.—Crystalate Manufacturing Co., Ltd.

Insulator spindles.—Bullers, Ltd.

Telephones.—Peel-Conner Telephone Works, Ltd.

Bronze wire.—Shropshire Iron Co., Ltd.

Commissioners of Public Works, Ireland.

Electrical works and supplies.—J. F. Keatinge & Sons.

Hull.—The Electricity Committee has accepted the offer of Messrs. Priestman for a grab for the loading of coal, ashes, &c., at a cost of £1,800.

London.—Marylebone.—The Electricity Committee has accepted an offer from Messrs. A. Blackmore & Co. for the supply of 1,000/1,200 tons Granville 1½-in. nutty slack.

The Committee recommends the acceptance of the following tenders:—Two additional mechanical stokers, £1,809, Underfeed Stoker Co.; 22,000 tons of coke breeze, delivered into truck or barge at gas works, 8s. per ton, Gas Light and Coke Co.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, April 27th. At 5 p.m. At the Royal College of Science, Exhibition Road, South Kensington, S.W. Ordinary meeting.

Royal Society of Arts.—Monday, April 30th. At 4.30 p.m. At John Street, Adelphi, W.C. Howard Lecture, "The National Shortage of Iron Ore Supplies Available Home Supplies of Iron Ore," by Prof. W. G. Fearnsides.

Faraday Society.—Tuesday, May 1st. At Burlington House, Piccadilly, W. At 8 p.m. Discussion on "Osmotic Pressure." To be opened by Prof A. W. Porter, F.R.S.

Roentgen Society.—Tuesday, May 1st. At the Cancer Hospital, Fulham Road, S.W. At 8.15 p.m. Discussion (continued) on "The Future of the British X-ray Industry."

Institution of Civil Engineers.—Wednesday, May 2nd. At 5.30 p.m. At Great George Street, S.W. James Forrest Lecture on "The Standardisation of Engineering Materials, and its Influence on the Prosperity of the Country," by Sir John Wolfe Barry, K.C.B., F.R.S.

Institute of Metals.—Thursday, May 3rd. At 8.30 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Lecture on "Researches made Possible by the Autographic Load-Extension Optical Indicator," by Prof. W. E. Dalby, F.R.S.

Junior Institution of Engineers.—Friday, May 4th. At 7.30 p.m. At 39, Victoria Street, S.W. Paper on "Pneumatic Tubes," by Mr. H. E. Cosgreave.

Royal Institution of Great Britain.—Saturday, May 5th. At 3 p.m. At Albemarle Street, Piccadilly, W. Lecture on "The Electrical Properties of Gases," by Prof. Sir J. J. Thomson, Pres.R.S.

NOTES.

Earth-to-Air Discharges and Fire Risks.—We have received a shoal of cuttings from the *Manchester Guardian* of April 17th, regarding a recent fire in Manchester, and are much indebted to our various correspondents. The following is the item which has aroused so much interest:—

"The Portland Street Fire.—'F. J.' writes from Manchester:—I suggest that the cause of this fire, and of others like it, may be found in the metal conduits—water, hydraulic, and gas mains—which conduct the earth electricity inside the buildings until it reaches the upper storeys. Here a resistance is met with, as the conduits are smaller. This resistance produces heat, and thus sets fire to any inflammable material. If the conduits are sufficient in electrical carrying capacity to conduct the earth electricity silently inside the building until it reaches the upper storeys; it discharges itself through the roof into the air, and, of course, sets fire to neighbouring inflammable material. It is definitely known that a large building in this area was set on fire by earth-to-air electrical discharge. The conflagration was discovered immediately, and the actual cause was evident. Had this occurred when there was nobody on the premises, the origin would not have been discovered. This instance was not made public. None of these warehouses was protected from either earth-to-air or air-to-earth electrical discharges. It is interesting to note that no big fire has occurred in Manchester where provision has been made for these discharges by the erection of lightning conductors, which form a permanently effective means for silently discharging highly charged areas of earth or clouds."

One of our correspondents—Mr. G. L. Enderby—satirically inquires whether, in view of the high price of electrical energy, our readers will kindly put forward suggestions for the utilisation of this valuable source of electricity to light a few lamps in the upper stories of tall buildings. We fear, however, that such hopes are doomed to disappointment. We do not know who "F. J." is, or where he acquired his profound insight into atmospheric electrical phenomena, but we could suggest other initials which would be more appropriate.

American Electrical Industry and the War.—Under the title "Electrical Industries Ready to Serve," the *Electrical World*, U.S., publishes appropriate messages from leaders of these industries, the writers being Mr. E. W. Rice, jun., president of the General Electric Co.; Mr. S. S. Wheeler, president of the Crocker-Wheeler Co.; Mr. H. W. Buck, president of the American Institute of Electrical Engineers; and Mr. H. A. Wagner, president of the National Electric Light Association. The letter from Mr. Rice reads as follows:—

"The Industry's Pledge.

"To the *Electrical World*.

"The President's message expresses in simple but powerful words the solemn and final judgment of a great peace-loving people on the issues of this great war.

"While every thoughtful citizen must realise the gravity of the step which we are now taking, there will be no holding back, and no matter what trials the future may have for us, the knowledge that we are fighting in defence of all that makes life worth living will enable us to persevere until victory for ourselves and our natural allies has been obtained.

"Men of the electrical industry, representing every phase of scientific and engineering activity, will be able to render invaluable service, as a modern war, as is well known, cannot be won by courage and strength alone, but demands skill in control of complicated machinery and the use of scientific methods all the time and everywhere.

"This is not a war between peoples, but a mighty conflict of irreconcilable ideals of government and of life, and there can be no question, therefore, that every citizen of this country who treasures our ideals will welcome the solemn privilege, which has been forced upon him, of fighting for them. We all devoutly hope and believe that the entrance of our nation on the side of liberty and humanity will bring to a speedy end this terrible scourge of the world.

"E. W. Rice, jun.

"Schenectady, *April 4th*, 1917."

Restriction of Sunday Labour.—According to the *Daily Telegraph*, Sunday labour is, as far as possible, to be abolished in a large majority of the establishments controlled by the Ministry of Munitions, from the beginning of May. Establishments in which the process worked is of necessity of a continuous nature will not come within the operation of the new order, and an exception will also be made in the case of firms whose contracts are of great urgency.

The abolition of continuous Sunday labour in the national factories and in controlled establishments has, in most cases, been highly beneficial, as would be anticipated in view of the results of investigations noted in our pages, which showed that a suitable division of time between labour and rest diminished fatigue and increased output. Long working hours do not pay.

That Sunday labour has a pernicious effect on the health of workers, particularly in heavy trades, says the *Times*, is one of the conclusions of an interim report on Industrial Efficiency and Fatigue, which has just been issued by the Health of Munition Workers' Committee. The report contains certain memoranda which have already been published, but much of it is a record of new and important work. The investigations of Prof Loveday on the incidence and causation of lost time reveal the fact that insufficient allowance is generally made for the extent to which lost time is caused by sickness, partly owing to the difficulty of obtaining reliable medical certificates. Except when hours have been very long, relatively to the class of work, evidence is lacking of an increase of sickness. On the other hand, the hours gained by overtime may be lost, to a large extent, by lost time. Prof. Loveday suggests reasons for the opinion that the employment of workers before breakfast is uneconomical and unprofitable. In regard to "staleness," a single day off given occasionally, at the right time, would, it is suggested, have avoided much wasteful reduction of capacity, and, in the worst cases, the total loss of many days of work.

Volunteer Notes.—First London Engineer Volunteers.—Headquarters: Balderton Street, Oxford Street, W.

Orders for the Week, by Lieut.-Colonel Clay, V.D., Commanding:

Monday, April 30th.—Technical for No. 3 Company, Right Half Company, at Regency Street. Drill No. 3 Company, Left Half Company. Signalling Class. Recruits' Drill, 6.30—8. Medical examination and attestation, 6—8.

Tuesday, May 1st. Lecture, "Demonstration of Landscape Target," by Platoon Sergeant Hoad, 6.30. Physical drill and bayonet fighting, 7.30 to 8.30.

Wednesday, May 2nd. Instructional Class, 6 15. Drill No. 1 Company, Right Half Company.

Thursday, May 3rd.—Drill No. 2 Company, Right Half Company. Ambulance Class by M.O., 6.30. Signalling Class.

Friday, May 4th.—Technical for No. 3 Company, Left Half Company, Regency Street. Drill No. 3 Company, Right Half Company. Recruits' Drill, 6.30—8.30.

Saturday, May 5th. Commandant's Parade, 2.45. Uniform, for drill in Hyde Park.

Sunday, May 6th.—Special work at Bombing School. Parade, Clapham Common Station (City and S.L. Railway), Tube, 9.45 a.m.

(By order), Macleod Yearsley, *Captain and Adjutant.*

Metropolitan Association of Electric Tramway Managers.—A meeting of the members of this Association was held at the Municipal and County Club, Whitehall Court, Whitehall, S.W., last Friday, when there were present: Messrs. Ullmann (East Ham), chairman; Hammond (M.E.T.), vice-chairman; Bruce (L.C.C.), Harvey (Ilford), Mason (South Met.), Mackinnon (London United), and Goodyer (Croydon), hon. sec. Letters of inability to attend were received from Messrs. Murray (Walthamstow), Slattery (West Ham), Williams (Erith), Stokes (Bexley Heath), and Schofield (Leyton). Various matters of interest were discussed.

Manchester Engineers' Wages.—The pieceworkers in the engineering trade in the Manchester district have received notice that the Government Production Committee has awarded them an advance of 7½ per cent. for the period of abnormal conditions which have been brought about by the war. The application was for a 15 per cent. advance, and originally the men were granted a 3s. a-week bonus. Against this award they appealed.—*Morning Post.*

Decimal Coinage and the Metric System.—It was announced by Mr. Bonar Law, in the House of Commons, on Monday, that Lord Balfour of Burleigh's Sub-Committee of the Reconstruction Committee on Commercial Policy is considering the question of British and Imperial weights and measures and the decimalisation of British coinage.

On Monday, the Central Chambers of Agriculture adopted a resolution in favour of a new system of weights. The report recommended that the existing legal cental of 100 lb. should be substituted for the 112-lb. cwt., 20 such centals to be the ton of 2,000 lb. It was also recommended that quotations should be given on the basis of the pound and cental, and that the Press should be urged to adopt the same basis for market quotations. Evidently the farmers will not oppose the introduction of the decimal system.

Federation of British Industries.—As a result of the deputation of representatives of the Federation of British Industries, the British Manufacturers' Association, the Central Association of Controlled Firms, and the Employers' Parliamentary Association, the following gentlemen have been appointed to form an Advisory Committee to the Ministry of Munitions, and the appointment has been approved by the Ministry:—Messrs. G. Muir Ritchie, Douglas Vickers, Geo. Terrell, M.P., R. G. Perry, H. M'Gowan, and Sir Frederick H. Smith, Bart. We shall refer further to the matter later.

The Schedule of Protected Occupations: Electrical Workers.—There is obtainable from the Government printers a Schedule of Protected Occupations (M M 130, one penny), dated April 21st, 1917, for men employed on Admiralty, War Office, or Munitions work, or in railway workshops. This is in connection with the decision of the War Cabinet that, in order that the supply of men for the Armies in the Field may be maintained, a considerable number of men fit for general service must be released. The War Service Badge Certificates and Trade Cards are to be superseded by a system which protects from recruiting men who may from time to time be found indispensable. The schedule shows the age above which workers are protected for the present; but if the needs of the Army again become urgent, the arrangements may be modified. Electricians may be called up below the age of 23, but electrical fitters of all ages are protected. In instrument making, all electricians on medical apparatus are protected, whatever their ages. In scientific and electrical instrument making, there is protection for all ages of men making scientific instruments and wireless telegraph instruments, while the age of 23 is fixed as the limit for protection of "electrical instrument makers." In X-ray apparatus manufacture, there is protection for coil makers and pumpers of all ages, but for photographic-plate makers (including chemists) the age is fixed at 23. Skilled men of all ages in the manufacture of electrical insulating material and electrical wire and cable are protected, as are a number of classes of men engaged in electrical accumulator manufacture, though departmental managers or foremen are protected above 25 only. Skilled workmen only, engaged in electric lamp manufacture, are protected at all ages. The entry respecting electrical generating stations is as follows:—

Station and sub-station engineers, switchboard attendants, shift engineers, cable jointers, age 23. Electrical generating stations include those for tramway undertakings in cases where the undertakings are certified by the Ministry of Munitions under the Munitions of War Act. Other workmen employed by certain electrical undertakings are to be as and if specified in the "Engineering" Section of the Schedule. Under Professional occupations, electrical engineers are protected above the age of 23.

Institution and Lecture Notes.—Institution of Electrical Engineers.—The report of the Committee of the Birmingham Local Section was presented to the annual general meeting on Wednesday last. It stated that the average attendance at meetings was 46, compared with 43 in the previous session. The membership showed a net decrease of four members. The following are the office-bearers and Committee for 1917-18:—

Chairman.—S. T. Allen.

Vice-Chairmen.—N. B. Rosher; C. C. Garrard, Ph.D.

Ordinary Members of Committee:—F. H. Clough, F. Forrest, W. H. Heaton, E. J. Kipps, W. A. Jackson, S. James, W. Marden, A. Pearson, T. Plummer, W. E. Sumpner, D.Sc., F. Thursfield, E. O. Turner, and J. M. Walshe.

Honorary Secretary.—J. D. Morgan.

We understand that, acting under Article 30, some 36 gentlemen, many of them very well known in the electrical world, have sent in the nomination of Mr. Gerald W. Partridge, for the office of vice-president of the Institution.

Institution of Civil Engineers.—At the annual general meeting on April 17th, the result of the ballot for the election of officers was declared as follows:—President, Mr. W. B. Worthington; vice-presidents, Mr. J. A. F. Aspinall, Mr. H. E. Jones, Sir John P. Griffith, and Mr. J. A. Brodie. Other members of Council include Dr. Dugald Clerk, F.R.S., Colonel R. E. B. Crompton, C.B., Sir Robert A. Hadfield, F.R.S., Prof. Bertram Hopkinson, C.M.G., F.R.S., Dr. W. H. Maw, Mr. Basil Mott, Capt. H. P. R. Sankey, C.B., and Sir John F. C. Snell.

S.A. Institute of Electrical Engineers.—In his presidential address, Mr. W. H. Perrow took the induction coil as his text, and reviewed its early history, subsequent development, and some of its applications.

Faraday House Scholarships.—As a result of the Scholarship Examinations held at Faraday House Electrical Engineering College, Southampton Row, London, W.C., this month, the following awards have been made by the Governors of the College:—To John Arnold Gundry (St. Bees School), a Faraday Scholarship of 50 guineas per annum, tenable for three years; to Arthur Leslie Long (Hertford Grammar School), a Maxwell Scholarship of 50 guineas per annum, tenable for two years; to Harold Charles Reeves (County School, Wood Green), an Exhibition of 30 guineas per annum, tenable for three years; to Eric Gledhill (County School, Fishguard), an Exhibition of 30 guineas per annum, tenable for three years; to Cecil Corbin (the Philological School, Southsea), a Special Prize of 25 guineas.

The Colonial Premiers.—On Tuesday afternoon, at Stationers' Hall, the British Manufacturers' Association, 1915, gave a reception to the Colonial Premiers. The address of welcome was given by Mr. George Terrell, M.P., chairman of the Association, which has a membership of 700 firms engaged in practically every branch of manufacture. He explained that one of the main purposes of the Association was to foster better trading relations with the Dominions and Colonies, while another was to arrive at a better understanding with the employés. Their members were prepared to make any necessary sacrifices for the successful prosecution of the war, and after the war they would do all that lay in their power to prevent the Huns from coming back here to overrun the country as in the past. They must also prepare for the gap of many months which was certain to occur between the stoppage of the manufacture of munitions and the resumption of normal manufacturing. Unrest was always certain in times of unemployment, and the Association urged the Government to be ready with a policy of reconstruction, a policy of protection for British trade, and a policy of consolidation of the Empire on the basis of preferential trade. Sir Edward Morris, Prime Minister of Newfoundland, responded, and in doing so, referred to certain after-the-war problems. Thorough organisation was necessary in order that we could deal with them aright. The Kaiser had done more than any man before him to bring about the unity of the British Empire.

American Help for British Engineers.—We read in the American *Electrical Review* that a Committee of representative American engineers, including a very large percentage of prominent electrical men throughout the country, has issued an appeal to the members of the engineering profession in the United States to contribute to a fund for the relief of the families of engineers in Great Britain who are experiencing serious privation. Mr. Lewis B. Stillwell is acting as treasurer and receiving subscriptions,

Appointments Vacant.—The Cape Town City Council has been inviting applications for the position of city electrical engineer, at a commencing salary of £1,000 per annum ; applications have to be received by the town clerk by May 15th.

Chief assistant, two maintenance engineers, two switchmen and sub-station supervisors, and two stokers, for the Oxford Electricity Co., Ltd. ; shift engineer for the Stepney B.C. Electricity Works ; shift engineer (42s.) for the Queen Mary's Military Hospital, Whalley ; two shift engineers for the Batley Corporation Electricity Works. See our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Mr. J. E. Pearce, engineer-in-charge at the Hammersmith B.C. electricity works, has been granted a commission as Lieutenant in the Royal Engineers. Mr. H. R. Watts, meter superintendent, has been granted a commission as Lieutenant in the Royal Garrison Artillery.

Southport T.C. has increased the salary of Mr. T. J. Kendrew, the borough tramways manager, by £50 to £300. Ald. Griffiths said there was not an undertaking of similar size and importance where a manager received so low a salary.

The Lancaster Electricity Committee has agreed to pay a bonus of £75 to Mr. J. B. Patterson, acting electrical engineer, for extra services during the absence of Major E. C. Milnes.

General.—Mr. A. W. Bush has resigned his position in the Sheffield Corporation electricity supply department, and has joined Messrs. Marsh Bros. (electricians), Ltd., of Sheffield, as their representative.

Mr. A. H. Desforges, who has been in the employ of Messrs. Siemens Bros. & Co., Ltd., Woolwich, for nearly 20 years, has been gazetted as a Temporary Second-Lieutenant on probation as Equipment Officer, Royal Flying Corps.

At Stoke-on-Trent, on April 17th, the marriage took place of Mr. Henry Bedson, A.M.I.E.E., of London, to Miss Rosalie Newton.

Roll of Honour.—Captain A. N. Drysdale, M.C., Highland Light Infantry, a director of Messrs. Drysdale & Co., Ltd., "Bon-Accord" Works, Glasgow, died on April 15th, at a casualty clearing station in France, from wounds received in action on April 1st.

Private Stanley Spurgeon, Essex Regiment, who has fallen in action whilst serving with the Egyptian Expeditionary Force, was with Messrs. Crompton & Co., Ltd., of Chelmsford.

The Military Medal for bravery at the Front during an air raid has been awarded to Bombardier Geo. Bass, R.G.A., who enlisted from the Dover Corporation tramway staff.

Private W. Kirby, Royal Warwickshire Regiment, who is reported killed, after being missing since July 1st last, was with the Rugby works of the B.T.H. Co., Ltd.

Third Air Mechanic M. Bruce, who joined the R.F.C. only three weeks ago, whilst with the B.T.H. Co., Ltd., of Rugby, has died from illness at a military camp.

Private W. Podmore, North Staffs. Regiment, who was with Messrs. Taylor & Tunnicliffe, of Hanley, has been killed in action.

Gunner George Lewis, Salford, of the R.G.A., who has died of wounds, was employed at the British Westinghouse Works, at Trafford Park.

Private Tom Yates, of Stretford, Royal Berkshire Regiment (late Northants Regiment), who was formerly in the employ of Messrs. W. T. Glover & Co., Ltd., Trafford Park, is reported to have been killed on April 4th.

The *Times* states that Lieutenant George Laurence Forbes Mackay, Leinster Regiment (Royal Canadians), attached to a Signal Company, R.E., died on April 12th, aged 19, of wounds received whilst supervising the mending of a buried cable.

Obituary.—Mr. George G. Ward.—It is with regret we have to record the death from heart failure of Mr. George G. Ward, deputy-chairman of Messrs. Davidson & Co., Belfast, which occurred suddenly on Tuesday morning at his residence at Craigavad. Mr. Ward, who was 56 years of age, was at business last Saturday, and was in his usual health on Sunday, but was suddenly taken ill during the night. He was the eldest surviving son of the late Mr. F. D. Ward, and began his business career with the well-known firm of Marcus Ward & Co., where he served his time, and eventually held a prominent position. He joined the Sirocco Works 21 years ago, and was appointed a director when the company became a limited concern in 1898. A good business man, an energetic worker, he loyally supported Mr. S. C. Davidson, whose lifelong friend he was, during the many years of their close association, and contributed in no small measure to the success of the firm, not sparing himself in any way, and more especially since the outbreak of the war, when the absence of two co-directors at the Front greatly increased the work and responsibility of the remaining directors. Mr. Ward was a genial man of very kindly disposition, whose loss will be sincerely mourned by his many personal and business friends. The greatest sympathy is felt for Mrs. Ward in her bereavement.

Mr. Alwyn Walter Staveley.—We regret to report the death of Mr. A. W. Staveley, of the firm of Messrs. Gent and Co., Ltd., Leicester, which occurred suddenly on Monday morning last, at his residence in Redcliffe Road, Nottingham, at the age of 58 years. Mr. Staveley was at the works up to mid-day on Saturday, and appeared in his usual good health, but a sudden attack of illness during the week end caused his decease through heart failure. Mr. Staveley joined the late Mr. J. T. Gent in 1880, and took an active part in the management of a growing business. When the firm was eventually formed into a limited company, he took the position of senior director, and continued this office up to the time of his death.

Mr. Ferdinand W. Roebling.—Mr. F. W. Roebling, treasurer and managing director of John A. Roebling's Sons Co., died on March 16th, at Trenton, N.J., aged 75. His father was the founder of the business.

Mr. Rankin Kennedy.—We deeply regret to record the death of an old friend, Mr. Rankin Kennedy, who, in his earlier years, when his interests were more directly electrical than they have recently been, was a frequent contributor to the pages of the Electrical Review.

Dr. W. Gould Rhodes.—We regret to announce the death, after a prolonged illness, of Dr. W. G. Rhodes, at Manchester. His scientific training was acquired at Owens College (Victoria University), Manchester, where his remarkable mathematical gifts were developed, and he attained the degree of M.Sc. (later proceeding to the Doctorate). Coming to London, he spent some years at the Central Technical College as demonstrator and lecturer in physics and electrical engineering under Prof. Ayrton, and contributed numerous articles to our pages. In 1896 Mr. Rhodes took up the position of chief lecturer in electrical engineering at the Royal Technical Institute, Salford, with which he was connected for many years, eventually becoming head of the electrical engineering department. He also developed a private consulting practice; in conjunction with Mr. J. M. Hewitt he was consulting engineer to the Llandudno & Colwyn Bay Electric Traction Co., and undertook an interesting investigation of the Belgian system of light railways. He was the author of a number of technical papers and books on alternating currents. Both as a valued contributor and as a personal friend of long standing, he stood high in our esteem, and many of our readers will share our sorrow at his early death. He leaves a widow and one son.

Mr. R. H. Burnham.—Mr. Richard Henry Burnham, late telegraph superintendent to the S.E. & C. Railway, passed away at Norwood, on April 24th, aged 71 years.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

J. Stone & Co., Ltd.—Debenture dated April 4th, 1917, to secure £100,000 charged on the company's undertaking and property, present and future, including uncalled capital. Holders: London County and Westminster Bank.

Chelsea Electricity Supply Co., Ltd.—A memorandum of satisfaction to the extent of £53,212 on December 13th, 1916, of debenture stock created March 6th, 1895, securing sums to the nominal amount of the share capital.

Rawlings Bros., Ltd.—A memorandum of satisfaction on April 4th, 1917, of debenture dated March 16th, 1909, securing £200, has been filed.

Harpin & Co., Ltd. (109,290).—Capital, £2,500 in £1 shares (1,500 pref. and 1,000 ord.). Return dated March 12th, 1917. 775 pref. and 727 ord. shares taken up, £977 paid, £525 considered as paid. Mortgages and charges: Nil.

Clarke, Chapman & Co., Ltd. (39,045).—Capital, £250,000 in 18,000 ord. and 7,000 pref. shares of £10 each. Return dated March 16th, 1917. 15,281 ord. and 6,985 pref. shares taken up; £10 per share called up on 3,536 ord., £2 10s. on 200 ord., and £10 on 4,435 pref., £80,210 paid, £142,450 considered as paid, being £10 per share on 11,545 ord. and 2,550 pref., and £7 10s. per share on 200 ord. Mortgages and charges: £100,000.

British Mica Co., Ltd. (72,187). Capital, £5,000 in 2,000 pref. and 3,000 ord. shares of £1 each. Return dated December 17th, 1916. 785 pref. and 2,194 ord. shares taken up; £979 paid; £2,000 considered as paid. Mortgages and charges: Nil.

CITY NOTES.

Western Electric Co. (U.S.A.) The report for 1916 shows a remarkable increase in gross sales. They jumped last year from $63,852,469 to $106,986,677, a gain of 62 per cent. The orders on hand December 31st, 1916, were $22,028,000 in value more than on December 31st, 1915. The report states that manufacturing conditions in America during the year have been extremely difficult. It has been almost impossible to provide a regular supply of material, not only on account of the general shortage, but also on account of the uncertainties of freight transportation. The demand for products increased very rapidly during the year, and the necessity of meeting this demand has taxed all available resources for machinery, tools, and other expense items. The detailed earnings report for the year 1916 is as follows:—

Sales	$106,986,677
Other income	1,229,636
Total income	108,216,313
Cost of merchandise	95,936,433
Expenses	7,014,254
Taxes	587,050
Special payments to employés	973,866
Reserve for contingencies	500,000
Available for interest and dividend	3,204,710
Interest paid	880,094
Dividends	2,100,000
Carried to common stock	224,616

—*Electrical Review and Western Electrician.*

Urban Electric Supply Co., Ltd. Mr. P. D. Tuckett presided at the annual meeting on April 11th. He said that the available net profit showed a reduction of £4,000. It was disappointing to have their progress interrupted and the preference dividend in arrear, but it would not be prudent to maintain the dividend at the expense of their slender cash resources, cumulative though the dividend was. The loss of profit was far less than might have been expected. But for the war they would have had £20,000 to dispose of that day over and above the full preference dividend, and he hoped that that would be their position a year or two hence, when they returned to more normal conditions after the war. Including the item of £328,608 due to contractors, which was subject to conversion into debentures, their total debenture debt was not far short of £800,000. This heavy burden of debt, without being a menace to the company, since he felt sure they could always rely on Edmundsons' assistance in case of need, nevertheless rendered it practically impossible for them to finance themselves independently of them except by means of resources drawn from revenue. Unless, therefore, they were to resort to Edmundsons, which they were anxious to avoid as far as possible, the annual provision for depreciation furnished the fund on which they had mainly to rely to meet current capital requirements. Last year, in spite of the very large increase in their connected load, they managed to keep their capital expenditure within the limit of their reserve provision, and before the rate of expenditure materially exceeded that figure, he hoped they would see a marked recovery in profits, enabling them substantially to increase the appropriation to reserve. Owing to the stimulus which the war had afforded to the development of the power load, their connections increased by 2,770 kw. in 1915, and last year by the record figure of 3,510 kw. These additional connections had been made without a corresponding increase in capital expenditure, with the result that in several instances they were now working with a smaller margin of plant than was altogether desirable. Under the circumstances there was nothing else to be done, since additional plant was not obtainable, but in so far as this additional load was permanent, they would sooner or later be faced with the necessity of supplementing the plant to meet it, as well as the further load which they must look forward to, and this consideration emphasised the importance of husbanding the cash resources. It remained to be seen how far the additional load connected during the past two years would be permanently retained after the war. A substantial part of it represented industrial activities directly connected with the war, which they must expect to see disappear in that form, but he hoped that many of them might survive in some other form. It was fortunate that they had in this way been able to compensate to some extent for the wholesale falling-off in the lighting load. Twickenham, with an increased power connection of nearly 2,000 kw., an increased power output of nearly 2,000,000 units, and an increased power revenue of nearly £10,000, afforded the most conspicuous example of this development, the beneficial results of which were clearly shown in the increased profit of over £3,000 which it was thereby enabled to realise. Newton Abbot had also developed a useful power load, substantially increasing its profits. On the other hand, Hawick had, in spite of an increased connection of 150 kw., dropped its profit to within £150 of the figure at which it stood two years ago, the mills, which were working day and night on large Government orders at the beginning of the war, having this last year become comparatively slack. Grantham again showed a gratifying increase of profit, no less than 140 per cent. during the past three years, until it now represented a return of over 11 per cent. on the capital; but whether these results would be maintained after the war must largely depend on circumstances. Grantham was the only undertaking whose lighting load had increased during the past year. In all the others there had been a very marked and serious decrease, amounting in the aggregate to 554,000 units, and it was this decrease, combined with the heavy increase in cost, which had produced the poor results shown by most of them. The principal causes which had operated to reduce the lighting load were the Summer Time Act, from which they had suffered severely, the more drastic lighting restrictions, and the general appeal for economy in the use of electric light based on the entirely erroneous belief that a corresponding saving of coal was thereby effected. In the case of a gas undertaking, reduced output to a large extent represented reduced coal consumption, whereas their plant had to be run, and approximately the same amount of coal was burned, whether the daily output was 1,000 or 1,100 units. That was one of the reasons why their profits were so seriously affected when the output and resulting revenue fell, and why they tended to be correspondingly increased when the output and revenue expanded. Of the increased costs, by far the largest item was represented by coal, the increased price of which accounted for an increased cost of over £13,000 as compared with 1915, and of over £23,000 as compared with 1914, in addition to which the quality had generally been inferior to that of similar class coal prior to the war. Increased wages, war allowances to the dependents of men on active service, and aircraft insurance accounted approximately for a further £2,000. Altogether 225 of their men had been called up, and eight of them had been killed. In connection with the aircraft insurance, he invited them to share the responsibility which they had taken upon themselves in refraining from covering the stations in Devonshire and Cornwall. It appeared that the risk of damage in their case was so remote that they were justified in exercising their discretion to save the company the cost of their insurance, which would have amounted to over £100. The sum involved was not large, but in these times every pound was of importance. In order to meet the increased costs they had further increased the rates of charge, until they were now, in most cases, as high as they were able to raise them. Indeed, in three of the undertakings they had, with the Board of Trade's approval, raised them above the legal maximum. It was always difficult to forecast the effect of increased rates, because they were liable to be partially offset by reduced consumption, but they hoped that the increases which they had made would compensate them for any increased costs to which they might be put this year. After alluding to the disorganisation of the staff consequent upon the demands of military service, the chairman gave a tabulated record of the financial results realised during the past nine years. The steady progress disclosed was calculated to reassure them, should they be inclined to feel somewhat discouraged by the exceptional difficulties of these exceptional times. In regard to the current year's prospects, it was impossible to form any reliable estimate, so abnormal were the conditions. They were doing all they could to minimise their adverse effects, but they were powerless to overcome them, and as long as the war lasted he was afraid they could expect no material relief. Whatever fate this year might have in store for them, they had every justification for anticipating that soon after the war was over they would see a marked expansion in their profits.

Johnson and Phillips, Ltd. The profit on trading accounts, &c., for 1916, after making provision for bad and doubtful debts, and after charging to revenue upwards of £8,000 for maintenance of buildings, plant, &c., amounts to £56,061, plus £34,050 brought forward (less £8,750 for dividend paid May, 1916), making £81,361, which is dealt with as follows:—Remuneration of directors, &c., £1,897; debenture stock interest, £5,345; debenture sinking fund reserve, £7,557; second debenture interest, £2,500; depreciation on machinery and plant, &c., £12,139; interest on loan, £1,709; reserve account, £10,000; income-tax and excess profits duty, £8,928; written off patents, £2,575; special reserve account, £10,000; dividend of 5 per cent., free of tax, on the ordinary shares, £8,750; carrying forward £9,961. The above transfers to reserve and special reserve are to meet contingencies in connection with the war. Annual meeting: April 26th.

Amalgamated Wireless (Australasia) Ltd. The report for the six months ended December 31st shows a net profit of £4,540, which, with £1,023 brought forward, makes £5,563 at credit of profit and loss, which the directors propose to carry forward. Trading is still seriously interfered with by the war. The ships' message traffic shows considerable fluctuations, owing to war regulations. Subsidy ships have increased to 97. The following comparison is made in the *Sydney Morning Herald*:—

	Half-year ended		
	Dec. 31, 1914.	Dec. 31, 1915.	Dec. 31, 1916.
Net profit	£7,812	£2,229	£4,540
Dividend per cent. . .	5*	—	—
Amount of dividend ...	3,500	—	—
Carried forward	4,312	3,331	5,563

* Per annum.

At the half-yearly meeting, on March 1st, Mr. H. R. Denison said that, in spite of the difficulties of the war, business had been extremely well maintained. They practically had control of the whole of the maritime wireless over the coasts of Australia and New Zealand. All the coastal steamers, together with those trading from the old country, were on their register, and had been equipped by the company with their ship's stations. There were 97 vessels dealing with the company, and all paid a reasonable royalty. Since the last half-yearly meeting Mr. Fisk had returned from the old country. He had arranged for three more agencies, and had opened up negotiations with manufacturing firms, which they hoped would soon prove advantageous to shareholders. They had clear rights to the Poulsen system, the only British one which had been in competition with Marconi Wireless. They were the only systems in use in the British Empire, and this placed them in a strong position. Mr. Fisk had also made such arrangements regarding the relay automatic telephone that at small expenditure the company could have a complete installation sent out for demonstration purposes, together with an engineer at the Relay Co.'s expense. He had not the slightest doubt that when the system was demonstrated they could do good business with the postal officials, because experience in other parts of the world showed that the telephone was peculiarly adapted to conditions in Australia.—*Sydney Daily Telegraph.*

W. T. Glover and Co., Ltd. The credit balance on trading for 1916 is £49,811, plus £11,701 brought forward, making £61,512. From this are deducted £1,026 for directors' fees and expenses, £7.745 for debenture interest on 4¼ per cent. first and 5 per cent. second debenture stock, £4,000 transferred to trustees of second debenture stock, 5 per cent. dividend on the pref. shares £3,875, transferred to first debenture redemption fund £2,500, a dividend of 6 per cent., less income-tax, on the ordinary shares £5,340, to reserve fund £10,000, to cable maintenance reserve £5,000, leaving £22,025 to carry forward, subject to the payment of Excess Profits Duty for the two years 1915 and 1916, which cannot be ascertained at present. After making the above appropriations, the redemption fund for the first debenture stock will stand at £43,000, for the second £40,501, and the reserve at £60,000, making a total of £143,501. Many of the conditions mentioned in last year's report continue, making it still necessary to strengthen the company's reserves in order to provide further working capital. The development of the land referred to is proceeding rapidly, and will involve considerable capital expenditure in the near future.

Cuba Submarine Telegraph Co., Ltd. For 1916 the receipts were £51.747, and the expenses £15,813, plus £2,178 income-tax. The amount brought forward was £7.581, and £41,337 is available. There has been added to general reserve £14,000, and to the pension fund £2.500. Ten per cent., less income-tax, is paid on the preference shares, and 5 per cent. and a bonus of 4s. per share on the ordinary, free of tax, are recommended, carrying forward £7.637. The general reserve fund, which last year stood at £100,000, has been charged with £24,000, the balance of the depreciation to date on the investments. The directors record their appreciation of the valuable services of the late Mr. George Keith rendered during 40 years. Mr. F. E. Nosworthy has been appointed director and engineer in his place. The Articles of Association are to be altered, varying the arrangement respecting directors and their fees, so as to meet the present conditions. Annual meeting: May 2nd.

River Plate Electricity Co., Ltd.—The report for 1916 states that the net revenue, after providing for administration expenses, bad debts, and depreciations, amounts to £43,558, plus £18,387 brought forward, making £61,945. The board proposes a dividend of 7 per cent. on the ordinary stock and to carry forward £18,695. Owing to the prolongation of the war no interest or amortisation payment has been received in respect of the 5 per cent. obligations of the German Trans-Oceanic Electric Co. Interest has been duly paid upon the £66,667 5 per cent. debentures of the Tucuman Tramways, Light & Power Co., Ltd., and a dividend of 4½ per cent. has also been paid upon the company's shareholding in the Argentine Electricity Co., Ltd. Trading conditions in the Province of Tucuman, and also in the Province of Santiago del Estero, where the Argentine Electricity Co. operates, are still most unfavourable, and the outlook is uncertain.—*Financial Times.*

Montana Power Co.—The accounts for 1916 show a net income of $4.753,282, as compared with $3,167,504, and after placing $350,000, against $300,000, to reserve for depreciation, and paying dividends amounting to 3¼ per cent. on the common stock, there remained a balance of $1,339,157, increasing the total surplus brought forward to $2,399,351. Last year 2¼ per cent. was paid on the common stock. The depreciation reserve, after charging items to cover obsolescence and depreciation of equipment, and including the above sum from profits, amounted to $1,124,137 at December 31st last. —*Financial Times.*

Great Northern Telegraph Co., Ltd.—At the general meeting at Copenhagen, on May 25th, the board will propose to pay a total dividend and bonus of 24 per cent. for the year 1916, including the 5 per cent. already paid, and to transfer £83,333 to the reserve and renewal fund, £27,778 to the renewal fund for cable steamers, £55,556 to the dividend equalisation fund, and £27,778 to the pension fund. It is further proposed to set aside £111,111 for extraordinary income-taxes.

Norway.—The capital of the Stavanger Electro-Staalverk Bolag has been increased to 4,000,000 kronor (about £222,000), with the object of establishing a hydro-electric plant of about 7,000-H.P. capacity for the operation of its electric steel works. For this purpose the Ryfylke Waterfalls are to be utilised under a lease.

Direct United States Cable Co., Ltd.—The reserve fund account as at March 31st, 1917, shows a balance of £502,512, an increase of £14,807. A final dividend of 2s. per share, less tax, payable on April 30th, will make a total distribution of 4 per cent. for the year. Annual meeting: May 1st.

Evered & Co., Ltd.—The directors express regret that they are not in a position to issue accounts for 1916, as they are still under consideration by the Ministry of Munitions. The figures that have been prepared show a satisfactory result.—*Financial Times.*

Telephone Company of Egypt, Ltd.—Dividends of 6 per cent., free of income-tax, on preferred and deferred shares are announced, making 10 per cent. for year; £150,000 is put to reserve, and £87,376 is carried forward.

Birmingham District Power & Traction Co., Ltd.—The Court made an order on March 23rd confirming the reduction of capital from £1,050,000 to £700,000.

Auckland Electric Tramway Co., Ltd.—Interim dividend of 7d. per share, less income-tax, on the ordinary shares for the year ending June 30th next.

City of Buenos Aires Tramways Co. (1904), Ltd.—Dividend, 1s. 3d. per share, less tax, for the quarter ended March 31st.

Montreal Light, Heat & Power Co.—Dividend, 2 per cent. for the quarter ended April 30th, 1917.

Lima Light, Power & Tramways Co.—Dividend of 1¼ per cent., less income-tax.

STOCKS AND SHARES.

Tuesday Evening.

The near approach of the Budget is having but slight effect upon the buoyancy of the Stock Exchange markets as a whole. That the Chancellor will have heavier taxation to propose is known to be a certainty; but where the incidence will fall is a matter of guesswork (ask a smoker!). That the excess profits duty will be raised is accepted already as a foregone conclusion, but this is having little influence upon prices of shares in the companies that will be affected. The strength of the gilt-edged section is still noticeable, and the demand for industrials has spread to electric lighting shares.

The Brazilian Traction Co. provided an unpleasant surprise to its shareholders by deciding to pass the dividend for the remainder of the current year. The amount was reduced, it may be recalled, from 6 per cent. to 4 per cent; and for some time past, as the date of each announcement has approached, so the price of the shares has given way, in case further inroads were made upon the distribution. The shares, on the announcement that the directors had decided to pass the dividend, fell 4 points straight away. After touching 39, they recovered to 41½, leaving a drop of 6 on the week.

There is a good deal of speculation as to whether the shares are worth buying or not, because the company's trouble arises not from want of traffic, but by reason of the adverse exchange and what is regarded as unsound finance in the past—the piling up of liabilities without the outlook being sufficiently assured as to their being met. Time, of course, will rectify the exchange difficulty; and so long as traffics are good, a resumption of dividends is simply a matter of waiting. Upon this consideration, the price, as already noted, has recovered from the worst. The preferred fell 2 or 3 points to 82.

Of the other foreign issues, Mexicans stand out with some prominence. Mexican Light and Power bonds and certificates of deposit have risen 2-3 points during the past day or two. Other Mexicans are also better, upon vague rumours that Carranza declines to be beguiled by German blandishments. It is at any rate significant that the United States should have consented to mint for Mexico a fairly large sum of new currency; and those in this country who hold Mexican securities have noted this with pleasurable interest, not unmixed with surprise. But anticipation has so often been foiled in the past in regard to expected favourable Mexican developments that faith hesitates to put much confidence—or much money, either—into Mexicans at present; and when rises in stocks or shares take place, it is due more to sentiment than to actual business.

Reference has been made already to the improvements in electric lighting shares. County of London are good at 10¼, and there are buyers about for Citys, Charing Cross, St. James's, and other London issues. Prices are not quotably advanced to any particular extent, the reason for this being that would-be buyers have no wish to put up prices against themselves, but prefer—the market being so restricted—that quotations should remain as they stand rather than that they should be raised 10s. or 15s. with no increased chance of shares being brought to market. The preference list is good also, and there is hardly any debenture stock to be had.

Underground Electric incomes continue to derive support from the opening of the Watford extension. The new line seems to have attracted already a fair measure of traffic; and, of course, is likely to receive more as time goes on. But the coming reduction in the number of 'bus services is something of a bear point in connection with the Underground issues, and consequently prices go cautiously. Metropolitans are an uneasy market, with a fall of ¾ on balance; and the rest of the Home Railway market (in steam as well as in electric stocks) is quiet, waiting upon the appetite of the public.

Telegraphs are good all round. Substantial advances stand out in the leading groups. The largest rise is one of £3 in Indo-Europeans. Cuba Submarines are 15s. to the good. In several cases, weeks have elapsed since stock or shares changed hands, but buyers are eager, and have the right to see that prices are put up if they bid, unsuccessfully, the higher of the double quotations. Globes strengthened to 12¼. Callenders are 5s. better at 13¼; although other cable shares are nominally unchanged as to prices, they are sold much more easily than bought. The Marconi division is quiet, attracting no particular interest at the moment.

General Electric preference moved up ⅛. British Westinghouse preference eased off to 2 7/16 on the disappointment that the dividend was not raised. The accounts are good, but the board has adopted a cautious policy in regard to the dividend. The Rubber share market is rather less active than of late, operators keeping a wary eye upon Excess Profits possibilities to be announced next week. Armament shares receive a good deal of support, while the shares of base-metal companies remain steady and quiet.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1915.	Dividend 1916	Price April 24, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	9	6¼xd	—	£6 18 6
Charing Cross Ordinary ..	5	5	8 7/16	+ 1/16	7 5 6
do. do. do. 4½ Pref..	4½	4½	8½	+ 1/16	6 18 6
Chelsea	4	3	2⅞	—	5 4 4
City of London	8	8	11½	+ ⅛	6 19 2
do. do. 6 per cent. Pref.	6	6	9¾	—	6 8 1
County of London	7	7	10¼	+ ⅛	6 16 6
do. 6 per cent. Pref.	6	6	9¾	—	6 3 1
Kensington Ordinary	7	10	5¼	—	6 11 7
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	3¾	—	5 6 8
Metropolitan	8	8	2 7/16	—	6 3 1
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 4 0
St. James' and Pall Mall ..	8	8	6½	+ ⅛	6 8 0
South London	5	5	2¾	—	7 5 6
South Metropolitan Pref. ..	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	5⅝	—	6 5 9

Telegraphs and Telephones.

	Dividend 1915.	Dividend 1916	Price April 24, 1917.	Rise or fall this week.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	95	+ ½	6 6 2
do. Def.	83 6	1½	22¼	+ ¼	6 14 10
Chile Telephone	8	8	7	—	5 14 4
Cuba Sub. Ord.	5	5	8½	+ ¾	5 17 8
Eastern Extension	8	8	14	+ ⅛	*5 14 4
Eastern Tel. Ord.	8	8	141½	+ ½	*5 13 1
Globe Tel. and T. Ord.	7	7	12½	+ ¼	*5 14 8
do. Pref. ..	6	6	10	—	6 0 0
Great Northern Tel.	22	22	88	+1	5 15 9
Indo-European	13	13	51½	+3	6 8 9
Marconi	10	10	2⅞	—	8 9 7
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord. ..	10	10	2⅛	—	4 14 1
United R. Plate Tel.	8	8	6⅝	—	*6 0 9
West India and Pan.	6d.	6d.	1	+ ⅛	2 10 0
Western Telegraph	8	8	14	+ ⅛	*5 14 4

Home Rails.

	Dividend 1915.	Dividend 1916	Price April 24, 1917.	Rise or fall this week.	Yield p.c.
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	24	— ¾	4 3 4
do. District	Nil	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A" ..	Nil	Nil	5/-	—	Nil
do. do. Income	6	5	81½	—	*6 2 8

Foreign Trams, &c.

	Dividend 1914.	Dividend 1915.	Price April 24, 1917.	Rise or fall this week.	Yield p.c.
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	3¼	—	8 16 0
do. 2nd Pref. ..	5½	5½	2⅝	—	—
do. 5 Deb. ..	5	5	66½	—	7 10 5
Brazil Tractions	4	4	41½	—3	Nil
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	61	—	8 4 0
do. do. Preferred	—	Nil	46	—	Nil
do. do. Deferred	—	Nil	39½	—	Nil
do. do. Deb.	4½	4½	63	—	6 13 10
Mexico Trams 5 per cent. Bonds	—	Nil	26½	—	Nil
do. 6 per cent. Bonds	—	Nil	25	—	Nil
Mexican Light Common ..	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	—	—	Nil
do. 1st Bonds ..	Nil	Nil	30	+2½	—

Manufacturing Companies.

	Dividend 1915.	Dividend 1916	Price April 24, 1917.	Rise or fall this week.	Yield p.c.
Babcock & Wilcox	14	15	2⅞	—	5 4 4
British Aluminium Ord. ..	5	7	27/3	—	7 6 10
British Insulated Ord.	15	17½	12¾	—	6 17 3
British Westinghouse Pref. ..	7½	7½	2 7/16	— 1/16	6 8 0
Callenders	15	20	13¼	+ ¼	7 11 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	3 5/16	—	6 13 0
Edison & Swan, £3 paid ..	Nil	—	⅞	—	Nil
do. do. fully paid ..	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	69½	—	5 15 2
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9¾	+ ⅛	6 3 1
do. Ord.	10	10	14½	—	6 18 0
Henley	20	25	15½	—	8 1 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11⅞	—	*8 8 4
Telegraph Con	20	20	37	—	*6 9 10

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, April 25th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	"	£54	..
a Bisulphide of Carbon	"	£23	..
a Borax	"	£38	..
a Copper Sulphate	"	£61 10	..
a Potash, Chlorate	per lb.	2/6	..
a " Perchlorate	"	2/-	..
a Shellac	per cwt.	205/-	10/- inc.
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers ..	"	£32	..
a " Lump	"	£24	..
a Soda, Chlorate	per lb.	1/-	..
a " Crystals	per ton	120/-	..
a Sodium Bichromate, casks ..	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c " Tubes (solid drawn) ..	"	..	..
c " Wire, basis	"	..	..
c Copper Tubes (solid drawn) ..	"	1/8¾ to 1/9¼	½d. dec.
g " Bars (best selected) ..	per ton	£168	£6 dec.
g " Sheet	"	£168	£6 dec.
g " Rod	"	£168	£6 dec.
d " (Electrolytic) Bars ..	"	£145	£6 dec.
d " " Sheets ..	"	£170	£6 dec.
d " " Wire Rods	"	£153	£6 dec.
d " " H.C. Wire	per lb.	1/6 3/16	13/16d. dec.
f Ebonite Rod	"	3/-	..
f " Sheet	"	2/6	..
n German Silver Wire	"	*2/3	..
h Gutta-percha, fine	"	6/10	..
h India-rubber, Para fine	"	3/6¾	1½d. dec.
i Iron Pig (Cleveland warrants) ..	per ton	Nom.	..
l " Wire, galv. No. 8, P.O. qual.	"	£40	£2 inc.
g Lead, English Pig	"	..	..
g Mercury	per bot.	Nom.	..
e Mica (in original cases) small ..	per lb.	6d. to 3/-	..
e " " " medium	"	3/6 to 6/-	..
e " " " large ..	"	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/9½	½d. dec.
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	"	..	..
n " Wire, Nos. 1 to 16	per lb.	3/3	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Electric Dust Vans at Dover.—The March issue of the *Electric Vehicle*, in addition to a number of interesting articles on the subject of the battery-driven vehicle, contains a useful index to Vol. I (December, 1914, to December, 1916). One of the articles, referring to the subject of our headline, contains data recently presented by Mr. R. H. Crummack, the deputy borough engineer of Dover, to his Council, dealing with 15 months' use of such vehicles. He points out that extra house refuse, averaging 45 tons per week over the amount of the previous year, was dealt with, and that in the days of horse haulage this would have necessitated the employment of five additional horses and carts at an extra cost of £910 per year—an expense saved by using the "Electric." Five 2½-ton vans were employed, the last for only seven months of the fifteen. The total mileage was 28,825; annual mileage, 23,000; and total quantity of refuse collected, 12,741 tons. The monetary cost of the work, including wages, wages of man at tip and rent of two tips, repairs, &c., stores, tires, capital charges, electrical energy, and insurance, was £2,441 11s.; neglecting tip expenses, the operating cost was 19·4d. per mile, electrical energy at 1½d. per unit averaging 2·32d. per mile. The total cost per ton of refuse collected was 3s. 9·98d., which contrasts strikingly with the previous cost by horses and carts 6s. 2d. per ton. The cost per mile, excluding wages and capital charges, was 4·25d.

Luncheon.—The British Empire Producers' Organisation held a luncheon meeting yesterday at the Savoy Hotel, when the guests were the Right Hon. Walter Long, M.P., Colonial Secretary, and the Right Hon. Robt. Rodgers, Canadian Minister of Public Works.

Catalogues Wanted.—A correspondent on National Service requires catalogues (with prices) of lamps, motors, arc lamps, accessories, fuses, &c. They may be forwarded to us, marked "O.P." on cover.

Training in Science.—As a permanent memorial to the North Wales men who have given their lives in the war, new science buildings are to be erected at the University College of North Wales.

THE IMPORTANCE OF CANAL DEVELOPMENT TO THE ELECTRICAL MAN.

By W. T. WARDALE, A.M.I.E.E.

The Electrical Review has been a consistent supporter of the development of our inland waterways, and has pointed out on numerous occasions the benefits which would follow to the trade of the country in general, and the electrical engineering trade in particular, if such development was taken in hand in a thorough and comprehensive manner.

Few electrical men, however, seem to give the matter much thought beyond the realms of the cheaper carriage which might then be available, and the work which would fall to the electrical trade as the result of some of the canals being worked electrically. The correct development of the canals means the electrification of the canals; this in turn means that very considerable facilities will be placed in the hands of those engineers who seek to place the supply of electricity on a really national basis.

It may be argued by some engineers who are lukewarm to this development of our waterways that it would by no means follow that electrical means would be used for the propulsion of the vessels using the canals; that oil-engined and steam-driven tugs, and barges, make really good and satisfactory progress, and that in any case the canal development would be a costly matter for the nation.

Perhaps the latter point should be considered first, that is, the cost.

Granted that the cost of the canal improvements would be heavy, it would still pay the nation to make the development without looking for any actual return in the shape of direct dividends from dues collected from canal traffic.

After the war we shall be busy for a while, and then will come a period of somewhat acute slackness if arrangements are not made to prevent it.

Let the scheme of development for the canals be worked out, and prepared, and then work can be started as soon as the overplus of after-war work shows signs of dying down; let certain portions be taken in hand, and the work be arranged to start so that no trade, and no man, need be idle; this alone would save us millions of pounds as a nation in the relief of distress, and in poor-law charges; and instead of leaving the nation at the end of the slack period with a heavy debt, and a large proportion of men who have been pauperised to an undesirable extent, it would endow us with a superior means of inland transport, and keep the whole of our trades, and the people engaged therein, in the best state of health, which is engendered only by constant activity.

Again, sensible men do not protest against the idea of spending £16,000,000 on about five or six capital ships for our Navy, and the spending of several millions a year on the canals, until they are a really first-class asset to the nation, should be regarded as a protection for and method of developing the national trade, which finds the money to equip our Navy; for certain it is that if we have a declining trade, we must also have, as a natural corollary, a declining system of national defence.

This bugbear of excessive capital cost and no chance of a return on the money is fallacious, to a great extent, when judged in the light of what ordinary commercial concerns are wont to pay for the privilege of gaining access to markets or districts they consider desirable.

Besides the example of the Manchester Ship Canal, there are many other examples of huge expenditures which have been incurred for what may be termed wayleaves through particular areas.

It is urged that the cost of getting a widened and deepened canal through Birmingham, for instance, will be excessive on account of the buying-up of buildings on the banks, and the diversions of railways in the centre of the city.

In the first place, it may be possible to reduce greatly the cost of such a scheme by going wide of the original line of the canal; but in any case, did anyone ever find a railway company flinch at the cost of buying up and pulling down large areas in order to obtain terminal facilities for passengers or goods? The writer can remember the wholesale clearance of the Deansgate area of Manchester when the Great Northern Railway constructed their Manchester goods station, and the very expensive work which followed in order to bring the lines on arches into the chosen position. Then we have the example of the Great Central Railway, buying up and clearing the area to build Marylebone station. In both these cases very great sums were spent in order to obtain facilities in very restricted areas.

Coming to the electrical side of the matter, we find that a good deal of experimental work has taken place in connection with canal traction on the continent; and that present-day knowledge seems to advise the use of a tractor running on the canal bank, having several barges in tow. Further experience may show improvements on this system. Apart from these matters, however, electrical haulage for the canals has one outstanding feature which seems to have escaped notice. Whatever system of electrical haulage be used, it cannot be denied that traction by means of power supplied from a source outside the boat, or apart from the tractor running on the bank, has the great advantage of permitting the greatest possible load of paying cargo to be carried by the whole canal.

Put the motor in the boat itself; then there is no system of power supply which will permit the concentration of so much power in so small a space as that of electricity supplied from a central station. A tug equipped in this manner would be much more powerful for its displacement than any other type, and so could pull an additional number of barges, and still only occupy the same space in the canal as a steam or oil-driven tug of much less power. Hence the canal space is utilised more efficiently.

Take the motor out of the tug, and make the tug into a cargo barge, and we gain additional cargo-carrying capacity for the canal. Use either an oil or steam-driven tractor on the banks, and that tractor must carry its own fuel, its own power generating unit, and also waste space on the canal or canal banks by the fuel having to be carried about to suitable replenishing depôts.

Substitute electrical traction, and we get either a very much lighter tractor, of the same power, running on the canal banks, with reduced cost of operation; or by maintaining the same weight of tractor, we can double the power, and draw practically double the tonnage of paying cargo for equivalent weight on the bank and its track, besides saving considerable time and cargo-carrying capacity by having no necessity to carry fuel about from one part of the canal to another.

If the canals are to be reorganised, they must be reorganised on the best and most efficient basis; that means the greatest carrying capacity for the width and depth of the canals. This can only be obtained by electrical means.

This re-equipment of our canals would help the national electrical power development scheme very considerably. In many places it is impossible to think of placing a comprehensive power distribution scheme because the distances between the industrial areas are large, and the areas in question are small and somewhat scattered; thus, linking-up and interconnection in those areas are in the present circumstances going to cost more than they are worth.

Get the waterways through that district (and waterways, like roads and railways, must traverse barren districts) reorganised, and at once you not only have reason for placing a good-sized power station in the most favourable portion of that district, but you will be compelled to do so in order to equip the canal with the best and most efficient means of haulage.

Assume that it is decided that work will be done on a certain section; the question is at once asked, where can we place the power supply for this portion? The whole route is surveyed, the best site chosen, and lines run for power right to the spot at which work first starts, and the supply to subsequent portions erected as the work of developing the canal proceeds.

Thus, right from the start of the scheme, electricity will be called in to supply power and light for the work of constructing the improved waterways; once the improvement is finished, a good power load will be assured, and, moreover, districts which could not have appealed to manufacturers will then be able to offer cheap power, cheap land, and the advantage of canal wharfages; so adding to the traffic which will use the canal, calling for more and more power, and, with all the development, never spoiling the countryside by works and factories which vomit smoke into the atmosphere each in their own pet fashion.

The national benefits do not stop even at this point. Agriculture is going to benefit by electrical driving of farm and field machinery; but if there is only a 25 to 50-H.P. demand at intervals of every half-mile, or considerably more, then so much cable will be required, that the cost of distribution will come out heavy, and the cost of the unit be high; let the waterways be developed and electrically equipped, and there you get your agricultural supply of electrical power to a considerable number of areas; the open portions of the canal route consist of agricultural land, so that where one cannot get a factory load, it will be possible to work up a good farm load, and to supply the same at a low cost per unit.

It is true that present prices per unit pay the farmer, though they are high for power supply; from this it must not be argued that no need exists to cheapen the supply to these communities. Cheapen the supply, and immediately you will induce the farmer to do more of his work by electrical means; the petrol-driven plough is showing what can be done by machines to hasten and increase output, and we, as electrical men, ought to be ready at the end of the war to offer the farmer cheaper power electrically for the same work, with the added advantage, that the farmer need not bother about bringing petrol or coal from the station, nor about having a man who can humour petrol engines about his premises.

The development of the canals, therefore, is of the utmost importance to every electrical engineer, whether he is a consultant, manufacturer, or power supply engineer. Such development will not only enable the trade of the country to be carried on more efficiently, but will do much to stimulate the revival of agriculture in our own land and to solve the problem of our food supply by getting the utmost efficiency out of the land.

In brief, the writer's summing-up is as follows:—

The canals must have electrical power, light, and other facilities if they are to work at the highest possible efficiency. This demand for electrical power will give an excellent reason for the planting of large economical stations in situations which, without the canal work, would be unsuitable and unremunerative positions.

It will assist the development of the national electrical power supply by (1) giving a power load from the canal itself, (2) taking industries into districts which abut on the canal, but which are not suitable at present for industrial development, (3) giving a cheap supply of electrical energy to the farmer, who will produce more from a given area of land.

These are solid and desirable advantages in every way, and would be truly national developments; they are advantages, be it noted, over and above the advantage of increased transport facilities which the canals themselves would provide.

If the usual British short-sighted view be taken of the matter, canal development may look costly, and not very remunerative. If we will but take a long-sighted survey of the matter, the possibilities are immense, both to the nation and the electrical engineer.

VOLTAGE REGULATION OF ROTARY CONVERTERS.

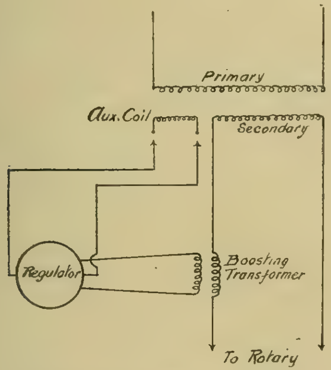
The paper by Mr. G. A. Juhlin was read and discussed at a meeting of the Manchester Local Section of the Institution of Electrical Engineers on Tuesday, March 13th.

Mr. R. Townend said that the rotary converter was primarily a machine for converting from A.C. to D.C. with as small a voltage variation as possible, and any increase in the voltage range was accompanied by some sacrifice in the heating, efficiency, power factor, or cost of the equipment. If the required voltage range was within the limits permissible with reactance control, this sacrifice might be small, but when the voltage range was outside the limits additional apparatus was necessary, and the sacrifice might be considerable. It was therefore important that the rotary converter should be designed for the voltage range under which it would have to operate, and, with a view to safety, this range should not be increased. With the rotary running inverted, *i.e.*, converting from D.C. to A.C., the conditions were quite different when the rotary was running alone from those obtaining when A.C. generating plant was running in parallel with it. In the former case any variation in the rotary field excitation would only cause a variation in the speed of the machine and would not affect the voltage, therefore some form of auxiliary apparatus was necessary to have control over the A.C. voltage. In the case of the rotary running in parallel with A.C. generating plant, a variation in the excitation of the rotary would not change the speed, because the rotary would have to run synchronously with the other machines, and therefore the change in field current caused a change in the wattless current flowing in the rotary, this change being sufficient practically to neutralise the alteration made in the field excitation. The change in the wattless current would, of course, cause variation in the A.C. voltage provided there was some reactance in the circuit, exactly as in the case of a rotary converting from A.C. to D.C. and having reactance control. This variation in the rotary wattless current simply meant that the wattless current carried by the rotary was now carried by the A.C. generators or *vice versa*, and it was therefore necessary to take care that this did not result in overloading these generators with wattless current.

Prof. Miles Walker said that the paper was so thoroughly sound that it was difficult to find important points to criticise, but there was a looseness in the employment of terms which, however justifiable in shop conversation, ought not to appear in important Institution papers. For instance, the word "reactance" was continually used where "reactance drop" was meant; similarly, "resistance" was used to indicate "resistance drop." Sufficient care had not been taken to make the clock diagram clear. Every clock diagram should be accompanied by a small sketch of connections showing the directions in the circuit taken as positive by the vectors in the clock diagram. Moreover, where different voltages were dealt with in the problem, which varied their phase difference under changing conditions, it should be definitely stated which vector was taken as standard of phase. Non-compliance with these simple precautions made all the clock diagrams in the paper exceedingly difficult to interpret. Moreover, in the first figure the scale of vectors was changed without intimation. The reduction of the wattless current required to produce a given voltage variation, when saturated reactance iron was used, was of great interest; but this gain was only possible where the reactance drop was used in pulling down the voltage when drawing a lagging current. Another fact of note was that where the compounding characteristic was of the kind shown in fig. 4 there was some danger, when a machine was being taken off load, of a sudden slump of load occurring as the load was being reduced, and a heavy reverse current being taken by the rotary before the circuit breaker came out on reverse current.

Mr. J. Frith said that a comparison of the rotary converter with the motor converter should have been considered. In the case of a motor converter, voltage regulation could be obtained with much less tampering with the power factor. There was certainly a looseness of expression throughout the paper which made it difficult to understand whether currents were lagging or leading to the rotary. The whole matter might have been much simpler if treated from the magnetic standpoint. The word "flux" might have been used instead of "voltage," and would have prevented many false impressions.

Mr. A. G. **Ellis** said that in deciding the system most suitable for any particular case, the question of reliability in service was important, and in this connection the primary voltage of the system should be taken into account. In high-voltage transformers the introduction of magnetic shunts between the primary and secondary windings in order to increase the reactance, was liable to weaken the transformer from an insulation point of view. Also, for low transformer secondary voltage, *i.e.*, low voltage on the D.C. side of the converter, large sections of copper would be necessary, which would be more susceptible to parasitic losses due to large leakage field. A reactance up to 10 per cent. could generally be obtained as inherent reactance of the transformer without resorting to the use of magnetic shunts of sheet iron placed between the primary and secondary windings, still retaining a rational design as regarded material and efficiency. Above this value magnetic shunts were usually necessary, and a reactance up to 50 per cent. could be obtained by skilful designing with a short-circuit characteristic not deviating appreciably from a straight line. Such high reactance was not usually necessary for the range of voltage variation required in practice. This was fortunate, as the disabilities as regarded parasitic losses, space required for the reactive iron, and mechanical rigidity, increased with the reactance. These difficulties were not, however, insuperable, even with very high reactance. A wide range of voltage was practically only required in the case of rotaries working on either lighting or traction load for, say, 440 or 550 volts D.C. In such cases the most satisfactory arrangement was to provide a tap for the lower voltage on the L.T. side of the transformer. This was generally a practicable proposition, although it was not always an easy matter to bring out such a tap, especially when dealing with large currents and high primary voltage. Continental firms had not gone in for high-reactance transformers to such an extent as was usual in England, but had supplied the necessary reactance in the form of a separate choke coil in series with the transformer. This was partly due to the high primary voltage used in Continental systems. Booster transformers, apart from the question of cost, were undesirable on the ground of extra complication, namely, two extra transformers and a voltage regulator. For large rotaries with wide voltage variation limits, a large number of steps on the regulator would be required, or trouble would be experienced on account of the large number of volt-amperes between contacts. This would lead to a large and expensive regulator, and such a fine degree of regulation was not usually required, especially in traction work. The series booster transformers also required special care in construction, as they had to withstand heavy shocks in case of short circuit.



Arrangement Referred to by Mr. Peck.

Mr. J. L. **Thompson** discussed the methods employing static apparatus, namely:—

1. Transformer with internal reactance.
2. Transformer with external reactance.
3. Static boosters and regulators.

For machines transforming power from A.C. to D.C., any one of the three types of static apparatus could be used, but for inverted running alternatives 2 and 3 only could be used. Alternative 1 could not be used on account of the excessive voltage drop, unless the machine was feeding an A.C. system, as outlined by Mr. Townend. The overall efficiency of the static apparatus was about the same for all schemes, although the advantage, if any, lay in favour of that embodying the transformer having high internal reactance. Regarding costs, the following comparison, taking the cost of a transformer of normal reactance as 100 per cent., would be of interest. The transformer was a 550-K.V.A. 3/6-phase, 50-period, with standard adjusting tappings such as used for a 500-K.V.A. rotary converter.

(1) Main transformer	100 %	
(2) 25 % reactance embodied in transformer, extra cost	15 %	
(3) 25 % reactance embodied in an external reactance, extra cost	23 %	
(4) A static booster and regulator to give 7½ % regulation—*i.e.*, the same as would be obtained with 25 % reactance	33 %	45%
Additional switchgear involved, extra cost	12 %	

These rough estimates showed that the high-reactance transformer was by far the most favourable as regarded cost. Floor space was usually very limited, and from this point of view the high-reactance transformer was by far the most economical, while the external reactance was better than the static booster and regulator. If inverted running was required, an external reactance which could be short-circuited, with adjusting taps on the transformer, would be required, or, as an alternative, the static booster. This condition was most favourable for the static booster, and was the only case recommended by the speaker. It was necessary in dealing with a static booster to consider its position with reference to the transformer electrically. When converting from A.C. to D.C., the L.T. side was the correct place, whereas converting D.C. to A.C., the H.T. side was correct, *i.e.*, whichever conversion was used it should be on the secondary side of the main transformer in order to obtain the highest efficiency. A rotary converter feeding a three-wire D.C. circuit with a booster on the L.T. side would require a six-phase booster, this boosting equally each side of the six-phase neutral in order to obtain equal D.C. voltages from the middle wire to the outers. This necessity involved further expense, and depreciated the value of the scheme still further as regards cost. He had designed transformers embodying 45 per cent. reactance, which were working satisfactorily.

Mr. J. S. **Peck** said that the arrangement shown in the accompanying figure for varying the voltage on a rotary converter by means of a boosting transformer and tappings from an auxiliary coil of the main transformer was actually standardised, and was used on rotary converters up to perhaps 500 or 600 KW.; it was perfectly satisfactory in every respect excepting the regulator dial, which gave trouble, and on account of these difficulties, which were largely mechanical, this type of regulator was finally abandoned in favour of the induction type, which was even now being used to a certain extent, and might again come into general use. It was also possible that the step-by-step regulator might again become popular on account of its cheapness, and improved mechanical construction might make it entirely satisfactory. After the induction regulator came the synchronous booster, due to Prof. Walker. This type of control came into use first in this country, and then in America, and finally on the Continent, and rapidly superseded all other types. When the synchronous booster was first introduced, commutating poles were not generally used on rotary converters, and the difficulties which had since been encountered in connection with booster control had been largely due to the use of the commutating pole, as explained by the author. Designers now hesitated to employ the booster, except when special conditions made its use essential, but devices had been worked out which neutralised the effect of the booster on commutation. These devices, however, introduced complications which it was desirable to avoid whenever possible. Reactance control would give perfectly satisfactory service in many places where previously it was thought that booster control was necessary. With reactance control the power factor of the rotary improved with increase in D.C. voltage, which in general meant that as the load increased, the effect of the rotary was to improve more and more the power factor of the system.

Dr. **Cramp** (in a communication) said that converters were used not only in connection with sub-station distribution for large districts, but also to supply individual factories; this point of view seemed to have been lost sight of in the paper altogether. The author spoke of wattless current to the extent of 50 per cent. to 60 per cent. of the load current, and omitted to take into consideration the very serious effects of such a condition upon the consumer's account. In many large towns electricity was charged for upon a K.V.A. basis, and in consequence the purchaser had to pay for every ampere of wattless current, whether this was lagging or leading. In such a case the control of power factor was of prime importance, and it often paid to expend more capital to get control of the power factor rather than to use a converter with reactance control. Another point which was omitted altogether from the paper was the loss in the leads between the transformer and the converter. In the case, for instance, of a converter for 500 KW. and 250 D.C. volts, the distance between the transformer and the converter might easily be so great as to lose half per cent., or even more, in efficiency at full load on unity power factor, and this would be considerably increased by the extra wattless current which the author admitted might be as much as 60 per cent. of the load current. For these reasons, the table in the paper was really only a true summary for sub-station conditions. For private plants in general, it was more economical and satisfactory to adopt either a booster control or a motor converter. With reference to the comparison between the rotary converter and the motor converter, the following figures, which were taken from estimates submitted a short time ago for 500-kw., 460-volt sets, would be of interest. The machines were required to operate at voltages varying from 440 to 480 on the continuous side. Under these conditions the figures were as follows:—

Rotary Converter.

420 volts.

Load	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	1	
Cos ϕ	55	80	90	95	Lagging.

480 volts.

Load	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	1	
Cos ϕ	55	80	90	95	Leading.

As against the above, the motor converter power factor only varied from .93 to unity over the same range of voltage and load. A d.c. booster might be rather more expensive, but it had the merit of leaving the power-factor control untouched, and of not interfering with the commutation of the converter itself.

The Author, in reply, said the paper had been prepared for designers and the average engineer; shop terms were used in the paper as generally understood by engineers. The title of the paper clearly stated that it dealt with rotary converters; if a comparison were made with motor converters, the rotary would certainly justify itself. The treatment of the subject from a magnetic standpoint appeared very attractive, but, in the author's opinion, it would present considerably difficulties; for example, how would a wattless current be represented when there was no change in flux? Transformers of all classes were looked upon as so reliable that all questions of breakdown were of minor importance. There were no grounds for fear on the score of the booster transformer being a source of weakness, and being delicate to control. The costs referred to in the paper were in terms of the rotary converter alone, and did not include the transformer.

FIRST LONDON ENGINEER VOLUNTEERS.

It is seldom that a volunteer corps is fortunate enough to obtain so valuable and enjoyable a training as that of the First London Engineer Volunteers during Easter. The only unpleasant part of it was the severity of the weather, but the work done was of so vigorous and interesting a nature that the men laughed, rather than grumbled, at its inclemency.

A programme of training, admirably adapted alike to the requirements of the Corps and the brevity of the time, was most kindly arranged by Col. Chesney, R.E., the Commandant of the Royal Engineers at Esher, and carried out by Capt. Courtman, R.E., the Commandant of the School of Military Engineering, and Capt. Higgins, R.E. It was felt that in dealing with a corps of this nature, what was required was rather a thorough grounding in technical essentials than any attempt at more ambitious work. The course was, therefore, confined to knots and lashings, the use of spars, trestle bridging, floating bridges, and bridging expedients. So successful, however, was the course that it is not improbable that a more advanced course may be carried out in the future.

It was originally intended that the working party should go into billets at Esher during the four days, but the impossibility of obtaining any accommodation precluded such an arrangement, and necessitated daily travelling to and from Waterloo. In some ways this proved to be an advantage, as certain members were thus able to attend who could not have been absent from town for the whole period. The wretched state of the weather, too, counterbalanced any regret for the absence of camp conditions.

Owing to the uncertainty as to whether Easter would be kept as a holiday, the number attending was not as large as had been hoped. It averaged, roughly, 10 officers and 40 N.C.O.'s and sappers daily. The party left Waterloo each morning about 9 a.m., and returned about 6 p.m.

On reaching Esher on Good Friday, the party marched at once to Sandown House, the headquarters of the School of Military Engineering, and proceeded without delay to the lecture room. Here officers and sappers were cordially greeted by Col. Chesney, and a lecture on the use of spars was given by Capt. Courtman. This over, a three-mile march brought the party to Heywood, where the remainder of the morning was spent in going rapidly through the various knots and lashings. The First London Engineers have received a thorough grounding in these elementary matters, and the work was, therefore, rather a recapitulation than a lesson. After twenty minutes for lunch, three sections were formed for practical instruction in the use of spars. A standing derrick, a swinging derrick, and shears were prepared, and when these were ready the squads were invited to join in hoisting the structures which each had made, and to have their aim and working explained.

For the remaining three days the party was divided into two sections, A and B, whereby the subjects to be dealt with could be taught to and practised by each in turn without overcrowding. The lectures were delivered by Captains Courtman and Higgins, and dealt with trestle bridging, floating bridges, and bridging expedients.

An interesting part of the programme was the construction of barrel piers and rafts, work which came to many of the sappers as a novelty. The enthusiasm with which they "rocked and heaved," although with some it was a physical impossibility to keep one foot on the gunwale, was only equalled by the pride with which they leisurely rowed their ponderous rafts up and down the Mole, oblivious of sarcastic warnings from the shore to "look out for U-boats!" It was a moment of much secret satisfaction to some when they marched in fours on to half a real barrel bridge of their own construction over a real river, and stood thereon to be photographed in perfect safety.

But the real cream of the training was the making of bridging expedients. "A" bridges, hop-pole bridges and pile bridges were interesting, but single barrel-rafts, fascine boats, brushwood boats, and a boat constructed from a canvas horse-trough, with a spar catamaran attached, gave the greatest delight. Those engaged in making these varied expedients for crossing (or falling into) rivers found, when they had finished, that it was the R.E. rule—inexorable, and not to be evaded on any pretext—to "try your own medicine." The training blossomed, therefore, into a veritable regatta, and the Mole was dotted with uncouth craft propelled, with various degrees of skill, by sappers in grey-green, armed with shovels. But nobody fell in or got more than a trifle wet.

The party returned on Monday evening to Waterloo thoroughly satisfied with the work they had done, and feeling that there had never been such a training before.

The Corps owes a very great debt of gratitude not only to Col. Chesney, who arranged for the training, but also to Captains Courtman and Higgins for the way in which it was carried out. To Sergeant-Major Gordon and his body of instructors (all of whom cheerfully gave up their Easter leave for the purpose) also hearty thanks are due. Mention must also be made of the kindness of the Quartermaster of the School of Military Engineering, who arranged tea for the party when work was done.

The training was honoured by several visits by Col. Chesney, on Good Friday by General Dickie and Major Edwards, on Saturday by General Sir Desmond O'Callaghan and Colonel Ormond, and again on Sunday by Major Edwards.

NOVEL FEATURES IN D.C. WATT-HOUR-METER CONSTRUCTION.

Continuous-current meters of the Thomson type are used so extensively, and yet have advanced so little in design during the past quarter of a century, that the improvements described by R. Ziegenberg in a recent issue of the *E.T.Z.* are of especial interest—particularly since the retention of the Thomson type of drum-wound armature has been due simply to lack of a substitute, and not to any high degree of technical excellence in design or performance. The principal features of the new meter here described are the use of a flat coil armature and an electromagnetic connection between meter and counting train. In order to emphasise the advantage of these innovations the author enumerates certain alleged defects of the drum-wound Thomson meter as hitherto constructed. These defects include extreme sensitivity to stray magnetic fields, and serious frictional resistance. By doubling the meter in such manner as to form an astatic system we obtain a very unwieldy instrument, and one which is still far from unaffected by asymmetric stray fields. This expedient, which is at best only partially successful, is only applicable to switchboard or other special meters. For all ordinary work, a single-system meter must be employed, any neighbouring current-carrying conductors must be arranged with special care, and, in most cases, the meter must be adjusted and calibrated *in situ*, since even the earth's field has appreciable effect on the law of the instruments. As regard frictional resistance. Schmiedel's P.T.R. tests on seven commutator motor meters of various makes showed that according to the type of drive employed, friction in the counting train amounted to anything from 7 to 28 per cent., and in one case to 54 per cent. of the total meter friction. These data referred to new meters, higher values for gear friction being observed in meters after some time in service. Add to this the fact that meters with jumping-figure dials may be held stationary on light loads for indefinite periods by the increased frictional resistance to be overcome when two or more dials need moving simultaneously, and it becomes obvious that a counting train which is mechanically independent of the meter represents a very appreciable advance. The sole *raison d'être* of the d.c. watt-hour meter lies in its measuring watt-hours instead of measuring ampere-hours and assuming constant supply voltage. If, however, the advantage gained in the principle of the meter is to be sacrificed to friction errors and susceptibility to stray fields, one might as well use the simpler and cheaper ampere-hour meter, particularly in small lighting installations where the revenue is low and meter cost a serious item, and where the frequent occurrence of light-load periods renders meter accuracy correspondingly important.

Many attempts have been made to build satisfactory D.C. watt-hour meters of the disk-armature type, the advantages anticipated including immunity from influence by stray fields; light and simple construction; easy access to armature, and possibility of removing and replacing the moving system without disturbing calibration. Sector-shaped armature coils are used, and the armature disk thus built up runs between two pairs of D-shaped field coils (or else above or below one pair of semicircular field coils). The armature and spindle can be withdrawn without moving the field and compensating coils, and since the two halves of the armature lie in fields of opposite polarity the instrument is astatic to a high degree; if a four-pole field system be used (with quadrant-shaped field coils), the meter is almost perfectly astatic, even as regards attempts at fraud by placing a permanent magnet near the armature.

The chief reason why disk-type armatures have not hitherto gained much acceptance in this connection is that sector coils of too small an angle have been employed. Increasing the number of armature coils renders the meter torque more uniform, but it also reduces the actual value of the torque. Current flow in adjacent radial conductors is in opposite directions (save in the case of the radial conductors connected to the commutator bars undergoing commutation at the moment), and when such contra-flow occurs in a single field, the net torque due to the conductors concerned is zero. The way to obtain a high driving torque from a light disk armature of low resistance is to employ wide-angle sectors, and not more than two armature coils per field pole, but preferably fewer. Adjacent radial conductors are then in fields of opposite polarities when they are carrying current in opposite directions or, at the worst, one set of radial wires is in but a weak field of the same polarity (near the neutral zone).

There is no particular mechanical difficulty in the construction of a disk armature, and, though the diameter of the latter be about 50 per cent. greater than that of the alternative drum-wound armature, the construction as a whole is simpler and more compact, and when using an electromechanical recording train, instead of directly geared mechanism, the total saving in spindle length is about 50 per cent. A four-pole field system and six-coil armature represents a satisfactory compromise between simplicity of construction, high driving torque and minimum dead weight, and resistance in peripheral copper (which is ineffective as regards driving torque).

The most obvious method of relieving the meter of the duty of driving the recording train is to use a shunt-wound electromagnet and ratchet gear controlled by a contact on the meter spindle, this contact completing the magnet circuit once in each revolution of the meter spindle. This solution is, however, unsatisfactory, for heavy sparking occurs at the spindle contact, and the use of the latter introduces an element of distinct unreliability into the working of the instrument. It is unnecessary actually to make and break the circuit of the electromagnet. A suitable variation in the exciting current will secure the desired result and, at the same time, eliminate the sparking difficulty. The minimum current may be kept quite small (say, 1 milliamp. or so) and increased to 3 milliamps. or so whenever it is desired to actuate the recording gear. The problem remains—whence to obtain a suitable varying current? Current of varying strength lies ready to hand in the armature circuit, but it cannot be actually diverted to the circuit of the recording magnet without introducing the contact difficulties which it is wished to eliminate. Evershed has devised a system of placing a small coil round the spindle, connecting it in the armature circuit and utilising the alternations of current to oscillate by induction a second winding or a permanent magnet. This arrangement involves keeping the recording gear quite close to the actual meter, whereas the system now to be described permits meter and recording gear to be placed at any convenient points, any distance apart, and connected only by a pair of small leads running to and from the electromagnet, which actuates the recording train by a ratchet arm attached to its armature. Figs. 1 and 2 show the shunt circuits only of a watt-hour meter with three-section armature A and three or six commutator bars C respectively. Fig. 1 corresponds to a two-pole field system, and fig. 2 to a four-pole field system, each armature section in the latter case consisting of two coils opposite to each other on the armature and connected in series.* It will be seen that in both cases one commutator bar is divided at the centre of its length, and the brushes are set so that during each revolution of the armature, connection is completed once through the direct lead B and once through the resistance R. When the latter is in circuit the P.D. across the brushes is increased by the amount I R (I being the armature current), and this pressure increase suffices to actuate the recording magnet, which is connected across the brushes. For convenience and security, the commutator is made rather longer than usual when this arrangement is employed. A central insulating ring is added (primarily to support the inner ends of the divided bar), and one brush bears on the upper and one on the lower half of the commutator.

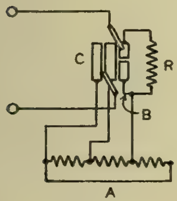


Fig. 1.

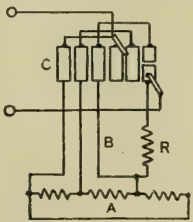


Fig. 2.

Meters built on this principle are at present made by the firm of Elster (Berlin and Vienna), but it is hardly necessary to remind readers that arrangements have been made to work enemy patents where such a course seems desirable. The advantages offered by the new construction include simplicity, compactness, immunity from influence by stray fields, light moving system, and a driving torque much higher than obtainable with a greater number of coils of equal weight, and amply sufficient owing to the meter being relieved of the duty of driving the recording train. With the new system of actuating the recording gear (which system is equally applicable to any commutator meter), the meter error is uniformly low at practically all loads. In a particular case, for instance, the error was 4 per cent. at 2 per cent. full load, 1.25 per cent. from 5 per cent. full load to full load, and about 0.6 per cent. at 50 per cent. overload. In switchboard and central-station practice generally it is an important advantage to be able to place meter element and recording train independently wherever desired.

THE WIRING RULES OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

By W. R. RAWLINGS, A.M.I.E.E.

(*Abstract of paper read before the* Association of Supervising Electricians.)

The I.E.E. Rules have been adopted by all the responsible fire offices (51 in number), the whole of the electricity supply authorities worthy of that name, 14 of the London supply companies, and 25 municipal undertakings. The Incorporated Association of Electrical Power Companies, and the Incorporated Municipal Electrical Association representing over 200 municipal authorities, also accept the Wiring Rules as standard practice and recommend their use. The foregoing facts definitely establish that the rules have become the standard rules for electric wiring and fittings throughout the country. There are still a few faddists who issue their own regulations, and do their best to enforce them by trying to belittle the contractor in the eyes of the consumer. The time is, I hope, not far distant when these superfluous rules will be removed, and the Institution Rules will become as binding upon all parties as the rules which govern factories and workshops.

My experience, and the experience of fellow contractors, shows that there is no difficulty in complying with the wishes and requirements of the fire insurance inspectors. The most difficult individual we have to cope with is to be found amongst the supply station engineers, whose training, perhaps, has not enabled him to become a judge of house wiring, but he often endeavours to enforce his ideas by threatening not to connect until his views are carried into effect. That he has no such power has been shown over and over again by Mr. R. Tweedy Smith, the honorary solicitor of the Electrical Contractors' Association.

As one is never anxious to fall into the hands of lawyers the contractor generally submits, if he is not a member of the E.C.A.

I hope the time is not far distant when the I.E.E. Rules will be adopted by the Board of Trade, when they will reign supreme, and thus stop all engineers from abusing their position, and by their improper actions checking the progress of the industry.

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* An ingenious method of effecting the connection between diametrically opposite commutator bars in this case (fig. 2) is to form each pair of such bars from a single silver strip bent to U-shape. The limbs of the U form the two contact bars, whilst the end piece forms a perfect and reliable cross connection and, being drilled, serves also for attachment of the commutator elements to the spindle. Insulating disks are placed between the three U-pieces, which are spaced circumferentially equidistant on the spindle in building up a six-bar, three-section commutator.

Perhaps the most important variation which has been made by the recent rules (1916) is the permission to use the Continental system of flexible wires. I cannot, however, learn that this alteration has been adopted to any extent. For my part, I do not think it a desirable method of wiring, except, say, for an office, where flexible wires are fitted to ceiling points over eyes to desired positions, which are subject to variations. The alteration of rules has also made permissible the introduction of new systems, such as the Stannos, Henley's, and also the rubber-compound sheathed wires. I think the Institution can be congratulated on its endeavour to popularise low-priced systems of efficient wiring.

Rule 32 is not always understood, although apparently it reads quite clear:—

"For lighting purposes in any final sub-circuit which supplies more than a single point, the current must not exceed six amperes for pressures up to 125 volts," &c., "and the maximum number of points on any sub-circuit must not exceed 10."

This clearly defines the question often raised—how can a lamp which takes more than six amperes be used? The answer is that if it does exceed six amperes you can only put one on a circuit. If a lamp takes 50 amperes it complies with the rule, so long as you do not put more than one on a circuit. The number of points also which can be fixed on one circuit has been clearly defined as not to exceed 10. This is a good rule, and should be better known.

Conductors. Rules 39—43.—To my mind the finest work done by the Institution in the rules is the course taken in dealing with conductors.

The only thing, except a drop in volts, which governs the size of a conductor is the heating effect, and on reference to the Institution rules you will find that the table is based on a rise in temperature of 20 deg. F. above the air. Whereas a No. 18 gauge wire was considered unsafe in the old days, if used for more than 1.8 amperes, the Institution rule allows 7.2 amperes, while a cable of 1 sq. in. area, which in the old days would be used for a thousand amperes, is limited by the Institution rules to not more than 595 amperes. I would, however, caution my hearers against the adoption of the table without carefully reading rule 40, which governs the permissible drop in volts. Rule 40 provides that for lighting the drop "must not exceed 2 per cent. plus a constant allowance of one volt," but as many of the fuses will bring about a loss of half a volt, my advice is to allow the one volt constant to be absorbed in fuses, switches, &c., leaving the 2 per cent. for the wires, which will work out with a sufficient margin in dealing with a complete installation. This rule altering the size of the conductors has done much to popularise heating installations, for whereas a pair of 7/18 cables had to be installed for a 1-KW. 100-volt radiator, the same piece of apparatus can be used, under the new rules, with a 7/24 cable, bringing about a considerable reduction in the cost, and the difficulties of installation. A drop of volts in the cable is not an important factor when dealing with heating circuits.

Earthed Concentric Wiring. Rules 76—78.—I am of opinion that electrical contractors do not realise the advantages of earthed return systems. I find that new private plant installations are still being laid down on the two-wire system. There is no doubt that concentric earthed systems are not only more secure, but also the initial cost of the installation is considerably reduced. A complete draw-through job can be obtained by adopting the Kalkos system, using the tube as the return, or even extended to form a three-wire system. If a solid system is preferred, one of the metacase systems could be adopted. I advise my hearers to devote attention to this subject, which, without doubt, has been the means of introducing electricity into many country mansions, which would not have been wired had steel tubes or casings only been available for use.

Fuses. Rules 98—99.—It will be noted that the rule allows a very large margin. Small fuses may be three times the area required for the working current, and for circuits over 10 amperes twice the area is allowed.

Motors. Rule 122.—This rule as to double-pole switching, &c., only applies where the machine exceeds one-third of a horse-power. This is a most useful concession, as it permits of domestic apparatus being used on ordinary lighting circuits.

Rules for the Use of Electric Light on board Vessels.—The last edition of the rules was registered in December, 1914, at Lloyds. I am pleased to state that there is at the present moment an influential and strong committee of the Institution framing special rules for the electrical equipment of ships.

National Insurance (Unemployment) Acts, 1911 to 1916. Contributions are payable in respect of:—

2,178 X. Workmen employed on metal work in connection with the manufacture of X-ray and electro-medical apparatus.

2,179 X. Workmen (other than those insurable under Part II of the National Insurance Act, 1911) engaged wholly or mainly in making (removable) lamps for buoys or beacons.

Contributions are not payable in respect of:—

2,180. Workmen described as rest room attendants, and engaged in looking after workers keeping rest room clean, &c.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

4,980. "Sparking plug." R. Taylor. April 10th.

4,993. "Demagnetiser for continuous or alternating currents." A. Hollingworth. April 10th.

5,005. "Electrical current or voltage regulator." R. W. M. Thomson. April 10th.

5,009. "Controlling current in connection with electro-magnetic gear-boxes of automobiles." T. Wardell & Wolseley Motors, Ltd. April 10th.

5,018. "Telephone transmitters, &c." A. Mark. April 10th.

5,054. "Magnetic separators." W. G. Fletcher & A. F. Hallimond. April 10th.

5,067. "Telegraphic receiving and tape-perforating apparatus." A. C. Huskinson, A. L. Muirhead and Muirhead & Co. April 10th.

5,072. "Electrically-heated resistance furnaces." H. Etchells & H. A. Greaves. April 11th.

5,073. "Alternating-current electric systems." A. E. McColl. April 11th.

5,088. "Electric switchboards." C. C. Garrard & A. H. Railing. April 11th.

5,112. "Housing of electrical switchgear." A. H. Curtis & Igranic Electric Co. April 11th.

5,151. "Electric welding apparatus." W. H. Isherwood & W. H. Turner. April 12th.

5,168. "Systems of control for single-phase commutator motors." British Westinghouse Electric & Manufacturing Co. (U.S.A., April 12th, 1916.) April 12th.

5,177. "Electrically depositing metal." E. H. Jones. April 12th.

5,178. "Electric machines." H. Chitty. April 12th.

5,196. "Reversing devices for internal-combustion engines with electrical ignition." A. G. Hallberg. April 12th.

5,214. "Sparking plugs for internal-combustion engines." J. C. de Hoedt. April 13th.

5,220. "Electric welding." W. H. Walker. April 13th. (U.S.A., April 14th, 1916.)

5,224. "Telephone meters." G. I. Bruschke. April 13th.

5,246. "Tanks for electrical transformers." A. Schaanning & J. L. Thompson. April 13th.

5,252. "Variable inductances." A. H. Bagnold, F. G. Goldstone & S. Johnson. April 13th.

5,254. "Electric current interrupters." K. Trosdahl. April 13th.

5,260. "Electrodes for electric arc soldering." E. H. Jones. April 13th.

5,267. "Ignition current generators." L. J. le Pontois. April 13th.

5,281. "Electric submarine destroyer." F. A. Hirst. April 14th.

5,282. "Mouthpiece for telephones." W. R. Walkey. April 14th.

5,292. "Electric regulators." British Thomson-Houston Co. (General Electric Co., U.S.A.). April 14th.

5,295. "Insulation of submarine telephone cables." Felten & Guilleaume Carlswerke Akt. Ges. April 14th. (Germany, April 14th, 1916.)

5,301. "Control of dynamo-electric generators." British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.). April 14th.

5,305. "Insulating devices." E. T. Brook & W. E. Windsor-Richards. April 14th.

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

3,737. Automatic and Semi-automatic Telephone Systems. Relay Automatic Telephone Co. & H. J. Herink. March 13th, 1916. (Cognate application, 12,971/16.) (104,892.)

4,049. Casings for Electric Batteries. A. H. Shepherd & British Ever-Ready Co. March 18th, 1916. (104,900.)

4,143. Searchlights and like apparatus. A. A. Lyon. March 20th, 1916. (104,907.)

4,184. Electrical Distributing System depending on the use of Condensers. H. G. Longford, W. W. Longford, W. A. Clark & T. Morris. March 21st, 1916. (104,909.)

4,196. Means for Indicating the State of Adjustment or Output of Dynamo-electric Machines. J. Stone & Co. (Rohman, H. D.). March 21st, 1916. (104,910.)

4,376. Maximum Indicators for Electricity Speed and other Registering Apparatus. Chamberlain & Hookham and S. James. March 24th, 1916. (104,924.)

4,467. Interrupters or Contact Make-and-break Mechanism for Magnetos. A Guedatarian. March 25th, 1916. (104,931.)

6,720. Mechanical Tee-joint for Multicore Electric Cables. A. J. Lovell. May 11th, 1916. (104,959.)

6,823 Automatic Machine for the Manufacture of Stems for Metallic Filament Electric Lamps. Morris & Whitham and J. A. Allison. May 12th, 1916. (104,962.)

8,128. Electric Motor Control Systems. British Thomson-Houston Co (General Electric Co., U.S.A.). June 8th, 1916. (104,979.)

10,142 Pendulum Indicators for use with Electric Bell Systems or for other purposes. J. H. Parsons July 19th, 1916. (105,004.)

11,125 System of Electrical Distribution. W. H. Cole. August 12th, 1915. (101,151.)

11,191. Electric Motor Control Systems. Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.). August 8th, 1916. (105,013.)

12,999. Telephone Appliance. F. Mayer & W. C. Croxon. September 13th, 1916. (105,028.)

13,585. Means for Carrying Electric Cables. A Detraux. March 23rd, 1916. (Divided application on 4,353/16.) (105,029.)

14,524. Apparatus for Electrically Sterilising Foods. J Hansser. October 12th, 1915. (101,804.)

17,923. Electric Pocket Lamps. O. Pletscher November 18th 1916 (105,046.)

1917.

449. Stators of Electric Generators. J Bethenod & E. Girardeau. August 10th, 1915 (Divided application on 10,576/16.) (103,658

THE
ELECTRICAL REVIEW.

VOL. LXXX. MAY 4, 1917. No. 2,058.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: May 4, 1917. [No. 2,058.

Page
Salesmanship and Electricity Supply 477
The Policy of Empire 478
Employers and Employed 478
The British Westinghouse Co.'s Works, Manchester (*illus.*) ... 479
Wayleaves 480
Correspondence—
  Electric Vehicles 481
  Central Station Employés 481
  Electrically-Operated Valves for Internal-Combustion Engines 482
  The I.E.E. Nominations 482
The Engineering Industry 482
New Electrical Devices, Fittings and Plant (*illus.*) 483
Industries and Munitions 485
The Industries of the Empire 486
War Items 487
Legal 488
Business Notes 488
Notes 492
City Notes 495
Stocks and Shares 498
Promotion in Electricity Supply Undertakings 499
The Deterioration of Curtis Rateau Turbine Blading (*illus.*) ... 501
Some Points in Connection with Engineering Specifications ... 503
New Patents Applied for, 1917 504
Abstracts of Published Specifications 504
Contractors' Column ... ... Advertisement page xx

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The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 8s. 10d. ($5.80). To all other countries, £1 10s.

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ELECTRICAL & ALLIED TRADES DIRECTORY
(THE RED BOOK),
1917 EDITION
NOW READY.
H. ALABASTER, GATEHOUSE & KEMPE,
4, Ludgate Hill, London, E.C. 4.

SALESMANSHIP AND ELECTRICITY SUPPLY.

THE efficient production and the successful disposal of electricity are two closely allied and mutually interdependent factors in all present-day electric supply work.

As regards the former, the supply authorities of this country have within the last year or two awakened to the fact that there is a much broader and more advantageous aspect of production than that usually associated with this branch of industry in the past, and this present-day appreciation of "what might be" has, as we know, found practical expression in the formation of the various linking-up committees throughout the country, with the direct sanction and co-operation of the Board of Trade, and, more important still, in the recently constituted departmental committee on Electric Supply, formed by the Board. The war has riveted the attention of industry on the utility of modern electrical methods, and the developments to which we have just referred are tangible steps towards the realisation of the ideal of electricity supply on national lines, as a fundamental basis of our national industrial prosperity and individual welfare; the question for us to consider is how far these steps are likely to carry us towards attaining our ideal.

To produce electricity efficiently is not a difficult matter given a suitable market for our wares, but to sell electricity as we want to sell it, *i.e.*, to provide the suitable market, is quite another problem, and one, moreover, in regard to which the electricity supply industry as a whole has as yet taken no adequate step of any kind. In saying this we have not overlooked the puny efforts of local sales organisations, or the occasional attempts at publicity by individual engineers—efforts which are, of course, praiseworthy in themselves, but yet are of such a desultory character as to have no appreciable effect in moulding public opinion in the mass in the desired direction.

These isolated and uncoordinated efforts are in any case unworthy of the great industry which tolerates them, and will be totally inadequate as a weapon wherewith to supplement a national technical and financial organisation for electrical supply such as was outlined by Mr. Williams in his address to the Institution of Electrical Engineers in April, 1916. Unless we can fittingly complement our enlarged views on electricity supply by an even more extended appreciation of "salesmanship" of electricity in its wider sense, we shall sacrifice no small amount of our possible progress during the next few years, and the first and most essential step to be taken must be to secure the goodwill and favourable opinion of the public generally; this is an imperative preliminary, both from the point of view of facilitating the subsequent efforts of those who, following the ordinary channels of salesmanship, endeavour to sell electric light, heat, power, &c., and the various apparatus associated therewith, and also with a view to interesting the investing public, and the capitalist, on whom every commercial venture is dependent.

One does not expect to raise much of a crop merely by flinging seed on to uncultivated land; yet the electrical supply industry of this country carries out its business in precisely this way! its real business organisation is a myth, and its "salesmanship" an anachronism.

To win the sympathetic support of the British public should be the first act of salesmanship, and this can only be achieved by the organised and systematic use of the daily Press throughout the country, not by way of advertisement as usually understood, but in an educational way, naturally, with an appeal to the self-interest of the reader. This, of course, implies an understanding between the electric supply industry and the Press generally, and a suitable organisation to deal with the matter, neither of which have any existence at the moment. We are not primarily concerned here with the ways and means of securing the desired end—unfortunately, there is no body representative of the commercial and business end of the *whole* of the supply interests in the country to whom we might appeal. Rather do we desire to emphasise the very real need for an industry, with something like £100,000,000 invested in the supply of electricity, and with immense prospects of development opening up before it, to take appropriate action with a view to influencing public opinion as a whole—in other words, preparing the ground for subsequent developments.

We are quite aware that in writing thus under the heading of "salesmanship," we have rather encroached on the sphere of publicity; to the hypercritical we would point out that the sole commercial end and aim in view is the sale, first of the "idea," then of the consuming apparatus, and finally of the electrical energy which it may utilise. To place the "idea" we must create a sympathetic attitude on the part of the general public; imbue it with the feeling that electricity is in some way part of its daily life, as it is, in fact, with a considerable number of more enlightened or more fortunately situated people.

It is quite true that this is a matter which should rightly devolve on a representative "development" committee, but unfortunately the nucleus development committee formed by the I.M.E.A. before the war is in a state of suspended animation, and, in any case, we cannot but feel that the outlook for electricity supply development in this country has undergone such a material transformation in the interval, that even this committee will require reconstituting on lines more in keeping with the national ideal which we now have in view.

It is possible that a reconstituted development committee, representative of the whole of the electric supply and allied interests of the country, and embodying in addition to, or conjointly with, its publicity sub-committee, a special "Press" sub-committee, for the purpose of facilitating friendly relations with the daily Press, so as to influence public opinion by its means, might meet the case. On the other hand, the matter is relatively of superlative importance and calls for some immediate steps, independently, at any rate in the first instance, if necessary, of any existing committee.

The Policy of Empire.

The past week has produced quite a crop of speeches from Ministers and other leaders respecting the coming problems of trade and industry. Mr. Long, the Secretary for the Colonies, as a guest of the British Empire Producers' Organisation at the Savoy Hotel, has referred to the vastness and the varied character of our Empire resources and the need for business men to play a greater part, and "politicians" a smaller part—but both working in co-operation—if those resources are to be developed and utilised in the common-sense interests of the people of the Empire. Mr. Robert Rodgers, the Canadian Minister of Public Works, has urged a policy of trade preparedness so that, on the signing of Peace, we shall not suffer from the lack of trade munitions as we had suffered at the beginning of the war from the want of war munitions. Sir Albert Stanley, as President of the Board of Trade, has reminded us, in a speech at the Aldwych Club, that if some of our past methods of doing business are not "scrapped," we shall fail to hold our place in the front rank of business countries. The enemy penetration policy—a serious fact that we had so long mistakenly tolerated—must not be allowed to continue, for this was a commercial era in which the efficient conduct of our great industries was vital to our welfare. Sir Albert, like the speakers already mentioned, dwelt upon Empire resources, and expressed the conviction that it was the duty of the Government to see that those resources were properly exploited. The workman must do his best in return for a day's wage, but the employer also must do likewise. We must profit, too, by the experience of other countries, and if it was found that small undertakings could not exist in competition with the great foreign combinations, we must adapt our methods to meet that form of competition. Our industries must be carried on as efficiently as those of our foreign competitors, and we must be able to produce manufactured products at a price that would compare with theirs; if not, how could we hope to stand up against them? Lord Northcliffe followed with the advice, which is so familiar to the electrical industry, that concentration or combination in place of small and scattered businesses has been proved by the war to be one of the essential things for the coming days. Mr. H. Samuel, M.P., has been speaking on the reorganisation of the Empire, and showing the need that exists for an Imperial Executive which should initiate policy for the Empire as a whole. Lord Rothschild followed Mr. Samuel with a reference to the parts of the population that are not now represented in Parliament, and to the wisdom of having their views somehow represented. All of the foregoing matters will be recognised as being very closely related to engineering and industrial affairs. They unitedly serve to emphasise the truth of what has now been said so many times, and in so many ways, namely, that our real interests as a people, whether as capitalists or workers, will be best served by a far-seeing Imperial development policy, by the use of modernised industrial and commercial methods, and by a more adequate representation of industrial affairs in the Councils of the Empire. How strikingly similar to the policy which Mr. Hughes, the Prime Minister of Australia, energetically and forcefully elaborated before so many audiences here on the occasion of his memorable visit! The present War Cabinet has unanimously pledged itself to an Imperial preferential trade policy which shall show regard for our Allies, and shall not increase the cost of food, after the war. Mr. Lloyd George and Mr. Bonar Law have cleared the air by their definite statements on this subject during the past week. Surely our leaders are progressing in the direction of a concrete policy of great promise!

Employers and Employed.

The excellent address of Mr. Michael Longridge to the Institution of Mechanical Engineers, which we abstract elsewhere in this issue, deserves special mention in connection with the speeches to which we have referred above, for it not only anticipated them in many respects, but also was characterised by candour and courage which compel our admiration. The President fearlessly pointed out the faults of both masters and men, and also put forward views upon the necessity of reform in education and in organisation, which we commend to the attention of our readers, regretting only that we have not space to reproduce the address in full.

THE BRITISH WESTINGHOUSE CO.'S WORKS, MANCHESTER.

Visit of Colonial Representatives.

On the 21st and 23rd ult. the representatives from the Oversea Dominions (including the Right Hon. Sir Robert Borden, the Right Hon. William F. Massey, and the Right Hon. Sir Edward P. Morris) and the Empire of India (including the Maharajah of Bikaner, Sir James S. Meston, Sir Satyindra Prassana Sinha, and Sir James R. Dunlop Smith) paid a visit to the British Westinghouse Co.'s Works at Manchester.

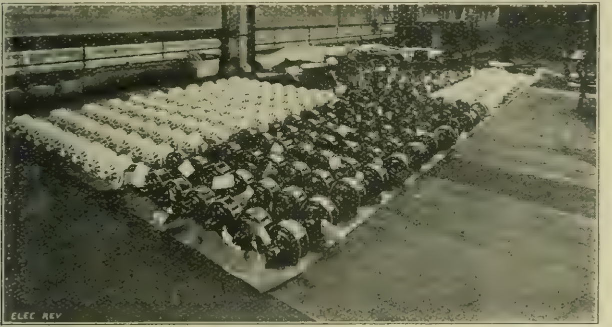


Fig. 1.—Group of Ceiling Fan Motors.

The works occupy 160 acres in Trafford Park, of which approximately 40 acres are roofed in. Building operations were commenced in the year 1901, the manufacture of goods commenced early in 1902, and since then the volume of business done by the company has steadily and progressively increased. Extensions of buildings were made from time to time, and further extensions are now in progress.

The whole of the works are now engaged at the highest pressure, the number of employés being over 10,000. Included in this aggregate are a large number of women workers, and it is interesting to note that these total approximately 2,500 more than in pre-war times. The women wear neat khaki overalls, and are engaged in nearly all departments of the works. A number of special canteens have been provided for their use, and their general welfare is specially cared for by a "Lady Superintendent of Women Workers."

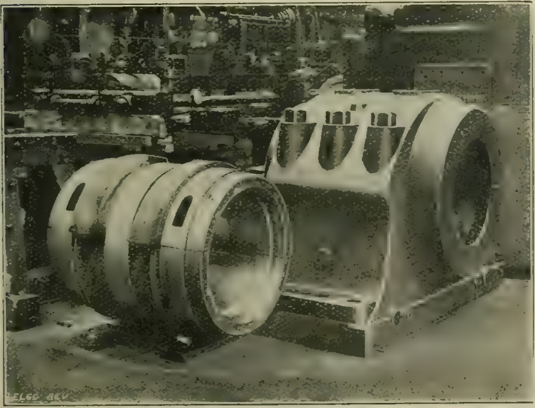


Fig. 2.—Bearing and Bearing Housing of 15,000-h.p. Rolling-Mill Motor.

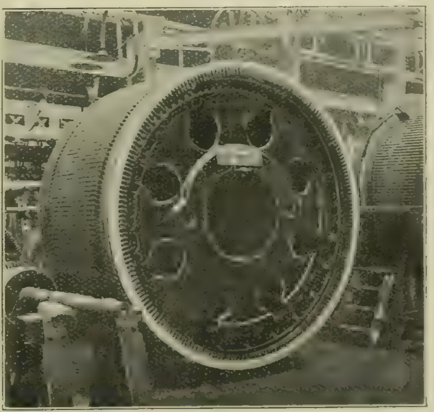


Fig. 3. Armature of 15,000-h.p. Motor.

Over 2,600 men have left the company's employ since the outbreak of war to join the Colours, and of these about 200 have given their lives for their country.

The diversified character of the manufactures of the company was well illustrated by the exhibits displayed. Apart from special orders, on which a large amount of work is being done, the company's products at the present time include steam turbines, turbo-blowers and compressors, condensers, pumps, vertical and horizontal gas engines, Diesel engines, and electrical machinery of all kinds, including traction equipment for railways and tramways, electric locomotives, transformers, switchgear, control gear, meters and instruments for all purposes, motor-car magnetos, and accessories for lighting, heating, cooking, and general power purposes.

The range of sizes manufactured was amply illustrated in turbines for turbo-generators, ranging from 15,000-kw. capacity for electricity supply undertakings down to 100-kw. sets for ship lighting. In another department, motor armatures of 7,500 h.p. to 15,000 h.p. were placed next to a motor armature having a capacity of $\frac{1}{32}$ h.p. Similarly, a shaft belonging to a fan motor, weighing less than 4 oz., was placed alongside of a shaft of approximately 20 tons weight, belonging to a 15,000-h.p. rolling-mill motor, which we illustrate herewith.

The company have a school in the works for the instruction of apprentices. Two grades of apprentices are accepted—one consisting of graduates in engineering, and other technically-trained men, who are allowed to take a two or three years' course of a varied character in the shops, testing departments, and offices: while the other consists of boys who enter the works between the ages of 14 and 16 years, and remain until they are 21. During this time, the boys are given experience in various departments of the shops, and also provided with instruction in the Works Trade School. The whole of the lecturing work is undertaken by members of the company's staff, the lecturers numbering about 40 in all.

An interesting development due to existing conditions has been the attempt suitably to train educated women to enable them to fill posts of intermediate responsibility in the company's office staff.

The Westinghouse Co. has now direct representatives all over the world, and under normal conditions does an enormous volume of export business, in addition to that for home trade. We reproduce a number of photographs of some of the interesting exhibits that were shown to the visitors.

Fig. 1 represents a group of motors for ceiling fans, part of orders for 2,000 of these machines for use in British military hospitals in Mesopotamia.

Fig. 2 shows the bearing and bearing housing for the shaft of a rolling-mill motor of 15,000 H.P., fig. 4 the shaft, and fig. 3 one of the two D.C. armatures that will be mounted on the shaft of this motor.

Fig. 5 shows two of three ship-lighting sets just completed for Messrs. Harland & Wolff, Ltd. These sets consist of impulse-type back-pressure steam turbines, driving the generators at a speed of 3,000 R.P.M. at a continuous output of 125 KW., 400/450 volts, when supplied with steam at 150 lb. gauge and exhausting into 5 lb. gauge back-pressure. The generators are compound wound, and are supplied with static balancers to be suitable for supplying energy to a three-wire circuit. The machines are fitted with the Westinghouse patent radial type of commutator, which ensures good contact between brushes and commutator, independently of cross-axial vibration, and with small pressure between the contact surfaces, thereby reducing the wear of both brushes and commutator to a negligible amount.

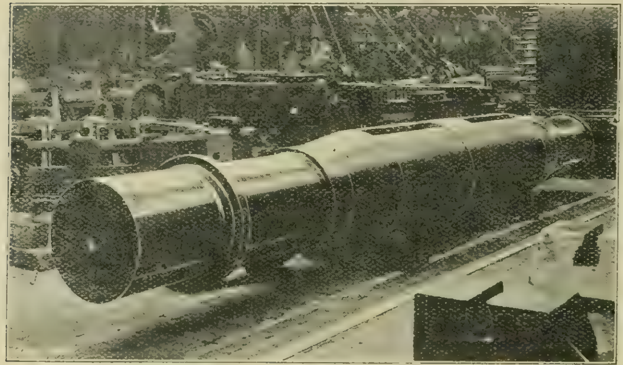


FIG. 4.—SHAFT FOR ROLLING-MILL MOTOR.

WAYLEAVES.

MR. C. VERNIER'S paper on "Wayleaves" was read and discussed at a meeting of the YORKSHIRE LOCAL SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS at Leeds on April 25th.

Mr. W. B. WOODHOUSE said he was rather restricted in discussing the question, because he was serving on committees which were dealing with this matter. One of these bodies had already given evidence before a Board of Trade Committee as to the necessity for compulsory powers for wayleaves, and no doubt would give evidence before the new committee. He thought that the feeling was that the question of wayleaves should be referred to a tribunal set up to deal with all matters of electricity supply. If they were to get compulsory powers it was most essential that they should make the public appreciate the fact that they were only asking for what was reasonable. His own experience of obtaining local authority consents and wayleaves had been very much like that of the author. A case in which compulsory powers were necessary for underground mains was that of streets dedicated to the public, but not taken over by the local authority. In recent years a large number of Gas Acts had contained a provision that, in such cases, the undertakers might lay gas pipes to supply the houses in such streets. It was a very valuable power, and just as necessary in relation to electricity as to gas.

Mr. T. B. JOHNSON said there was one strong ground of claim for better powers which was not mentioned in the paper, and that was the enormous improvement which there would be in the atmosphere when they got a large extension of electrical power. No one who compared the conditions and the atmosphere in Newcastle 20 years ago with that of to-day could fail to realise the difference owing to the number of electric power companies at work. It was high time that the public should recognise that electric power had become a prime necessity, and that, therefore, the rights of individuals or of private property could no longer be allowed to stand in the way of its distribution. The getting of the approval of the Board of Trade would be valuable, because the fact that they had to go to the Board would in itself prevent supply companies from making unreasonable demands, and would meet the objection of the public to facilities being granted to private companies which were making dividends. It was rather hard to expect replies within a month in the cases of small public bodies, the members of which lived in scattered localities, and did not often meet. He thought also that colliery companies could not expect to be able to run their machinery to the very last gasp and then to find an electrical authority 20 miles away able to link them up within a month. He was glad to see that the author proposed a tribunal on which there should be no lawyers. Time and cost would be saved to a very considerable extent thereby. The mere knowledge that compulsory powers existed would have the effect of making the application of such powers unnecessary except in special cases. The Post Office had not yet had occasion to go to the Courts, but they had unquestionably had cases where unreasonable demands had been disposed of without trouble because the other side hesitated to make public the terms which they had required for facilities which, though they would be valuable in the public interest, it would have cost them nothing to concede, and the knowledge that they would have to go and justify such terms had certainly resulted in their withdrawal. He had no doubt that the electrical companies would have a similar experience if they had the help of such powers.

Mr. W. H. BROWN said that, from conversations which he had had with factory owners and others, he found that there was a disposition to object to let overhead wires run over their property on the ground that it might benefit their neighbours who might, perhaps, be in competition with them in business. Good might be done through such assemblies as the chambers of commerce inducing people to see the national bearing of the matter of wayleaves.

Mr. W. LANG said that there would always be trouble in approaching people unless they remembered the point of view of the owner also. There was need to educate their wayleaves men how to go about the matter; those would be most successful who had the keenest appreciation of the human element. The question of compulsory powers for wayleaves had been forced upon the industry, and Mr. Vernier's recommendations were very fair to all parties.

Mr. E. C. WALLIS said it was high time that the rights of the private owner were limited. There was no country on earth where the rights of the private owner were more considered than they were in the United Kingdom; but it must be declared that the rights of civilisation were higher. They did not want this country spoiled as some parts of Canada were, but compulsory powers, under proper restrictions, were a vital necessity.

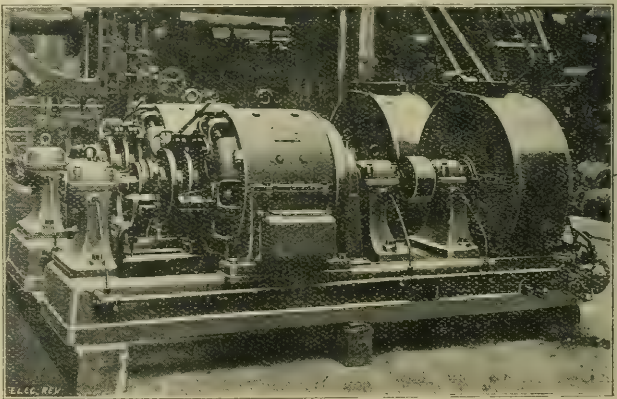


FIG. 5.—WESTINGHOUSE SHIP-LIGHTING SETS.

Mr. VERNIER said it was generally agreed that compulsory powers were essential, and the discussion seemed to turn more particularly on the need of educating the public. With regard to the powers of gas companies in new streets, Newcastle had those powers. He had been very glad to hear from Mr. Johnson that so far the powers acquired by the Post Office last year had had a satisfactory result, and that people would not come into court and state their terms. He was quite convinced that if people had to stand in broad daylight and make a statement of what they considered to be a reasonable rent they never would dare to do it in many cases. He did not think it was possible at all to contemplate any electricity supply undertaker having the right which the Post Office had. The Postmaster-General, of course, had executive power, but the supply undertaker had not, though the President of the Board of Trade could act for him, and it would be hopeless for them to try to get past the Board of Trade, for Parliament would never entertain the idea. With regard to the suggestion that the period of a month was a short time for the reply from the private landowner, in the case of powers for breaking up streets scheduled in a provisional order under the Electric Lighting Acts the landowner was expected to give an answer within three weeks if he wished to go to arbitration. The non-statutory undertaker was not subject to any Board of Trade regulation at all until the Board of Trade served him with a notice, and, as a rule, they did not do that until some accident happened, or the Postmaster-General wanted something done which he could not get done; so that many of these lines did not comply with Board of Trade regulations, and that was very unfair to statutory undertakers, because the workmanship was often indifferent, and the position was that, after an accident happened, the Board of Trade had to make a regulation to prevent a similar accident, and then the statutory undertaker got it; so that the position was not at all satisfactory. The people who needed educating were the landowners, who were, perhaps, not largely on the chambers of commerce; still, perhaps something might be done through those chambers from the publicity point of view. There was a great lack of information amongst the public about the regulation of public undertakings. Such undertakings were regulated by the State, and could not make unlimited profits. They were given a reasonable return on their capital. Take a company working under a provisional order. Maximum prices were scheduled, and the Board of Trade could revise these periodically. If the undertaking proved to be a gold mine, the local authority could purchase it. The Board of Trade, the public, and the consumer alike had a fair hold on the undertaking. In the case of power companies, the dividends were restricted to 8 per cent. If the price charged fell below the rate scheduled in the Order by 1¼ per cent. the dividend could be increased by a quarter of 1 per cent. These scheduled prices were subject to alteration under certain conditions. The only difference was that power company undertakings could not be purchased by local authorities. Any earnings which might be more than 8 per cent. had to be divided between the consumers and the shareholders. When there were companies of that sort under State control they should have all the privileges of the State undertaking, whether they were owned by the State or put into the hands of a company with suitable regulation. In either case the public interests demanded that the service should be given. If the public interest suffered because the company was looked upon as making a profit, it was fundamentally wrong to give these powers to the company. If the Post Office could get compulsory powers there was no reason why the company should not also get compulsory powers, because it should rank exactly on the same footing as a State undertaking. Overhead lines should be reserved for the most important transmission or trunk mains. The little overhead lines for distributing purposes were not worth putting up, when they considered the maintenance and repairs. Though they might save something in the early development of a district by putting up overhead wires for low-pressure distribution, the day was bound to come when the district had grown so much that the overhead lines would have to be taken down and put underground. Trunk mains were not so numerous, and they had to be run well away from towns and villages for reasons of safety, and he thought that powers for them should have the first claim, at any rate. He attached considerable importance to being able to run underground mains across country. He had done this in cases in which it had saved a good deal.

Council of American Engineering Societies.—At the annual convention of the American Institute of Electrical Engineers in 1913, Dr. W. McClellan presented a suggestion for the engineering profession to form a national body representative in its membership of all national engineering societies.

An organisation such as was then outlined is now in process of formation, and was referred to by President Buck, of the American Institute of Electrical Engineers, at a recent convention of that body. The functions of this Engineering Council are to provide for convenient co-operation between engineering societies for the proper consideration of questions of general interest to engineers and to the public, and to provide the means for united action on questions of common concern to engineers. Preliminary meetings have already been held, and a tentative set of by-laws drawn up.—*Electrical World*.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electric Vehicles.

At the risk of repeating oft expressed views, may I be allowed to point out what I think are the chief obstacles to the speedy evolution of the electric vehicle? They are:—

1. Want in standardisation of battery, both in size, means of connecting, capacity, and voltage.

2. A national company to own all batteries and charge them.

Imagine the above to have been realised. Well, mine is a big car; I take on three standard batteries at Avonmouth which are connected in parallel by being merely placed in position (the petrol can); I change them at Birmingham, again at Huddersfield, and finally reach Newcastle. Now as part of the equipment of my car, but belonging to, or approved by, the supply company, I have a meter which was read at Birmingham and Huddersfield, and the readings sent to the central office, from which I eventually receive my weekly or monthly account, according to my standing with regard to credit.

Also as part of the equipment, there should be a loose-handle sealed circuit-breaker for the protection of the battery. This should be supplied by the company, a small rental being charged. Under the present system, or want of system, imagine the difficulty of charging at a reasonably low rate seven or eight batteries of different voltages and charging rates at the same time, whilst the cars are waiting.

Finally, I ask what would be the position of the petrol car to-day if there were seven or eight widely different kinds of petrol, and as many sizes of cans to carry it in?

E. F. Rowley.

Avonmouth, *April* 27th, 1917.

Central Station Employés.

[We were recently asked by a correspondent whether all central-station and sub-station workers are entitled to the 5s. increase granted by the Ministry of Munitions. If so, whether it was compulsory that it should be paid. Further, whether they are entitled to the 3s. granted to engineering workers last October. We have received the following communication on the matter from Mr. W. J. Ebben, the hon. general secretary of the Association of Electrical Station Engineers:—]

The 5s. increase referred to was not granted by the Ministry of Munitions, but is the result of a decision of the Committee on Production given in settlement of a demand by the Federation of Engineering and Shipbuilding Trades made to the Engineering Employers' Federation for increased wages. The electricity supply authorities are not represented in the Engineering Employers' Federation. The decision applies to the members of the various trade unions affiliated to the Federation of Engineering and Shipbuilding Trades, and a number of electrical station employés of various grades are members of the Electrical Trades' Union, the Amalgamated Society of Engineers, and one or two other unions who are members of the Federation.

I believe there is a clause in the decision which deals with men employed outside the generally recognised engineering trades, and the question whether in these cases the 5s. increase should be paid will be settled by the Committee on Production.

It cannot be said that it is compulsory that the 5s. or the 3s. be paid to sub-station and central-station workers, but they are quite at liberty to apply to their employers for it, and, failing a satisfactory result, they can appeal through their organisations to the Committee on Production, if they are members of an organisation; if not ——? A total of 12s. has been obtained by the Federation.

A few lines on the present position of the Association of Electrical Station Engineers with regard to the various increases in wages that have taken place in the engineering industry may be of interest. The A.E.S.E. for the last year has been inactive, perhaps owing to the inactivity of the members, and, again, owing to the various officials being more occupied with their businesses than with the A.E.S.E. The official A.E.S.E. work has to be done in spare time, and there is very little spare time nowadays. The present inactive position of the A.E.S.E. is the result of the apathy of station engineers as a class; they wanted an organisation, and the members generally tied the hands of their own committees at the beginning. The members of the Association were dead against trade unionism or any affiliation to any federations, and now they want a 5s. rise.

The writer still vividly remembers the horror and the indignation when he seconded an amendment which was proposed by a member of the Electrical Trades' Union at a meeting of electrical employers and employés in London some years ago. This was the only time the London chief electrical engineers really took the A.E.S.E. seriously. As soon as the general committee and members severed all connection and correspondence with the E.T.U., the London chief station engineers, being clever and far-seeing men, ignored the A.E.S.E. members, and have done so ever since, because they knew they had nothing to fear. A new era is fast approaching when every man outside an organisation will have to review his position; employers are fast seeing that it is better to deal with an organisation of employés than with individuals.

Conditions in the engineering industry are rapidly changing, and the organisations want all the men of high intelligence and good education, some of the men who have been standing aloof. There is the nucleus of an organisation in existence to amalgamate the metal and engineering trades with the ultimate idea of the workers taking part control of the industry. It is an idea that will grow.

Electrical engineers must take an interest in the general condition of the electrical industry at all times, and not at the moment when somebody else gets a 5s. rise. They must read; they must work; and they must organise. Trade Unionism to-day means something different to what it did two years ago. The lawyers, the doctors, and the electrical station managers, are highly organised, and employers expect their employés to organise; it tends to peace and better conditions. Electrical engineers are being roused by other trades going ahead of them. Station engineers are thinking, and when they think the future looks to me much brighter.

Organise and improve the electrical industry, and the electrical industry will improve you!

W. J. Ebben.
Hon. Secretary, A.E.S.E.
26, Little Park Gardens, Enfield.

Electrically-Operated Valves for Internal-Combustion Engines.

I have read the interesting description of the valve arrangement of Mr. Jos. C. Youngblood, of Atwood, U.S.A., and beg respectfully to point out that this method of operating the large valves of high-powered marine, locomotive, and industrial internal-combustion engines was embodied in my designs of "Paragon" cycle engines in connection with my electrical ship propulsion system, and my locomotives, and also that this type of efficient valve operation and control was embodied in the designs of the 4,000-H.P. units which I proposed in my large "County of London gas-generated electrical power supply scheme" in 1914.

The first mention of the merits of this method of timing and control was in connection with my paper on "Internal-combustion Engines," read before the Institute of Marine Engineers, at the Engineering Exhibition, on Saturday, September 17th, 1910.

There is no question as to the economies that can be effected, and in my opinion it is essential in the coming large-powered internal-combustion motors that "electrically-operated" valves, &c., be employed, for dozens of good commercial reasons.

William P. Durtnall,
M.I.Mar.E., M.I.Loco.E.
London, N., *April 30th*, 1917.

P.S.—The valves were to be pulled off their seats with highly efficient variable control, got by no other method so effectively as by "electromagnetic power."—W.P.D.

The I.E.E. Nominations.

A very strong effort is being made to further the claims of Mr. G. W. Partridge as one of the Vice-Presidents in the forthcoming election of the Institution of Electrical Engineers.

Many of us who have been associated with electrical engineering for the last quarter of a century have very clearly appreciated Mr. Partridge's services. His electrical attainments are well known. He has been associated for years with one of the pioneer high-tension systems, and obviously possesses unusual knowledge of the public service of electric supply.

As chief engineer of the London Electric Supply Corporation he has been deeply concerned in the latest developments of electrical machinery, and as his company supplies electrical energy for the London, Brighton & South Coast electrified line, which is one of the few lines in Europe operated on a single-phase system, it is clear that he is in closest touch with the modern developments of electric traction.

As far as the Institution is concerned, Mr. Partridge has the advantage of having been twice on the Council, and in consequence is in touch with the questions affecting the industry that are likely to come before the Council during the two or three critical years that are approaching.

Member.

THE ENGINEERING INDUSTRY.

In his presidential address to the Institution of Mechanical Engineers on April 20th, Mr. Michael Longridge said that the war had taught us many things, but none more clearly than the importance of our engineering industry, upon which we depended for victory to-day, and for security and prosperity to-morrow. Action was urgently necessary to avert its loss after the war, and to regain the pre-eminence which British manufacturers had lost. Reviewing the advantageous conditions under which mechanical engineering had developed in this country in the past, he pointed out that the mechanical engineer, though a trustee for the Empire, and responsible for the transformation of the nation from an agricultural and practically self-supporting nation into a manufacturing community dependent for its existence upon imported food, had not invoked the aid of science or cared for the welfare of the thousands of employés, nor had he given the latter a fair share of the profits of his business. There was a time when Lancashire was supreme beyond dispute in the engine-building trade, but at the Paris Exhibition in 1900 Mr. Longridge discovered that the Continental engines excelled in appearance and detail any he had ever seen, and presented a startling contrast with the inferior exhibits of British manufacturers. Nevertheless, the Exhibition failed to produce any important changes in the practice of British engine-building firms, for the men in authority were trained exclusively in the shops, and men provided with technical training had not yet acquired any effective influence on current engineering practice. Consequently, when repeated loss of orders forced British engineers to recognise the estimation in which Continental work was held by customers, foreign draughtsmen were employed and foreign designs adopted, while foreign-built engines were purchased and erected even in Lancashire itself. In the meantime, famous British engineering firms were being wound up. In some cases the inducement to buy abroad was lower price, or earlier delivery, but in most it was a guaranteed rate of steam consumption which could not be obtained at home, though it should have been. Most other branches of mechanical engineering had suffered more or less from foreign competition, due partly to inefficient technical education, lack of trade organisation, and the policy of the trade unions.

In the early days of the Institution most engineers were trained entirely in the shops. Theoretical knowledge was uncalled for, and even held to be antagonistic to practical success. There was no supply of scientific engineers, partly because there was no demand, and partly because the places where a man could study the theoretical side of his profession were few and far between.

The foundation of the City and Guilds Central College in 1880 marked the first public recognition of the need of something more than office or workshop training for the engineer. In 1890 the transfer of the control of technical education from the school boards to the local authorities initiated a vast expenditure on technical schools of all ranks, and was followed by the provision of engineering courses in most of the older, as well as the new, universities; but the problem had not been solved. The functions of the engineer and the craftsman were entirely different, and their training must be different also; moreover, differentiation was needed in the training of the various classes of engineers and workmen, and the lack of differentiation seemed to be one cause of the inefficiency of our technical education relatively to its cost; another was the insufficient preparation of those entering the technical schools. The education available for the higher ranks seemed fairly satisfactory, but many men of high mental qualities were unable to assimilate much book learning, and it was a mistake to force them through the same collegiate course as men of different mentality. Further, the obstinacy of Oxford and Cambridge Universities in retaining Greek as a compulsory subject in their examinations reacted upon the public schools, and was a serious handicap on those who, intending to deal with the concrete rather than the abstract in their future lives, yet wished to find their level in the social life and moral discipline of these two universities.

The education provided for the workmen, on the other hand, both general and technical, was most unsatisfactory. Trade apprentices seldom had opportunities for learning other than at evening classes. In parts of Scotland parents and employers were compelled to send young people to continuation schools during working hours, between the ages of 14 and 17 years; in some large works in England promising boys were allowed to spend some of their working hours at technical schools without loss of time or pay, and in others technical instruction was given in the works, but lack of co-operation prevented such arrangements from becoming general. Yet the workman must have better education, and either the age for leaving school must be raised or some scheme devised for combining technical instruction in the works with general instruction in the schools in working hours. Technical colleges of University rank should provide courses for designers and managers, admitting only those capable of profiting by the teaching. The idea of "free university education for the million" was "most pernicious nonsense." Senior and junior technical schools should similarly have separate courses for foremen and for those likely to remain manual workers. The work should be coordinated between the secondary schools and technical schools or colleges, and a uniform system of adequate scholarships should be established.

Passing on to the subject of organisation, or the lack of it, Mr. Longridge said that the work of the consulting engineer was decreasing in importance, and he would become rather an inspector than a designer as men of science and high technical ability assumed their proper places in works. Manufacturers, however, should give their customers more precise and detailed information about their products. They would benefit by the interchange of ideas, secrecy being folly—the secret of success in mechanical engineering nowadays lay in quality and workmanship, not in drawings.

Workshop organisation had not received sufficient attention here; unorganised shops would be driven out by those in which scientific management prevailed, and the endeavour was made to get the workman to regard his work more as a problem to be solved than as a task to be got through. Not only on the manufacturing side, but also in the commercial department organisation was inadequate; each firm had its own agents, many of them without engineering knowledge, instead of central selling agencies, and the position of a commercial representative was too uncomfortable to attract the right class of men. For foreign representatives, cultivated men with expert knowledge, the social equals or superiors of those with whom they dealt, were necessary; small firms could not afford to employ such men, or to keep their machinery up to date, or to obtain scientific assistance, and some kind of combination or co-operation seemed very desirable, as had occurred in other trades and in other countries. Mechanical engineering should be represented by a powerful body, such as the British Engineering Association and the B.E.A.M.A.; in these associations might be found the components of a practical and effective scheme for the organisation of the British engineering industry, and Mr. Longridge sketched the outlines of such an organisation, together with a similar scheme for the men, the two following parallel lines from the manufacturers and the shop stewards respectively up to the Minister of Industry and Commerce, who did not as yet exist, but might be developed from the Minister of Labour.

Turning to the relations between employers and employed, and the negotiation of a treaty to secure a lasting peace between them, upon which the future of the British Empire depended, Mr. Longridge referred to the Government pledge to restore all the Trade Union rules and customs which had been abrogated for the duration of the war, and said he hoped the Trade Unions would have learnt, before the war ended, that a policy of limitation of output and earnings was as injurious to the workman as to his country, and would ultimately ruin both. Competition with other nations was impossible under such conditions. But if the unions voluntarily gave up their restrictive system we were bound to give them some acceptable equivalent, and he welcomed the report that conferences were being held between representatives of both parties with a view to the negotiation of a treaty of industrial peace. He advocated a spirit of sympathy and great forbearance; if the policy of the men had aroused indignation, the employers themselves were not free from blame. Reviewing the history of a hundred years' warfare between employers and employed, he pointed out the hard conditions which oppressed the workman in 1817, and the injustice meted out to him by Acts of Parliament, whence arose the intolerance and selfish economic policy of the Unions.

Limitation of output and objections to piece-work were partly due to the short-sighted policy of the employers in cutting piece-work rates, so that a workman's earnings were limited by precedent; the fear of unemployment also prompted the workman to limit output, lest the market should be glutted, a delusion which could only be removed by education. It was necessary to convince the workers by experience that piece-work, co-partnery, and large output were to their advantage, and that only by putting the best machinery to the best use could high wages, relatively to the cost of living, be maintained. As the Prime Minister recently pointed out, in connection with shipbuilding, wherever payment by results had been adopted there had been an increase in the output of 20 to 40 per cent.; it involved an undertaking on the part of the employer that if large wages were made by men as a result of special effort, no advantage must be taken of that to reduce the rates—that had been the great folly of the past.

Another question that would have to be considered was the length of the working day; it might be possible, if the unions allowed the men to do their best, to adopt an eight-hour day, but in the engineering trade standing charges and interest on cost of machinery amounted to several times the wages bill, and ran on while works were standing idle. Would it be possible to introduce a two-shift day, changing over once a fortnight?

The three great disputes in the engineering trades arose out of the qualification of men to work machines, hours of work, and limitation of output; in the first and last public sentiment and right were with the masters, who won, in the second with the men, who won. He believed there was a power that worked unceasingly through right and wrong to weave the tangled web of anarchy into the pattern of an ordered life, and that these ephemeral troubles were but means that it employed to lead both sides to a right conception of their duties to each other. That this enlightenment would come was sure, the ignorance of men, their prejudices and their greed, alone postponed its advent. If they could bury strife, suspicion, and ill will, the ideal of industrial life would be in sight.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Large Spinning.

The accompanying illustration shows a special spinning in course of production, one of a large quantity which have recently been supplied to an important Government contract by the Benjamin Electric, Ltd., of 1a, Rosebery Avenue, E.C. Finished spinnings will be noticed in the foreground and middle of the picture. These were spun in aluminium from blanks 42 in. in diameter, of 18 gauge metal, the finished spinning measuring 31 in. in diameter and 16½ in. in depth.

Fig. 1.—A Large Spinning.

This is only one example of the widely varied types of spinning produced at the Rosebery Avenue Works, where a complete metal-spinning plant is installed capable of turning out all classes of spinning work, especially that of an unusual or novel character. In this category the company's past achievements guarantee their ability to produce successful results.

Siluminite: a New Insulator.

The essential qualities of a perfect insulating material are high electrical resistance, high dielectric strength, high tensile and compression strength, immunity from attack by acids, alkalis, and oils, that it shall be easy to mould and to machine, and able to withstand exposure to high and low temperatures, that it shall be non-hygroscopic and waterproof, and that it shall be cheap. There are numerous varieties of insulators which possess some or other of these qualities, but none which answer to them all. Perhaps it would be too much to expect that perfection should be attained in this world, but it is right to aim at the ideal and to strive to attain it. We therefore accord a hearty welcome to a new insulating material introduced by the Siluminite Insulator Co., Ltd., of The Green, Southall, which possesses a remarkably large proportion of the qualities above scheduled.

We have been favoured with some samples of Siluminite in the forms of rod, sheet, tube, and moulded insulators, and have submitted them to such mechanical tests as are at our disposal. The material is a hard black substance, ringing like slate, but of far greater strength; it can be sawn, filed, drilled, tapped, turned, and polished with ease, and can be moulded to any shape in the course of manufacture, but not afterwards. It is not softened by heat (it is subjected to a temperature of more than 600° F. at the makers' works) and is not brittle. Immersion in oil or caustic alkali, or boiling water, leaves it unchanged, and it is non-hygroscopic. It possesses high dielectric strength, this being between 10,000 and 13,000 volts per mm. as tested by the National Physical Laboratory. Its structure is homogeneous and dense, the weight of a square foot ¼ in. thick being 2·4 lb. The substances with which it will most directly compete are porcelain, glass, mica, fibre, ebonite, wood, slate, marble, and moulded compounds. While Siluminite possesses most of the qualities of these materials, it excels in respect of its mechanical strength: this fact is illustrated by the following statement of tests made by Mr. E. T. Brook, of the Metropolitan District Railway, on tramway and railway insulators:—

"No. 1. *Siluminite L.C.C.-pattern Insulator.*—This insulator was fixed in a frame and by means of a hydraulic ram, the pin was drawn. With a pressure of 36 tons, the Siluminite broke away inside the outer casing and the pin commenced to draw.

"No. 2. *Porcelain L.C.C.-pattern Insulator.*—This insulator was subjected to a similar test as No. 1, and at a pressure of 6·7 tons, the porcelain broke away, and the pin pulled out.

"No. 3. *Siluminite Negative Rail Insulator.*—A crushing-strain test was made on a third rail insulator 3½ in. high, 4⅝ in. diameter inside the petticoat, and at 50 tons pressure the outer parts of the base broke away from the centre, but the centre remained solid.

"No. 4. *Porcelain Negative Conductor Rail Insulator.*—This was tested in a similar manner to No. 3 on the Siluminite insulator of the same pattern, with the following results:—At 8·9 tons pressure, the insulator cracked in two places about half-way through. At 18 tons pressure, the insulator split into a number of pieces.

As regards the electrical properties of the material, the following tests were also made by Mr. Brook:—

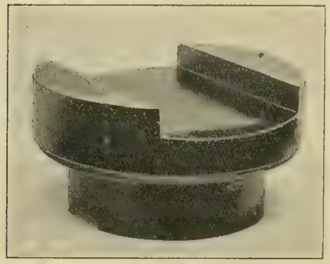


Fig. 2.

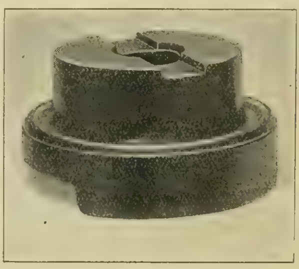


Fig. 3.

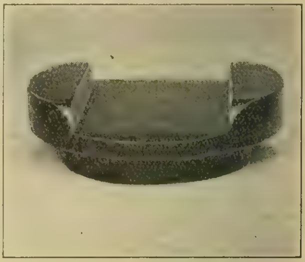


Fig. 4.

Siluminite Rail Insulators.

"No. 1. *Siluminite Negative Rail Insulator.*—At a pressure of 28,900 volts this insulator flashed across from the cast-iron cap to the top of the base clip.

"No. 2. *Porcelain Negative Rail Insulator.*—At a pressure of 28,100 volts this insulator flashed across at the same point as No. 1.

"These tests show that the flashing was due to surface leakage, and the fact that the base clip is pointed at the top."

The material was submitted for test to the National Physical Laboratory with satisfactory results, which we hope to publish shortly.

Perhaps, however, the most convincing demonstration of the strength of Siluminite is its use for rail insulators *without the aid of the usual iron cap.* We illustrate herewith examples of their application on the Metropolitan District Railway, where they have been subjected to severe practical tests, and have been on the track since June of last year. The larger insulator weighs 8 lb., and is designed for use without the usual malleable cast-iron clip to hold the positive conductor rail; the smaller insulator is also designed to dispense entirely with the metal clip, and the negative conductor rail is simply laid in the seating on the top of the insulator. Figs. 2 and 3 show the top and base of the former, and fig. 4 the latter type of insulator. An anchor insulator is also made for railway work.

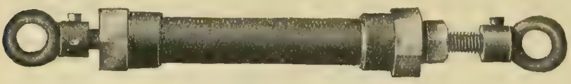
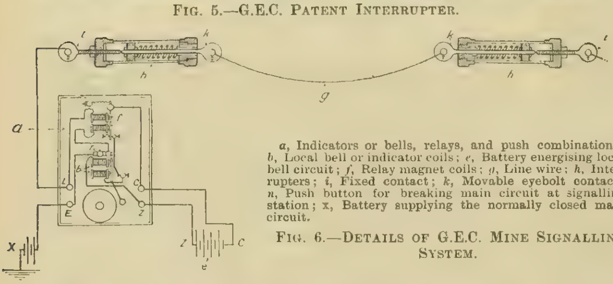


Fig. 5.—G.E.C. Patent Interrupter.



a, Indicators or bells, relays, and push combinations; *b*, Local bell or indicator coils; *e*, Battery energising local bell circuit; *f*, Relay magnet coils; *g*, Line wire; *h*, Interrupters; *i*, Fixed contact; *k*, Movable eyebolt contact; *n*, Push button for breaking main circuit at signalling station; x, Battery supplying the normally closed main circuit.

Fig. 6.—Details of G.E.C. Mine Signalling System.

Passing to the other extreme, we understand that ignition plugs for motor-car engines, made of Siluminite, have successfully withstood the high temperature of explosion for long periods without deterioration in any respect.

In addition to the properties before mentioned, Siluminite is found to withstand the effects of lengthened exposure to an atmosphere highly charged with ozone, and orders are in hand for sheets of dielectric for the ozonisers of an underground electric railway ventilating system.

Metal parts can be insulated by compressing Siluminite on to them in any desired shape or form, thus avoiding the cementing or screwing process now necessary in most cases. The most notable instances are those of insulated bolts for transformers, and conduit, track, and overhead insulators for electric railways and tramways.

The Siluminite Insulator Co. are in the quoting list of the Ministry of Munitions and the Royal Dockyard, Woolwich, and their material is in use in many munition factories, including the Royal Air-Craft Factory, Farnborough; they are supplying, amongst other firms, the Igranic Electric Co., Ltd., the Solenoid Regulator Co., and the Midland Electric Manufacturing Co., Ltd.

As regards the limitations of the material, it is not at present made in sheets thinner than ⅛ in., and it is not claimed that it is acid-proof. The numerous applications to which it can be put, in view of the foregoing description, need not be detailed to electrical readers, who will readily see that it offers a wide range of possibilities. And it is remarkably cheap.

Combined Switch and Plug.

Messrs. Ward & Goldstone, of Sampson Works (Salford), Manchester, in connection with their recently issued list No. 103, describe the "Banquo" interlocked plug and switch (fig. 7), which we gather has been extensively adopted by the trade. It is substantial in design and of waterproof construction, consisting of an iron base, screwed for ¾-in. conduit, and fitted with a three-pin plug (one pin being for earthing). It has a carrying capacity of 5 amperes; the plug top piece is made of gun metal, and has a cord grip arranged to take cab-tire cable or the firm's standard tough rubber flexible cable. The arrangement can be supplied with a double-pole switch if desired.

We may add that Messrs. Ward & Goldstone list a number of patterns of plugs and switch-plugs adapted for domestic or factory use.

Signalling in Collieries.

A novel and interesting system of signalling on haulage roads in coal mines has been developed by the General Electric Co., Ltd., London, representing a distinct departure from current practice. The essential principle is the use of a circuit normally closed, the interruption of which causes the bell to ring—an idea incorporated in some burglar alarms, &c., but entirely novel, we believe, in the present connection. A single insulated line wire is used, which serves the purpose of a pull wire, and carries the operating current, which has a maximum value of 0·02 ampere at 6 volts, and is therefore free from any possibility of causing ignition of explosive gases. The return is by earth; but if an efficient earth cannot be obtained, a bare wire is run along the road for the return. The apparatus consists, in addition to the line and a battery of four Leclanché cells, of specially-designed mining-type bells and relays, and patent interrupters, which are fixed at intervals in the line. One of these interrupters is shown in fig. 5; fig. 6 shows the interior of the device, and its connection with the bell and line. It will be seen that by pulling the line, the circuit is broken in the gas-tight interior of the interrupter, allowing the armature of the relay to fall back and close the bell circuit. It is claimed that sparking on the line wire is entirely eliminated, less battery power is required, signals can be given from any part of the line by simply pulling the line wire, the signals

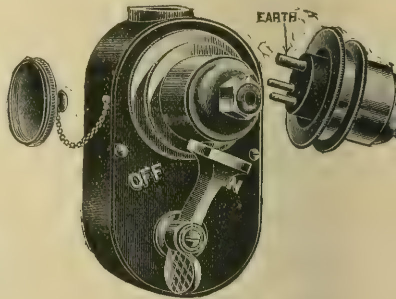


Fig. 7.—"Banquo" Interlocked Switch and Plug.

are positive and unaffected by dirt, &c., on the wire, troubles on the line are avoided by the use of a single line wire, and the system is extremely simple. If the line wire is broken, the bells ring continuously, and thus call attention immediately to the fact: if the line wire is earthed, the fault is easily traced, as signals can be given up to the fault, but not beyond it. The system appears to possess marked advantages for use in fiery mines.

"Girder" Machine-Lighting Fitting.

The great influence of suitable illumination on the output of industrial works is daily becoming more widely recognised. No single factor plays a more important part in promoting efficiency in production, due very largely to the avoidance of eye strain and benefit to the general health of the operative.

Messrs. Drake & Gorham, Ltd., 47, Spring Gardens, Manchester, have recently introduced a special type of fitting suitable for engineering shop requirements and similar work, which is designed to fulfil the necessary requirements—*i.e.*, to be strong and rigid, yet flexible and adjustable in any direction; easily fixed to a machine, for instance, and to direct the light on to the work, while at the same time shielding the source of light from the eyes of the operator.

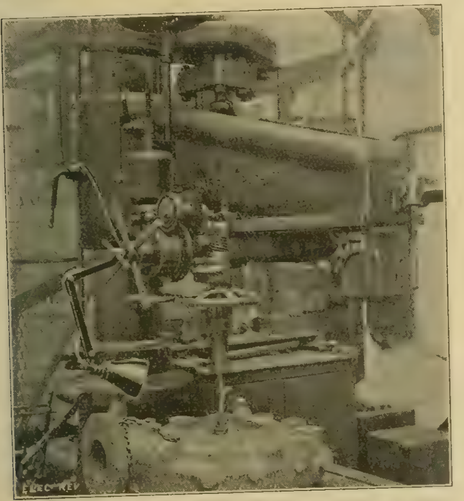


Fig. 8.—Girder Fitting attached to Drilling Machine.

Figs. 8 and 9 show the general construction of these fittings, in which ordinary wear can be taken up by means of a spanner, standard bolts and nuts, with spring washers and double nuts at joints, being employed.

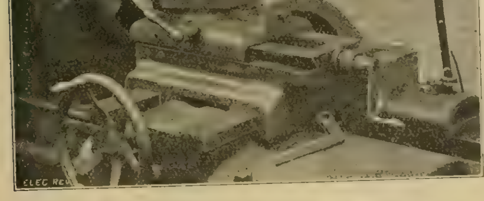


Fig. 9.—Girder Fitting Attached to Lathe.

A variety of interchangeable bases is supplied, so that fittings can be fitted to machines of various types or on to the wall, &c.

In addition to the fittings, Messrs. Drake & Gorham are introducing, for use with them, low-voltage metal-filament lamps with static transformer or direct-current generator, as the case may be—an 8-watt low-voltage metal-filament lamp being ample for lighting purposes, if properly applied, and capable of superseding, probably, a 60-watt carbon lamp, such as usually employed in positions exposed to vibration and mechanical shock. The low-voltage metal lamp is practically as strong mechanically as the carbon lamp, and obviously saves energy. Two new type reflectors are being introduced for use with this fitting: for the low-voltage system a small shade is used to contain the small lamp. The larger shade for use on ordinary 100 or 200-volt lighting circuits is similar in construction, except that the lampholder is insulated from the shade by being screwed into an insulating bush fixed in the back of the shade. An insulating hood covers the projecting dome of the lampholder in cases where complete insulation is necessary. The new pattern shade enables a stronger mechanical construction to be employed, more suitable for rough works' use.

We understand that a patent has been applied for, for the "Girder" fitting.

INDUSTRIES AND MUNITIONS.

Last week we were only able to refer briefly to the deputation from the Federation of British Industries and other Manufacturing Associations to the Government, at the House of Commons, on March 13th. We give a full abstract of the proceedings below. Dr. Addison (Minister of Munitions) presided.

Mr. George Terrell, M.P., of the British Manufacturers' Association, who introduced the deputation, said that it comprised the Federation of British Industries, which had 347 members, and included an important number of associations each having their own membership: the Central Council Association of Controlled Firms, with a membership of 3,500 manufacturing firms; the Employers' Parliamentary Association, which had a membership of 2,500 manufacturing firms; and the British Manufacturers' Association, which had a membership of about 700 manufacturing firms. There was a total represented in these organisations of something like 8,000 or 9,000 manufacturing firms. The amount of the capital involved was something over two thousand million pounds, and the number of hands employed ran into several millions. Their object was not to find fault or to complain of mistakes, but to put facts before the Government showing the mistakes which had occurred in the past, and to submit practical suggestions for their avoidance in the future. They knew that they had to make sacrifices. They were prepared to make any sacrifice necessary for the common cause. But there were many sacrifices which they were called upon to make which were of no good to the country, which were simply a waste of time and waste of money, and it was to prevent the recurrence of waste of that kind that they came to ask for help. They knew that there had been enormous difficulty in the creation of the Ministry of Munitions. It had accomplished great things, and great credit was due to the many officials employed there. Men of the highest intelligence and knowledge in the business world were serving from patriotic motives, but among them there were gentlemen occupying important positions who, with every desire and enthusiasm to serve their country, were, probably through lack of experience and knowledge, making mistakes. The deputation was anxious that in the future mistakes should be avoided as much as possible. The Government required men for the Army and for munitions. The employers who had to produce munitions and other national requirements were struggling to obtain the greatest possible output from their factories. The Government wanted the output; they were always pressing for it. Therefore, it was necessary for the energies of works managers and others to be concentrated on their work, and not taken up unnecessarily with the filling up of forms, attending Tribunals and at the Ministry of Munitions, and doing other work of a similar kind. They suggested that if employers were taken into confidence and consulted in regard to the steps the Government considered it necessary to take they would probably be able to meet the requirements of the Government with the minimum interference of output. Mr. Terrell went on to say that what the deputation asked was that manufacturers, through their organisations, should be consulted in regard to any new orders or instructions which might be considered necessary by the Government for the regulation of labour, raw material, and manufactures. It meant simply that the Government should notify any changes or rules or regulations which they might desire to pass to the Federation of British Industries. The Federation would make inquiries for the whole trade of the country, find out which were the industries really affected, and get first-hand information which they would submit to the Government for their consideration. They asked to be allowed to gather the information, and to submit it for consideration before any definite action was taken of the kind which he had indicated in the cases to which he had referred. If the Government could see its way to adopt the suggestions a great deal of time would be saved, a great deal of waste would be avoided, and the employers would be able to show that they could render the Government very important and valuable work in the responsible duties they had to carry out.

Sir Vincent Caillard (Vickers, Ltd.) cited numerous instances in which closer co-ordination between the manufacturer and the Government would have had the effect of stimulating the output and removing friction.

In reply to these and other speeches, Dr. Addison, thanked the deputation for having put their case so clearly and distinctly, and expressed the regret of the First Lord of the Admiralty for being unable to meet them, but stated that he would be glad to confer with Mr. Chamberlain, Lord Derby, and himself on the general question which had been brought before them. For the most part, he was afraid that the department most concerned appeared to be the Ministry of Munitions, but he believed that some of their complaints were perhaps based on a little misunderstanding of some of the considerations involved. In the first place, he ought to thank them for bringing forward so few instances. He admitted that they had been compelled to interfere with trade all over the country. The fact that he saw before him gentlemen he had seen on so many previous occasions was, he thought, considerable proof that they had been frequently consulted. With regard to copper, aluminium, lead, steel, and so on, it was essential to preserve sufficient working stock in this country to make munitions. It was quite evident that the restrictions which had been imposed would, unfortunately, in a good many cases inflict serious harm on the trade, and the Government were only too glad to welcome any suggestion whereby that hardship could be minimised as much as possible. But they should not deceive themselves on this point. These things could not be done without causing harm. We should never get out of these difficulties so long as the war lasted, but what they wanted were businesslike arrangements to deal with them. They must not blame the Ministry of Munitions, or the War Office, or the Admiralty, or the Shipping Controller. Nothing was more difficult, said Dr. Addison, than the issuing of the priority certificates. To protect our supplies we had to divide priority orders into various classes. Two or three gentlemen had complained that they could not get priority certificates for certain classes of work. The departments immediately concerned in keeping up the fighting forces were going to have the first cut off the joint. As to the general ground of complaint that the departments did not take employers into consultation often enough, they knew how urgent the business was, and, having regard to these times of emergency, he did not think that the deputation's suggestions as they stood really would quite work. They had in respect of the trade union organisations a very important and most valuable committee which they consulted on various questions affecting labour. If the various employers' organisations would be satisfied, the Ministry of Munitions, and he was quite sure his colleagues at the War Office, would be glad to consult with a standing committee of, say, three or four persons whom they could trust to speak in the name of those whom they represented when matters arose affecting new Orders and so on. He did not think it would be business to agree to anything which would mean sending all over the country to get all manner of people's ideas. It would simply result in a Babel of counsel, and the Government would never get anything done. The Government had to act quickly, and although it sometimes operated a little harshly the method they adopted was, they considered, the best. Quite recently he had appointed a small committee of business men whose business it was to advise the Priority Section of the Ministry of Munitions with respect to all orders, and so on, so as to occasion the minimum of hardship. He believed there were four gentlemen on that committee at present, and he would be very glad to afford that collection of employers' organisations the opportunity of appointing an additional one or two members. The gentlemen they appointed, he warned them, would have to attend to the work all day. It was not a case of dropping in now and then, because the cases requiring their attention were continually occurring, and it must be an understanding that anybody who was appointed must be prepared to spend his whole time at that work. They had between 1,000 and 1,500 applications every day, and he believed it would bring them to a nearer realisation of the Government's difficulties than perhaps some of them possessed at the present time, and might in that way have a wholesome effect. Let there be no misunderstanding. He did not want to have one committee, say, for the shipbuilders, another for the engineering employers, another for this, and another for that. It must be one committee to represent all concerned. That would be the only businesslike way of dealing with their complaints.

Mr. Neville Chamberlain (Director of National Service) said that it appeared to him that the discussion had really had very little reference to the department over which he presided. While he felt that it was extremely desirable that employers should be consulted upon matters in which their interests were concerned, he could see that, in war-time at any rate, there were a great many difficulties. They arose chiefly from the fact that there was not sufficient organisation among the employers themselves. In war they had to act quickly, and they simply could not afford to wait and consult all the interests concerned whenever they wanted to make an order. He desired to keep in touch with employers, and he was not only willing, but desirous of consulting anybody sufficiently representative of the employers. The essentials were that they should have a body which was always get-at-able. Questions arose at a moment's notice, and to get at people living in different parts of the country would mean several days' delay. Therefore, they must have a body domiciled in London, and representative of as many interests as possible. The representatives who came and consulted with them must be people of sufficient standing and able to speak without having to consult a lot of people behind them. Such a body would be of great assistance to the Government and of great use to the country. They would enable them to avoid mistakes which they might otherwise make, and do away with some of the friction which had occurred in the past. If the Federation of British Industries could supply such a body he should be glad to consult it.

Sir William Peat replied, expressing the thanks of the deputation. He said that a body created in the manner recommended by Dr. Addison might do a great deal to meet the difficulties which had arisen. But it could not do all that would be necessary, because when dealing with, say, shipbuilding, steel making, castings, or engineering, they were dealing with bodies entirely different from each other, and with interests entirely different from each other. Hence it would follow, it seemed to him, that it was desirable, if possible, that where their interests were affected some representatives, however small in number, should be co-opted to meet the needs of these special trades.

THE INDUSTRIES OF THE EMPIRE.

The following is a copy of the memorial which was presented to the Imperial War Cabinet, signed by 81 associations of producers and manufacturers representing, as far as can be estimated, about £1,000,000,000 of capital. The industries concerned are distributed throughout the Empire.

"We associate ourselves with the following principles which we believe now represent ideals appealing to the vast majority of the people of the Empire.

"1. That the deepened sense of our unity of interest in the face of national danger, as between various classes of the community, and as between the Dominions and territories of the Empire, must be recognised and maintained in all measures to be considered from the point of view of economic security and progress.

"2. That the first claim on Imperial statesmanship is that remunerative employment shall be made available for all under conditions that will crown with comfort and prosperity the freedom for which we are now working and fighting.

"3. That to this end the three great agencies of production, capital, labour, and science, should be systematically directed towards the development of the boundless resources of the Empire so that it may become more productive, not only of the prime necessaries of life, but also of the essential materials of industry and of all departments of manufacture.

"4. That the resolutions of the Paris Economic Conference provide a sound basis for national self-development, and for maintaining mutually advantageous and privileged commercial intercourse between the Allied Powers.

"5. That after the institution of such a system of reciprocal preferential arrangements as will give practical effect to the resolutions of the Paris Conference, which can best be settled in detail by conference with representative organised associations of manufacturers and producers, our next Imperial duty is to stimulate the employment of available resources of mechanical and chemical science for enhancing productive capacity, and so enriching the whole community.

"6. That the system of general and technical education should be thoroughly revised to afford to all classes equality of opportunity for talent and industry.

"7. That the state should, while facilitating general conditions, recognise and regularise the position of industrial organisations and give them additional responsibility for the efficient conduct of each section of industry. In conference with each other, with Labour, and with the Government, they may thus found a system of industrial security and progress in true accord with the spirit of British enterprise as being capable of continuous adjustment to varying circumstances, and giving opportunity for the exercise of individual energy and original endeavour.

"It is in the light of these principles that we believe an Imperial economic system can be constructed worthy of our vast natural resources, and of a manufacturing capacity greatly enhanced in volume and variety as the result of war demands. Further, we believe that a consistent policy aiming at the efficient and bounteous production of the wealth of the Empire by and for our own people will not only establish all British States on a higher plane of progress and prosperity, but will confer material and social advantages on the rest of the world."

The signatories to the memorial include the B.E.A M.A., the British Engineers' Association, the Cable Makers' Association, and the Electrical Contractors' Association.

Holland.—The Dutch Customs authorities have recently given a decision to the effect that the value to be declared for Customs purposes of transformers, which are dutiable at 5 per cent. *ad valorem*, should include the value of the quantity of oil contained in the transformer, and forming a whole with this. The oil in that case need not be declared, and subject to duty separately.

WAR ITEMS.

Brighton Tramway "Group" Scheme.—The manager of the Brighton tramways has worked out an ingenious plan for releasing men employed on the Corporation tramways for military service by groups. There are 38 men on the tramways who hold certificates of conditional exemption. In anticipation of a review of the exemptions, the manager has prepared, and the Tramways Committee and the Military Representative have approved, a scheme by which the men will be called up by instalments according to fictitious ages arrived at on the basis of each man's actual age with the addition of one year for each child and one-third of his period of service. The "youngest" men, according to this scale, will go first. —*Times*.

U.S. and the War.—The New York financial correspondent of the *Times* states that at a conference of leading steel manufacturers it was agreed to sell to the Government plates and structural shapes at about 50 per cent. under market prices. The orders will be divided among the companies according to their capacity. A committee of manufacturers will take care of all Government requirements during the war, arranging prices and expediting production.

To be Wound Up.—The Board of Trade has ordered the following to be wound up:—

Tandem Smelting Co., Ltd., Christchurch Road, Merton Abbey, London, S.W. 2, smelters and assayers. Controller: B. D. Holroyd, 6, Great Winchester Street, E.C. 2.

Kroll & Co., Bayham Place, Camden Town, N.W., metal workers. Controller: R. B. Tyler, 1, Queen Victoria Street, E.C.

Trading with the Enemy.—The "London Gazette" for April 27th contains particulars of further persons and bodies, in the following countries, with whom trading is prohibited: Argentina, Brazil, Chile, Netherlands, Norway, Spain, &c.

Employment of Discharged Soldiers at Marylebone Electricity Works.—In the House of Commons, recently, Mr. Anderson asked the President of the Local Government Board whether he had received a communication from the Marylebone and District Trades and Labour Council in regard to the employment of wounded soldiers at less than a standard rate of wages by the electricity department of the Marylebone Borough Council; whether it was the view of his Department when discharged soldiers were employed by a local public body that their State pension should be taken into account in deciding what wages should be paid them; and, in view of the objections to such a practice, what steps he intended to take?

The Parliamentary Secretary to the Local Government Board (Mr. Hayes Fisher), in reply, said:—"I understand that a few disabled soldiers are employed by the electricity department of the St. Marylebone Borough Council on work which, notwithstanding their disability, they are able to perform, and that they are paid a fair and reasonable wage and given the benefit of the Council's schemes as to sick pay and superannuation. As my hon. friend is probably aware, a Trade Advisory Committee, consisting of an equal number of representatives of associations of employers and workpeople, has been formed jointly by the Minister of Labour and the War Pensions Statutory Committee to give advice upon questions relating to the training and employment of disabled sailors and soldiers as electricity sub-station attendants; and I am informed that this matter has been considered by the Committee, who have reported that the rates of wages which are being paid by the Council to the men in question have been determined without regard to their pension and are the same as the rates that were paid in pre-war time, with an additional war bonus of 2s. In reply to the latter part of the question, I may point out that the matter is not one in which the Local Government Board would be empowered to take any action."

Belgian General Electric.—According to the "Frankfurter Zeitung" of April 16th, quoted in the *Daily Mail* of April 25th, The General Electric Co. of Belgium, Ltd., branch of The General Electric Co., Ltd., London, is included in a list of British firms whose liquidation has been ordered under decree of the German Government by the administrative authorities acting under the Governor-General of Belgium.

Imperial Preference.—Mr. Bonar Law stated in the House of Commons last week that the Imperial War Cabinet had unanimously accepted the principle that each part of the Empire, having due regard to the interests of our Allies, should give specially favourable treatment and facilities to the produce and manufactures of other parts of the Empire. There was no intention to make any change during the war. The Prime Minister also referred to this matter as a definite part of future policy in his speech in the City last Friday.

Post Office Electricians' Clearance Certificates.—Three electricians temporarily employed by the Post Office, wiring the Glasgow Post Office, were only allowed to work 48 hours a week. If they were employed outside they could work for a 54-hour week and earn more—a great consideration in these days when everybody in their particular trade is wanted to work as long as he can. They accordingly applied to the Glasgow Munitions Tribunal for clearance certificates. The Post Office opposed, and said that the wages question was settled by a Select Committee which fixed 48 hours per week. The men said that their engagement was temporary and that the Committee sat before the war. The Sheriff asked why the men could not be allowed to work a 54-hour week with the Post Office, and the officials answered that they were working alongside others who had accepted the conditions. The Sheriff said it was strange for a Government committee to recommend a reduction of working hours when tradesmen generally were working extra time. The men wanted to work more time, and being only temporarily employed might be dismissed any day on a week's notice. It was unreasonable that they should be kept from doing work outside and from earning more pay if they wanted. The Select Committee's recommendations were made before the war. The Assessors concurred with him in the view that the clearance certificates should be granted.

Exports Prohibited from Other Countries.—The Supplement to the *Board of Trade Journal* of April 26th contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported to various destinations from the Straits Settlements, Hong Kong, Nigeria, Gold Coast, Jamaica, Barbados, Trinidad and Tobago, and British Guiana.

Exemption Applications.—On Monday, at the Northampton Tribunal, Mr. J. T. Cameron, Corporation Tramways manager, appealed for several employés. Three months' open exemption was granted to the chief clerk, the armature winder, the senior cash clerk and the foreman painter, the V.T.C. B section condition being attached in respect of the two clerks.

At Dewsbury, F. Thompson (18), an electrical tester, passed A 4, said he was studying for an electrical examination and he would not be able to further attend the classes unless he passed. He was told that he would have two further medical examinations after he joined up, and his appeal was dismissed, but a month's grace was granted.

At Oxford, the Electric Co., Ltd., appealed for exemption for Mr. John F. W. Pierce (40), chief assistant engineer and mains superintendent, two engine fitters, turners and deputy shift engineers, two switchmen and superintendents of substations, and a shift stoker. For the company it was stated that since January three men referred for substitution had been released, and they were prepared to release a fourth if a substitute could be provided. Reasonable substitution could not be provided for the chief assistant engineer and the two deputy shift engineers, and the switchmen would be difficult to replace. The staff was cut down to its minimum, and any stoppage of supply would affect munition factories and hospitals. The Tribunal exempted Mr. Pierce, one deputy shift engineer, and the two switchmen for three months or until substitutes were found, and refused the other appeals, with a month's grace.

Reigate Tribunal has withdrawn conditional exemption held by C. W. Read (34), shift engineer at the Corporation Electricity Works, and given temporary exemption until July 24th.

At Taunton, the Taunton Electric Traction Co. appealed for V. L. Marshall (33), acting manager and traffic inspector, the only member of the staff liable for military service. He is responsible for five miles of live wire, and it was most important for the safety of the public that a competent man should be retained. He had been twice rejected, and was now passed for general service. The appeal was disallowed, 14 days' grace being granted.

Before the East Sussex Appeal Court, the Military appealed against exemption granted to an employé of a Brighton firm of electrical engineers. One of the partners said that 70 of their staff had joined up, and the man appealed against signed for munition work, but was left with them because the Ministry of Munitions recognised that he was doing work of exceptional importance. The firm was doing a great deal of electrical work in hospitals, and the man had been specially trained for it. The exemption was confirmed.

At Tonbridge, on April 24th, Mr. W. G. Gilbert (31, in Class C 1), electrical engineer, appealed for exemption on the ground of his numerous engagements on works of public utility, but he was refused exemption.

Conditional exemption has been granted to J. Burch, blacksmith, appealed for by Mr. Harvey, tramways manager at Ilford.

Southend-on-Sea Tribunal has granted until July 1st to a traffic inspector (35, in Class B 1), appealed for by the Corporation electricity department; and to the same period to an armature winder (35, in B 2), the only employé of this kind left with the Corporation.

At Oldham, Messrs. G. Buckley & Sons appealed for the man in charge of their electric motors, aged 30, and in Class A, but exemption was refused.

As Shrewsbury, Mr. G. H. Smallwood, electrical engineer, appealed for the retention of O. Landon, an apprentice, in Class C 2, and stated that he had a lot of Government contracts on hand. The Chairman said that Landon was not of much military value, and he would be given until October 1st.

LEGAL.

Douglas v. Creasey.

At the West London County Court, on Monday, before Sir Lucius Selfe, Dr. Creasey, of Grafton House, Piccadilly, was sued by John Douglas, builder and decorator, of Exhibition Road, South Kensington, who claimed £12 15s. 2d., balance of account.

Mr. Tetlow represented the plaintiff, and Mr. Henn Collins was counsel for the defendant.

The plaintiff, it appeared, entered into a contract with Mr. Hamilton, agent for the landlord of the flat at Grafton House, to carry out certain decorative and electrical work for an inclusive sum of £117, to which was added a supplementary account for £6 7s. 8d. for extra electric lighting work. The contract contained a clause that the plaintiff was to "provide, where necessary, new plugs and switches to 24 points to be indicated by the lessee," and as Dr. Creasey required plugs and switches to be placed in such positions that a considerable amount of re-wiring was necessary, the plaintiff, who had executed other work for the doctor, included in his bill a charge of £12 15s. 2d. for the re-wiring. The doctor refused to pay this, urging that the work was included in the arrangement between the plaintiff and the landlord's agent.

For the plaintiff it was argued that the clause quoted meant that the lessee was entitled to choose the kind of switches and plugs he desired; not that he could choose any part of a room for them to be placed, unless he was prepared to pay for the extra wiring required.

His Honour gave judgment for the defendant, remarking that the only meaning he could see in the words was that the lessee was entitled to indicate the positions in which he wanted the switches and plugs fitted, and that the wires were to be carried to those points.

Ellis v. Birkett.

At the Southend County Court, last month, H. H. J. Ellis, through his father, sued Robert Birkett, borough electrical engineer, Southend, for £100 damages for alleged breach of apprenticeship indentures. There was also a cross-action for £50, said to be due under the indentures. For the plaintiff, it was stated that nothing was alleged against Mr. Birkett personally, but it was alleged that plaintiff had practically received no proper instruction whatever. After evidence had been heard, the case stood adjourned to May 11th.

BUSINESS NOTES.

Bankruptcy Proceedings.—A. B. Craig, merchant, 8, Well Street, Cripplegate, E.C.—The application of this debtor for an order of discharge came before Mr. Registrar Hope, on April 26th, at the London Bankruptcy Court. The Official Receiver reported that the debtor failed in November, 1915, with provable debts £25,437 and assets expected to produce £25,858. The latter included a claim to £50,654 against the Occidental Syndicate, estimated to yield £8,000, and the debtor's share interest in the company, which he anticipated would eventually bring in £30,000. The syndicate controlled the Sturgeon Falls (Canada) Electric Light and Power Co., Ltd., which was formed in 1898, and owned certain water-power rights which it had leased in an undeveloped condition to the Sturgeon Falls Pulp Co., and the latter concern had agreed to supply a certain amount of power and light to the Power Co. There had been considerable litigation in Canada in regard to the properties, and, in the opinion of the Official Receiver, the debtor's estimate of the realisable value of his assets was excessive and unwarranted. Up to the present time, the trustee (Mr. S. R. Worley) had realised only £1,082; and with regard to the debtor's interests in the Occidental Syndicate, they were very involved, and could not be realised until after the war. The application was opposed by the Official Receiver, on the ground that the debtor had brought on, or contributed to, his bankruptcy by rash and hazardous speculations. Mr. E. W. Hansell appeared in support of the application, and, after a lengthy hearing, the learned Registrar upheld the report, and imposed a suspension of three years. Order entered accordingly.

F. Brown, electrician, 8, Stafford Street, Llanelly.—May 12th is the last day for the receipt of proofs for dividend. Trustee, Mr. H. W. Thomas, 4, Queen Street, Carmarthen.

E. W. Barton Wright, electrical therapeutic expert, Acton Park.—Composition of 5s. in the £, payable May 4th, at Official Receiver's office, 14, Bedford Row, W.C.

Auction Sale.—On Wednesday, May 9th, Messrs. Goddard & Smith will offer for sale by auction the stock of electrical appliances and fittings, &c., of the Magnetic Waves Institute, 133 and 135, Oxford Street, W. Particulars appear in our advertisement pages.

Trade Announcement.—The Fellows Magneto Co., Ltd., of Park Royal, W., have, it is announced, acquired the whole stock and effects, including the machinery and plant, of the Mea Magneto Co., Ltd., which was recently put up for sale under the Enemy Trading Regulations.

Catalogues and Lists.—Messrs. Ward & Goldstone, Sampson Works, Salford, Manchester.—Supplementary price list (No. 103) of 22 pages. This is an instalment of what would have been a large catalogue but for war conditions causing printing restrictions and price variations. It contains illustrated particulars and prices of a wide range of electrical lines which are in constant use, particularly in munition and similar factories. Large stocks of insulators of British manufacture are held and these are listed. Ironclad switches and fuses, lampholders, combined switches and plugs, distributing switchboards, hand lamps, watertight fittings, cables and flexibles, &c., are among the accessories and materials included.

Messrs. Landis & Gyr, Ltd., Hampton Hill.—Supplementary price list of time limiters.

General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—Revised price lists (April, 1917) of Osram drawn-wire lamps—a four-page leaflet O.S. 2,110, and a folder O.S. 2,108.

Messrs. Wright & Wood, Ltd., Century Works, Halifax.—Catalogue of alternating and continuous-current motors and dynamos and control gear. It comprises a number of sectional lists, some of which have been recently revised. These lists deal respectively (giving specification and tabulated prices and particulars) with two and three-phase induction motors; two and three-phase alternators; two and three-phase crane motors; continuous-current motors; ditto starters; oil and air break starters, &c.

Spain.—Under the style of the Industrias de Cobre Electroliticos Sociedad Anonima, there has been formed at Barcelona a company for the making of seamless electrolytic copper tubes. The company owns certain foreign patents, and has lately purchased a large factory with up-to-date machinery equipment.

La Maquinaria-Hispano-Inglesa is the title of a new company formed in Madrid to continue the business of the firm of Morgan and Elliott, the sale of machinery and the carrying out of electric installations.

Liquidations.—C. H. Blume, Western Road, Mitcham, varnish and enamel manufacturer.—The controller, Mr. J. W. Barrett, has applied for his release.

Climax Stopper and Ebonite Co., Ltd., Custom House, E.—The meeting of trade creditors summoned for May 2nd is postponed.

Crompton & Co., Ltd. (registered in 1888).—A meeting is called for June 4th at Salisbury House, E.C., to hear an account of the winding up from the liquidator (Mr. E. Reeves). This, of course, does not relate to the existing company which was registered in 1913.

Heinrich Traun & Sons.—The Controller, Mr. J. D. Pattullo, has applied for his release.

Wattmeter Charts.—The address of manufacturers of these charts is wanted. For particulars see our advertisement pages to-day.

The Tata Hydro-Electric Works.—We have received from Mr. Alfred Dickinson, the consulting engineer, a brochure of some 60 pages, in which there appears a very fine set of half-tone pictures of the works, pipe lines, lakes, dams, ducts, power house, transmission lines, &c., of the Tata Hydro-Electric Power Supply Co. Interesting group photographs are given of eminent personages, directors and officials on the occasion of opening and other functions, also of a group of workers.

LIGHTING AND POWER NOTES.

Aberdeen.—Loan Sanction.—The Electricity Committee reports that the Secretary for Scotland has sanctioned loans for £40,000 for electricity purposes.—*Aberdeen Express.*

Blackpool.—Price Increase.—The Electricity Committee has decided to increase the flat rate for lighting purposes from 4d. to 4½d. per unit. For the maximum demand system, the charge is to be raised from 6d. and 2d., to 7d. and 2d. per unit, and for power purposes it is proposed that the rate should be 3½d. and 1d., as against 3d. and 1d. For heating and cooking the advance is from 1d. to 1¼d. It is estimated that the new tariffs will represent an additional annual income of about £3,500, on the assumption that the consumption of electricity is equal to that of last year. There is a loss of £900 on the working of the undertaking for the past year, whilst in the previous year there was a net profit of £2,497.

Chester.—Loan Sanction.—The L.G.B. has informed the Council that it is prepared to sanction a loan of £4,500 for the proposed extension of electric cable to supply local works.

East Ham.—Price Increase.—The charges for current are to be increased to general consumers (including public lighting) by an additional 10 per cent. above pre-war charges, making a total increase of 20 per cent; to the tramway undertaking by an additional charge of 5 per cent. above pre-war charges, making a total increase of 10 per cent. Such increases are to be first charged in respect of current supplied during the September quarter, 1917.

Edinburgh.—The Magistrates have decided that all theatres, picture houses, and other places of amusement shall, in their application for a new licence, or for renewal, have a certificate from the resident electrical engineer that the installation of electric light is in perfect order.

Exeter.—Street Lighting.—The Lighting Committee has appointed a Sub-Committee to consider the desirability as a war-time economy of discontinuing the lighting of the majority of the public lamps during May, June, July, and August.

Halifax.—Wages.—A Special Committee recommends the T.C. that the wages of all male employés (other than clerical staff), with the exception of men employed in the tramways department, be increased as from April 1st, 1917, to such an amount as will bring the wages, together with war bonus, to 8s. a week above the respective rates before the war; that the chairmen of the Gas, Highways and Health Committees, and the chairman or vice-chairman of the Tramways and Electricity Committee be appointed a Sub-Committee to consider the matter of overtime and Sunday payment, and that the Finance Committee be requested to endeavour to arrange a conference with representatives from the Corporations of Leeds, Bradford, Huddersfield and Halifax on the question of the wages of Corporation employés.

Ilford.—Loan Refusal.—The L.G.B. has again refused sanction to the borrowing of £10,000, for the purposes of the electricity undertaking. It suggests that the Council should consider the installation of converting plant at the Ley Street works. A Special Committee of the Council has instructed the electrical engineer, with the surveyor, to report and estimate on a temporary scheme for the utilisation of the steam at the refuse destructor, also as regards the suggestion made in the Board's letter.

London.—The Metropolitan Asylums Board is to purchase 12 electrical cooking mincers and mixers. It was reported at the meeting of the Board that these machines are made in the United States, and it is hoped that, in view of the saving in food and labour, facilities will be given for their importation. The cost before the war was about £70 per machine.

L.C.C.—The Finance Committee has agreed to loans of £1,000 to the Battersea B.C. and £13,000 to the St. Pancras B.C. for electricity purposes, subject to the Treasury approval.

Fulham.—The B.C. has increased the charges for electricity on the kw. system by the addition of ·0075d. per unit for each 6d. per ton that the average price of coal exceeds 13s. per ton during the period of charge.

The Committee has received an application from a local works for the supply of electricity, guaranteeing an annual payment of not less than £1,000 per annum.

St. Pancras.—Recently an application was made to the L.C.C. for sanction to borrow £5,000 for the purchase of a turbine, and its conversion. The L.C.C. questioned the necessity for the proposed expenditure at the present time. The Finance Committee of the B.C. is to communicate with the central authority, pointing out that the work has Government sanction. The staffs of the generating stations and mains department have applied for increased wages and a Special Committee is to be appointed to consider the matter.

Lambeth.—The General Purposes Committee of the B.C. has agreed to the proposed bulk supply arrangement between the South London Electric Supply Corporation and the County of London Co., whereby the latter will install and maintain for seven years the necessary converting plant, mains, &c., the former agreeing to take a minimum of 1,500,000 units for the year ending December 31st, 1918, and to pay a fixed charge of £1,500 per annum, and, in addition, a running charge of ·45d. per unit for the first million units and ·4d. for excess units, subject to certain provisos as to demand and to the price of coal. The agreement is subject to the approvals of the B. of T. and B.C.

Westminster.—The Works Committee of the City Council has adopted a proposal of the Westminster Electric Supply Corporation to substitute modern incandescent lamps for the existing arc lamps for public lighting in the Parish of St. George, Hanover Square. The adoption of the proposal will affect a saving of at least 2,000 tons of coal and 250,000 pairs of carbons per annum, and the services of 10 men. The cost of the alteration will be borne entirely by the company. When all the lamps (962) have been altered, the rebate to the Council will be at the rate of £2,650 per annum. The lamp proposed to be used is called the "Dula," and is stamped as "made in Holland." The company is to be asked to undertake that the material and appliances to be used shall not be of enemy make and origin.

On Monday the Standing Joint Committee of the London Borough Councils refused to agree with the total abolition of lighting during summer time, but agreed to make representation for a restricted, but uniform, system of lighting throughout London during May, June, and July.

Lowestoft.—Price Increase.—The Electricity Works Committee has recommended that the charges for electricity for lighting be increased by ½d. per unit, and for power and heating by 10 per cent.

Nelson.—A loss was incurred on the Council's electricity undertaking during the past year of £1,336.

Preston.—The T.C. has appointed a Committee to consider the question of the supply of electrical energy for power purposes in the town, and to receive the report of the borough electrical engineer, Mr. J. F. Simpson, on the subject.

Manchester.—Reduced Rate Relief.—The Corporation Electricity Committee has decided that, owing to the exceptional conditions, it will be able to make a grant of only £16,570 in relief of the rates, instead of £30,000, as a year ago. In addition, it will pay the whole of the income-tax charges, amounting to £36,000. This will represent an over-appropriation on the year's profit of £10,570, which will be withdrawn from the reserve fund.

Rawtenstall.—Year's Working.—The Electricity Committee reports a satisfactory year's working. The income is over £2,500 in excess of that of the previous year, whilst working costs and loan charges are £2,100 in excess. The surplus amounts to £2,207, and will be utilised in payment of capital expenditure for which no borrowing powers have been obtained. The Committee is committed to an expenditure of about £4,800 out of these surpluses, to be met within two years.

Rochdale.—Year's Working.—The troubles which the Corporation electricity works have passed through during the past year are reflected in the state of the finances, though the deficit is larger than most people expected. Although the total income of £62,035 showed an increase of £10,727, there is a deficit on the year's working of £13,430. Working expenses reached the high figure of £54,574, an increase of £24,190. On coal, coke and removal of ashes the expenditure was £32,594, or £13,894 more; repairs and maintenance, £9,450, showed an increase of £6,974; wages have increased by £1,243, and there is an advance of £250 on water and engine-room stores. These items, under the heading of generation, absorb £47,000, or nearly £22,700 more than a year ago. The gross trading profit is £7,461, but this is wiped out, and the large net deficit left, as interest and sinking fund charges amount to £20,464, against £17,686 last year, and there is £767 for half-wages to men on service, and war bonuses. The Committee has decided to take £7,395 from the reserve fund—the whole of the fund—and to carry forward the remaining £6,035 as a debit balance. A year ago there was a surplus of £2,537, and the previous year a loss of £330. The number of units generated last year was 16,500,000, an increase of 3½ millions, and the number sold 14,809,985, an increase of over 3 millions. The total capital account is £241,721—£14,047 having been spent during the year; loans repaid amount to £22,119, including £1,200; depreciation stands at £12,703, an advance of £2,417, and the sinking fund has been increased by £9,302 to £44,316.

Rotherham.—Year's Surplus.—There was a net profit of £5,324 on the working of the Corporation electricity undertaking for the past year, as against a profit of £7,585 for the previous year.

Salford.—Proposed Loan.—It is proposed to obtain sanction for the borrowing of £8,000 to cover the cost of supplying energy to the Manchester Ship Canal Co.

Southend-on-Sea.—Proposed Loan.—The T.C. has decided to apply to the L.G.B. for sanction to the borrowing of £45,520 for additional plant, &c., at the electricity works.

Stowmarket.—Price Increase.—The Suffolk Electricity Supply Co. has notified its consumers that, from May 1st, the price of current will be increased from 8d. to 10d. per unit.

Surbiton.—Price Increase.—Messrs. Callender have informed the U.D.C. that the price of current for lighting is to be increased to the maximum of 8d. per unit for a year. Sir John Snell has informed the Council that existing conditions justify the increase.

Todmorden.—Proposed Loan.—The T.C. has decided to apply to the L.G.B. for sanction to the borrowing of £10,000 for new generating plant for the electricity works.

West Ham.—Local Authorities and B. of T. Committee. The Electricity Committee has passed the following resolution, a copy of which is to be forwarded to the President of the Board of Trade and to the various local authorities owning electrical undertakings throughout the country:—"That we are of opinion, having regard to the important part at present played by local authorities in the supply of electrical energy, and the extensive character of their capital commitments in relation thereto, that local authorities owning electricity undertakings are inadequately represented on the Committee appointed by the President of the Board of Trade to consider and report on the future supply of electrical power for all classes of consumers in the United Kingdom, and strongly urge upon the President of the Board of Trade the necessity of increased representation being given to such authorities."

Whitehaven.—The T.C. has decided to take two premium-free pupils at the electricity station, the candidates to be selected and recommended by the Borough Education Committee.

TRAMWAY and RAILWAY NOTES.

Belfast.—At a special meeting of the Corporation, it was decided to shorten the tramway stages and increase the fares. Nothing was done at the meeting with regard to the new electrical station which is to be built at the Queen's Island.

Blackburn.—Year's Working.—The annual report of Corporation tramways shows a loss on the year's working of £2,439, compared with a profit in the preceding 12 months of £1,756. The number of passengers carried was 11,862,343, which was 383,808 fewer than in the year before. The cash takings were £63,318, which was £1,060 below the figure for the previous year. Two hundred and five men from this department have joined the Forces: 10 have been killed or died of wounds, and one has won the D.C.M. At present, 12 females are acting as drivers, two as ticket inspectors, and six in other branches of the department. "They have shown," states Mr. Cowell, the manager, "great keenness and aptitude for the work, and the utmost good feeling prevails between male and female employés. The male employés deserve credit for the whole-hearted manner in which they undertook to initiate the females into the duties."

Blackpool.—The Tramway Committee has adjourned an application for increased wages.

Bolton.—The Tramways Committee has declined to consider a request by the Tramway Workers' Association for an advance in wages of 10s. per week.

Bournemouth.—Year's Working.—The annual report of the Corporation Tramways for the year ended March 31st last shows that nearly 18 million passengers were carried, being half a million more than in any previous year, though the car-mileage was 1,634,000, a decrease of 36,000. The net profit was £16,307, of which £3,000 has been allotted to the rates. Mr. Bulfin, the general manager, states that during the past six years the total profits of the tramways have amounted to over £66,000, or an average of over £11,000 per annum. Some £20,000 of this amount has been spent on the reconstruction and doubling of the lines in the Holdenhurst, Charminster, and Wimborne Roads and Winton, and the renewals fund will now stand at some £24,000, the reserve fund at over £5,000, and the working balance at close on £6,000.

Continental.—Germany.—A tax on the traffic receipts of privately owned railways and electric tramways and railways has been introduced. In those cases, however, where the cost of construction has exceeded £100,000 per km. the Federal Council is authorised to exempt these particular undertakings from the impost. Among the exemptions is the Berlin Elevated and Underground Railway Co., the chairman of which recently stated that the expenditure on this railway has amounted approximately to £250,000 per km.

Spain.—The railway company, "Caminos de Hierro del Norte de Espana," has decided to convert from steam to electric traction its line from Madrid to Gijon and the Port of Pajares, a distance of 62 km., and is prepared, up to June 15th this year, to receive tenders for its construction and equipment. The company's head office is at Madrid.

Doncaster.—It is understood that the Corporation is to advance the tramway fares on the Bentley route, so as to bring them into line with the other routes of the town. The Bentley route is the cheapest to the traveller and the most expensive to maintain.

East Ham.—The lease of the section of the Barking Council's tramways, which expires on May 31st, 1917, is to be renewed for a period of three years.

Edinburgh.—The Admiralty will support the Corporation in any application for a Provisional Order or Bill for a tramway to South Queensferry, provided there is no actual construction carried out during the war.

L. & Y. Railway Electrification.—It is stated on good authority that the principle of the electrification of the Manchester and Oldham line of the Lancashire and Yorkshire Railway, as far as Oldham, has been fully accepted by the company, as the result of the excellent results experienced on the Manchester to Bury section. Only the difficulties of war time have prevented the taking in hand of the work of equipping the line for electric traction.

London.—The London Electric Railways Co. has applied for an extension of time in which to extend the Charing Cross-Golder's Green line through Hendon to Edgware.

L.C.C.—The chairman of the Finance Committee, Sir George Goldie, in submitting the annual estimates, stated the Council's tramways had done better than expected, as instead of an anticipated deficiency of £74,000, a surplus of about £7,000 would result. Since the outbreak of war employés' wages had increased by £154,000 per annum, and war service allowances amounted to £114,300 per annum, and it was evident that the fares fixed before the war were inadequate to meet the additional expense.

The current estimates showed a probable deficiency in net revenue account of £89,402, and a call would have to be made on the already depleted renewals fund, unless means were devised for overcoming the adverse balance. He was not aware of any desire to adjust fares in order to contribute to the relief of the rates, but, on the other hand, it was generally agreed that the undertaking should involve no burden on the ratepayers. In the discussion which followed, it was suggested that a Committee on Reconstruction should be formed, but it was pointed out that the present Standing Committees were all doing something now in that direction.

The Highways Committee of the L.C.C. has, during the three months ended March 31st, 1917, settled 894 claims against the Council in respect of accidents arising in connection with the tramways, amounting to £7,624. In 24 other cases, actions were brought against the Council; in seven of these, an adverse verdict was given, and £642 and costs had to be paid; 11 actions resulted in the Council's favour, and six were withdrawn; £526 was received by the Council in respect of damage to tramway property.

The B. of T. has further extended the time for 12 months (to August, 1918) for the construction of certain tramways authorised in 1909-10 and 1914.

Rawtenstall.—The tramway undertaking requires £3,000 from the rates for the coming year, which is £1,000 in excess of the amount required last year. The receipts from passengers are over £1,300 more than in the previous year, and out of the rate in aid (£2,000) £1,734 is utilised to clear the loss for the year.

Southport.—The Tramway Committee has refused an application for a 10s. per week increase in wages.

U.S.A.—Electric Vehicle Revenue.—According to a recent estimate, the revenue of the electric lighting undertakings in the United States from the charging of the batteries of electric motor vehicles amounts to at least £720,000 per annum.

TELEGRAPH and TELEPHONE NOTES.

Post Office Staff Bonus.—A further war bonus to Post Office employés is granted in the first award issued by the Conciliation and Arbitration Board for Government Employés recently constituted by the Government. Including the previous war bonus, the general effect of the award is that adult permanent postal employés will become entitled, as from January 1st last, to a temporary war bonus at the following rates:—

Rate of pay.	Per week	
	Men.	Women.
30s. a week or under	9s.	6s.
Between 30s. and 40s. a week	8s.	5s.
Between 40s. and 60s. a week	7s.	4s. 6d.
Between 60s. a week and £250 per annum ...	5s.	3s. 6d.

—*Daily Telegraph.*

The "Heterodyne" Receiver.—On April 2nd, Judge Mayer, of the United District Court for the Southern District of New York, handed down an opinion in the suit of the receivers of the National Electric Signalling Co. *v.* the Atlantic Communication Co., in which he found for the plaintiffs. This suit was based upon a charge of infringement of United States letters patent 1,050,728 and 1,050,441, being respectively for the method and apparatus employed in a receiving station of a radio-telegraph system. These patents, issued January 14th, 1913, cover the invention known to the art generally as the "heterodyne," or beats, method of receiving radio-telegraph signals.

For receiving signals from a transmitting station in which the radiations are continuous, it is necessary to utilise at the receiving station some means of rendering these signals audible. Continuous waves, such as are sent from Nauen, Germany, for instance, having a frequency of approximately 30,000 cycles per second, are above the range of audibility, and cannot be used directly to operate a telephone. The "heterodyne" method of rendering these signals audible consists of producing another set of oscillations, at the receiving station, of a frequency slightly different from that of the incoming signals, and combining these local oscillations with the incoming oscillations in such a way as to compound their effects and produce "beats." These beats give a signal within the range of audibility, and thus make intelligible the incoming signals. The local oscillations continue of uniform strength all the time, but beats, of course, are produced only during the time of existence of the incoming signals, and hence the periods of sound and silence employed in forming the dots and dashes are indicated by the pitch of the particular tone. This is generally chosen of a frequency approximating to 1,000, so that in the example cited, with Nauen transmitting at 33,000 cycles, the local oscillations being 32,000 or 34,000, the beat frequency would be 1,000 per second, and would give a resulting high-pitched, clear musical tone.

The Court found that Reginald A. Fessenden, the inventor of this system, had produced an invention of great merit, and that the prior art cited by the defendants as anticipating the Fessenden invention had failed to teach the art anything in respect of the use of beats.

The Court also stated that Fessenden or his company, the National Electric Signalling Co., were the only ones to teach the art anything of value of this method of operation between the date of application of his original patent in 1902 and the date of applications for the patents in suit, 1905.

The "heterodyne," or beats, method of receiving is the one that is now commonly used by practically all stations receiving signals from transmitting stations employing sustained waves.—*T. and T. Age.*

United States.—The new directory of the New York Telephone Co. contains 410,000 names. It has 948 pages, and 712,000 copies have been distributed. During the year 1916, 415 tons of silver and nickel coins were collected from the coin-box telephones in New York City.

The Government has availed itself of the offer of the Marconi Wireless Telegraph Co. of America, placing the staff and stations at its service, and has taken over for the period of the war, not only the Marconi stations, but all other radio stations, for military purposes. The eligible operators will be enrolled in the Government service. Stations not required will be closed. The trans-Pacific stations will continue handling commercial traffic, but under Government supervision. No ship traffic will be permitted on the Atlantic and Gulf coasts and the Great Lakes, excepting for the Government, but it will continue for the present on the Pacific. Trans-Atlantic traffic *viâ* Glace Bay will not be disturbed.

The War Department has taken over the control of all telegraph and telephone lines, and the Navy Department has taken control of the cables. Henceforth only messages passed by the American censor will be transmitted abroad.

Wireless Telegraph School.—At the Newcastle Rotary Club, last week, Mr. W. D. Owen, the recently appointed chief of the Municipal Wireless School at Rutherford College, Newcastle, gave an interesting paper on "Wireless Telegraphy." He stated that at present there was a great dearth of operators, and the demand greatly exceeded the supply. This trouble was intensified by the fact that the training of operators was left almost entirely to commercial schools. He confidently predicted that the Municipal Wireless School of Newcastle would eventually be recognised as the finest in the kingdom. The North of England Shipowners' Association had generously subscribed £2,000 towards the installation, and thus the school was able to provide the most complete equipment possessed by any wireless college in the world. The Marconi system, the Poulsen system, and the Telefunken system were to be fitted. Ships taken from the Germans would have German installations on board, and someone would have to operate them; that was why they were teaching the German system in addition to others. All men started as assistant operators, with the honorary rank of junior officer. The starting salary was £1 a week with all found, and this salary automatically increased year by year until it reached £2 15s. per week, plus keep. A man who had not qualified for a higher position by that time was being overpaid. Coast station appointments were open to suitable men, but were only offered to men who could carry responsibility in wireless; as in most other businesses, the trouble was not in finding higher positions for good men, but in finding good men for the higher positions.—*Newcastle Chronicle.*

CONTRACTS OPEN and CLOSED.

OPEN.

Farnborough (Hants).—May 7th. 10-B.H.P. semi-enclosed protected-type motor, with direct-driven 6-in. Stereophagus or removable disk type centrifugal pump, with pipes and accessories, for the U.D.C. Mr. J. E. Hargreaves, Surveyor.

Manchester.—May 11th. Electricity Committee. Stuart Street generating station. (*a*) One hydraulic accumulator and electrically driven ram pump, (*b*) coal conveying plant. Mr. F. E. Hughes, Secretary, Electricity Department.

Sheffield.—May 8th. Tramways and Motors Committee. Carbon-filament lamps for tramcar lighting, for 12 months. See "Official Notices" April 27th.

Spain.—The municipal authorities of Torrelaguna (Province of Madrid) have just invited tenders for the concession for the electric lighting of the town during a period of five years.

Warrington.—May 22nd. Electricity and Tramways Committee. Underfeed mechanical stoker. See "Official Notices" to-day.

Wolverhampton.—May 4th. Electricity Committee. 5,000-KW. turbo-alternator, water-tube boilers, economisers, and induced-draught plant, and mechanical stokers. See "Official Notices" April 27th.

CLOSED.

Blackpool.—Electricity Committee :—

Stoker.—Underfeed Stoker Co., Ltd.
Cast-iron pipes for cooling-tower extensions.—Stanton Ironworks Co.

Derby.—T.C. Accepted tenders :—

Edgar Allen & Co.—Tramway points, £337.
W. Rickard, Ltd.—Cable, £523.
Newton Bros., Ltd.—Motors, £525.

Glasgow.—Corporation. The E.C. recommends the acceptance of the tender of the British Westinghouse Co. for one turbo-alternator set, &c., for £91,564, and that of Messrs. Fraser and Chalmers for another set for £94,678.

Halifax.—Corporation. For the electricity works :—

Babcock & Wilcox, Ltd.—One water tube boiler, superheater, chain-grate stokers, &c., £5,140.
E. Green & Son.—Fuel economiser of 320 tubes, £882.
Musgrave & Co., Ltd.—Induced draught fan, £200.

Hull.—Corporation. Cooling towers :—

Davenport Engineering Co., Ltd. ..	(accepted)	£5,100
Premier Cooler and Engineering Co., Ltd.		5,240
Lancashire Water Cooler Co., Ltd. ..		5,373

London.—L.C.C.—The Highways Committee has received the following tenders for high and low-tension cables in connection with the additional supply of power for the Woolwich district :—

Western Elec. Co., Ltd.	(accepted)	£24,922
Siemens Bros. & Co., Ltd.		25,799
Brit. Ins. and Helsby Cables, Ltd.		26,493

The general manager's estimate was £25,000.

The undermentioned tenders were received for H.T. switchgear for Greenwich generating station and Woolwich sub-station :—

A. Reyrolle & Co., Ltd.	£2,000
B.T.H. Co., Ltd.	2,990

The Committee has accepted the lowest tender, subject to certain modifications in the machinery to be supplied, which has increased the amount of the tender to £2,597. The general manager's estimate was £2,500.

The Highways Committee has purchased about £34,000 tons of coal for use at Greenwich generating station, at a cost of about £57,000, during the quarter ended March 1st, 1917 :—

The following tenders were received for alteration to the switchboard gallery at the Greenwich generating station :—

W. Downs, Ltd.	(accepted)	£361
C. Wall, Ltd.		433

The following tenders have been accepted for the supply of tramway equipment, &c., 1916-17, Class T 6 B :—

Cotton-covered copper wire.—Midland Electric Wire Co., Ltd. (items 1, 2, and 3), approximately £1,257; London Electric Wire Co. and Smiths, Ltd. (items 4, 5, and 6), approximately £1,041.

Supply of tramways equipment, &c., 1917-18. Class T 1.—Electrical equipment (motor and generator) spares :—

British Westinghouse E. and M. Co., Ltd., items 1 to 7, 8 (50 per cent. of estimated quantity), 10 to 17, 24; A. Clare & Co., items 9 (b), 19 (b), 25 (b); Dick, Kerr & Co., Ltd., items 20 to 23, 26 to 30; Manchester Armature Repair Co., Ltd., 8 (50 per cent. of estimated quantity), 18, 31 (six months only).

Class T 2.—Electrical equipment, controller, circuit breaker, and other switch, &c., details and magnetic brake spares :—

British Westinghouse E. and M. Co., Ltd., items 1 to 17, 20 to 44; Dick, Kerr & Co., Ltd., items 18, 19.

Class 3.—Contact fingers and parts, segments :

British Westinghouse E. and M. Co., Ltd., items 1, 12, 21, 26, 32, 34, 37, 38, 40, 45, 47, 48; Dick, Kerr & Co., Ltd., items 42, 44; E. Showell, & Sons, Ltd., 2 to 8, 10 to 11, 13 to 20, 22 to 25, 27 to 31, 33, 35, 36, 39, 41, 49; Tramways Supplies, Ltd., 9, 43, 46 (six months only).

Class T 6.—Electric cable, fuse wire, and cotton-covered copper wire :—

Midland Electric Wire Co., Ltd.—Items 1, 6, 9, 10, 11 (six months only).
Liverpool Electric Cable Co., Ltd.—Items 2, 4 (six months only).
Callender's Cable and Construction Co., Ltd.—Item 3.
Hooper's Telegraph and India-Rubber Works, Ltd.—Item 4.
London Electric Wire Co. & Smiths, Ltd.—Items 5 to 10 (for six months only).
British Insulated and Helsby Cables.—7, 8, 11.

Class T 10.—Moulded insulators (other than rubber) :—

British Westinghouse Electric and Manufacturing Co., Ltd.—Item 2.
Litholite, Ltd.—Items 3 to 22.
Woodite Co.—Item 23.

Class T 12.—Mica and micanite :

Micanite and Insulators Co., Ltd.—Items 1, 2 (six months only).

Class T 13.—Insulators and porcelains for electrical track-work :—

Bullers, Ltd.—Item 1.
Gaskell & Grevett—Item 2 (six months only).
Doulton & Co.—Item 2, for 2,000.

Class T 26.—Brake shoes :—

Pease & Partners.—Items 1 to 3.

Steel tires for tramcars :—

1,500 driving wheel tires, £4,875; 750 pony wheel tires, £2,334.—Messrs. H. Bessemer & Co., Ltd.

Manchester.—Electricity Committee. Accepted tenders :

Driving chains and wheels for cooling towers.—Hans Renold, Ltd.
High-pressure steam valves.—J. Hopkinson & Co., Ltd.
Cables.—Pirelli General Cable Works, Ltd.; British Ins. and Helsby Cables, Ltd.
Turbo-alternator and condensing plant for Stuart Street station.—Richardsons, Westgarth & Co., Ltd. Sub-contractors: Alternator, British Westinghouse E. and M. Co., Ltd., motors and pumps, Mather & Platt, Ltd., oil coolers, Birmingham Condenser Co.
Steel forgings.—Sir W. G. Armstrong, Whitworth & Co., Ltd.
Cast-iron pipework for cooling towers.—Aiton & Co., Ltd.

Salford.—T.C. :—

British Westinghouse Co., Ltd.—300-KW. rotary converter and transformer, for sub-station to be erected by Manchester Ship Canal Co. at Irwell Park Wharf, Eccles, £1,465; traction metal-filament lamps, &c., £568.
New Conveyor Co., Ltd.—600 steel trays, for coal conveyor plant at the electricity station, Frederick Road, £253.

Walthamstow.—U.D.C. Custodis, Ltd., £1,143 ; chimney at the electricity works.

West Ham.—The T.C. received applications for specifications for a boiler from Messrs. John Thompson, Ltd. (specification returned, no tenders sent in) ; Stirling Boiler Co., Ltd., and Messrs. Babcock & Wilcox, Ltd. The last-mentioned firm offered a marine type boiler identical with last two installed in the new boiler house, a few modifications in detail only being introduced as the result of recent practice. The Electricity Committee has accepted the tender of Messrs. Babcock & Wilcox (the lower received), at £10,731.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, May 4th. At 7.30 p.m. At 39, Victoria Street, S.W. Paper on "Pneumatic Tubes," by Mr. H. E. Cosgreave.

Royal Institution of Great Britain.—Saturdays, May 5th and 12th. At 3 p.m. At Albemarle Street, Piccadilly, W. Lectures on "The Electrical Properties of Gases," by Prof. Sir J. J. Thomson, Pres.R.S.

Friday, May 11th. At 5.30 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Radioactive Haloes," by Prof. J. Joly, F.R.S.

Chief Technical Assistants' Association.—Saturday, May 5th. At 3 p.m. At the Tavistock Hotel, Covent Garden. Discussion on "The Distribution and Transmission of Electrical Energy."

Society of Engineers.—Monday, May 7th. At 5.30 p.m. At Burlington House, Piccadilly, W. Paper on "The Goods Clearing House System," by Lord Headley.

Royal Society of Arts.—Monday, May 7th. At 4.30 p.m. At John Street, Adelphi, W.C. Howard Lecture : "The National Shortage of Iron Ore Supplies : Oversea Iron Fields which Supply the British Market," by Prof. W. G. Fearnsides.

Wednesday, May 9th. At 4.30 p.m. Paper on "Works Organisation and Efficiency," by Prof. W. Ripper.

Institution of Civil Engineers of Ireland.—Monday, May 7th. At 8 p.m. At 35, Dawson Street, Dublin. Ordinary meeting.

Association of Supervising Electricians.—Tuesday, May 8th. At 7.15 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Motor Control Gear," by Mr. J. T. Mould.

Salford Technical and Engineering Association.—Saturday, May 12th. Visit to Messrs. H. Wallwork & Co.'s works, Manchester.

NOTES.

Foreign Trade.—The March Figures.—The official returns of imports and exports during last month contain the following electrical and machinery figures :—

Imports.	*March,* 1917.	*Inc. or dec.*	*Three months,* 1917. *Inc. or dec.*
Electrical goods, &c. ...	135,394	+ 19,985	+ 87,981
Machinery	668,790	− 16,717	− 103,875
Exports.			
Electrical goods ...	303,771	− 24,402	+ 39,051
Machinery	1,868,783	+ 444,643	+ 1,236,444

Volunteer Notes.—First London Engineer Volunteers.—Headquarters : Balderton Street, Oxford Street, W.

Orders for the Week, by Lieut.-Colonel Clay, V.D., Commanding :—

Monday, May 7th.—Technical for No. 3 Company, Right Half Company, at Regency Street. Drill No. 3 Company, Left Half Company. Signalling Class.

Tuesday, May 8th.—Lecture, 6.30. Physical drill and bayonet fighting, 7.30 to 8.30.

Wednesday, May 9th.—Drill, No. 1 Company, Half Company, 6.15.

Thursday, May 10th.—Drill No. 2 Company, Left Half Company. Ambulance Class by M.O., 6.30. Signalling Class.

Friday, May 11th.—Technical for No. 3 Company, Left Half Company, Regency Street. Drill No. 3 Company, Right Half Company. Recruits' Drill, 6.30—8.30.

Saturday, May 12th.—N.C.O.'s Class, 2.30. Examination by Adjutant and Assistant Adjutant.

Sunday, May 13th.—Special work at Bombing School. Parade, Clapham Common Station (City and S.L. Tube Railway), 9.45 a.m.

Armlets.—Armlets must be worn at all plain clothes' parades.

(By order), Macleod Yearsley, *Captain and Adjutant.*

Engineering Wages.—Speaking at the annual meeting of Fairbairn, Lawson, Combe, Barbour, Ltd., last week, Mr. J. Campbell Inglis (the chairman) gave details of the advances in wages for various kinds of engineering labour employed by the company. He said that their wage bill for the three branches for the year 1916 showed an increase of more than £31,000 over the 1914 figures, and that the total for 1917 would be over £80,000 in excess of the 1914 figures. The advances were all imposed upon them by the Committee on Production after hearing representatives of the Unions and of the Employers' Federation. The special difficulties of their trade had been put before the Committee most forcibly. Nevertheless, these advances had been given, and the question of the ability of the employer to afford them seemed to have been given quite a back place. It was the duty of employers to take all the steps possible to cheapen and facilitate the process of output. The board had this point of view constantly before them, and during the present trying time they had all had in mind the making of adequate preparations for coping economically and efficiently with the rush of work they anticipated when the war was over and their men came back. With regard to the cost of materials, it was one of the factors by which they were restricted in the making of profits. They had in their business to work by contracts made a considerable time in advance of the actual execution of the work. The result was that, in cases like the present, when there were rising rates of labour and materials, they were under a considerable handicap.

Electric Light Switching.—We have received from Messrs. A. P. Lundberg & Sons, 477-489, Liverpool Road, Holloway, London, N., 7, a copy of a new Advanced-Grade Exam. Paper which they will be pleased to send to all who desire to tackle this stage of the subject. A glance through the problems shows that they are all of quite a practical nature, and also that special tumbler switches have many other uses besides those connected with lamp circuits. Thus there is an application for ensuring the release of a motor-starting rheostat, one for starting and braking the motor of a small lathe, one or two relating to heaters, one for a magnetic chuck, and others of a similarly varied nature. The problems relating to lighting circuits are, nevertheless, by no means the least interesting. The firm's examiner, Mr. W. Perren Maycock, M.I.E.E., is to be congratulated on having put together such an illuminating set of problems ; those who have not tried their hand at this game will find it an absorbing pastime, as well as a useful study. We reproduce a couple of easy ones :—

7. A voltmeter may be so connected through two two-way-off switches to a low-pressure three-phase line, that it may be put across any two of the three mains, or be entirely isolated therefrom. (*a*) Make a diagram of the connections, and show that the arrangement is foolproof ; (*b*) show how two similar switches may be used for connecting one side of a voltmeter to either phase of a three-phase, four-wire system, the other side of the voltmeter being permanently connected to the neutral.

14. A $\frac{1}{8}$-h.p. shunt motor driving a small lathe is required to be frequently started and stopped, the stopping to be very quick, as is necessary for expedition in certain kinds of work. Sketch a tumbler-switch control that will give electric braking, it being assumed that the field-winding of the motor can be left permanently in circuit while the lathe is in use.

British Science Guild.—The annual meeting of the Guild was held at the Mansion House on Monday last, the Lord Mayor presiding. Sir W. Mather announced that it was proposed to raise a sum of £100,000 to found Ramsay Fellowships for chemists and a laboratory at University College, in memory of Sir William Ramsay.

Lord Sydenham, the new president, read an address on "National Reconstruction," in which he advocated the application of scientific method not only to our industries, but also to every phase of public life. He referred to the waste and misuse of our resources which had been made evident by the war, and pointed out that great economies of fuel could be effected, and the injury done to the national welfare by negligence in the past could be alleviated by the adoption of a wiser policy in the future. New industries must be created and old ones developed ; the resources of the Empire were almost inexhaustible, and we had only begun to make use of them. The lessons taught by the war should be laid to heart, so that when peace returned the ignorance and abuses of the past should be avoided and sound methods of government should take their place.

Mr. H. A. L. Fisher, Minister of Education, said that we must look to the co-operation of science, industry, and education for the economic and industrial reconstruction that would follow the war. The practical teaching of science in our schools was as efficient as in the schools of Germany and France, but it had not awakened the interest of the general mass of the population, and he hoped that the Committee which was investigating scientific teaching would be able to put forward improved methods.

With regard to industrial reorganisation, he held that we ought to think on a larger scale, and organise our businesses on scientific lines. Already the Imperial Trust for Scientific and Industrial Research was engaged upon many problems of urgent importance. There was no antagonism between general teaching in citizenship and technical training ; a form of scientific training conceived on broad lines might have the same influence on mind and character as used to be ascribed to the older discipline.

Mr. H. G. Wells said that education was the fundamental question ; science was neglected, and the Greek shibboleth barred the way to the study of science and history. Classical teaching stuck like a cancer in the time table, and must be cut out.

The Committee on Production.—The *Times* states that the completion of the agreement for general advances has enabled Sir George Askwith to retire from the Committee on Production, and to devote his whole attention to conciliation work. In order to expedite the hearing and settlement of cases, the Committee will in future be divided into two Panels. The Committee will meet at 5, Old Palace Yard, and the secretary will be Mr. H. J. Wilson, to whom all communications should be addressed.

The Irish Question.—We have recently had brought before us a case in which an electrical engineer in Ireland was "turned down" for an electrical contracting installation job because he was a Roman Catholic. This reminds us of other cases, which will also be within our readers' memory, of Irish Councils which have advertised for a borough electrical engineer whose primary qualifications were to be a knowledge of Irish history and membership of the Roman Catholic persuasion. Electrical qualifications, apparently, are of secondary importance for electrical work in some parts of Ireland. What deplorable bigotry ! As electrical engineers, it moves us to ridicule and to scorn, but as Englishmen eager to see the Irish Question settled once and for all, it fills us with despair.

Institution and Lecture Notes.—Institution of Civil Engineers.—On Wednesday, the 25th "James Forrest Lecture" was delivered by Sir John Wolfe Barry, chairman of the Engineering Standards Committee, the subject being "The Standardisation of Engineering Materials, and its Influence on the Prosperity of the Country." The author, after a feeling reference to the loss sustained by the Institution in the recent death of the founder of the series of discourses, outlined the history of the Committee and its work, since it was established at his suggestion in 1901; as showing the need for standardisation, he cited the case of tramway rails, of which there were at that period no fewer than 70 different sections in use, now replaced with advantage by five standard shapes. The original Committee, consisting of only seven members, has grown to the present far-reaching organisation with a main Committee of 22 members, 64 Sectional Committees and Sub-Committees, and numerous Panels, dealing with standards relating to, practically speaking, the whole of engineering practice. There are now well over 500 members of the various Committees, giving their time and experience to this work of ever-growing national importance. The number of Specifications issued to date is 77, and others are under consideration. The total expenditure of the Committee has been about £51,000, or about £3,400 per annum, towards which the Government has contributed £10,397, the Indian Government £1,800, and the engineering profession and industry—in addition to time and money devoted gratuitously by members of the Committee to the work—£20,000. From 85 to 95 per cent. of our output of steel sections, and 75 per cent. of tramway rails, are rolled to British Standard, and the proportion of bullhead railway rails rolled to standard is rapidly approaching 90 per cent. Most of the telegraph material employed by the British Post Office, the whole of the tramway poles, and at least 90 per cent. of the cables and wires for electric light, telegraph, and power purposes, are made to British Standard. Great economies in manufacture have resulted from the adoption of standard designs.

Lastly, Sir John referred to the steps which had recently been taken to assist manufacturers in competing successfully in foreign markets by the translation of the Specifications into French, Spanish, and Russian, with metrical equivalents for the British measurements and formulæ, the formation of Local Committees at 12 important trading centres, and the reduction of the price of the Committee's publications to about 1s. per copy, and stated that cordial support had been promised by the Government towards the fulfilment of these proposals. The trades concerned had subscribed close upon £13,000, the Government had made a grant of £10,000 towards the expenses of the new departure, and the work had been commenced.

Iron and Steel Institute.—The annual report of the Council for the year 1916 shows that the total membership on December 31st was 1,872; 86 members of alien nationality were struck off the roll, in accordance with a new by-law confirmed at the last annual meeting. The accounts show total receipts £4,767 and expenditure £4,208, leaving a surplus of £559. Five Technical Committees were appointed to deal with subjects of practical interest to the iron and steel industries. A new class of members, to be known as Associates, hss been formed. A system of co-operation with kindred Institutes has been inaugurated, and the question of securing joint accommodation has been taken up with the Institutions of Mining and Metallurgy and Mining Engineers and the Institute of Metals. Steps have been taken towards promoting the study of science in schools. A list is given in the report of members on active service.

Institution of Electrical Engineers.—The annual general meeting of the Yorkshire Local Section was held on April 25th, at Leeds. The accounts were received and approved, and the chairman announced that the only nomination for the chair was Mr. W. Lang, who therefore took the office; the vice-chairmen elected were Mr. R. H. Campion and Mr. E. C. Wallis; Mr. J. D. Bailie was unanimously re-elected hon. secretary. The filling-up of four vacancies on the Committee was balloted for, resulting in the election of Messrs. W. M. Rogerson, W. B. Woodhouse, J. Shepherd, and C. A. Hefford. At the conclusion of the business, Mr. C. Vernier read his paper on "Wayleaves," and a discussion took place thereon.

The ballot papers issued last week-end for the election of the Council contain the following names:—President, C. H. Wordingham; vice-presidents (two vacancies), G. W. Partridge, Dr. A. Russell, W. B. Woodhouse; hon. treasurer, J. E. Kingsbury; ordinary members of Council (six vacancies), Ll. B. Atkinson, W. A. Chamen, J. S. Highfield, T. Roles, Lieut.-Colonel A. E. Le Rossignol, C.B., Sir W. Slingo, Lieut.-Colonel H. C. Sparks, D.S.O., M.C., A. P. Trotter, B. Welbourn. Like that of Mr. G. W. Partridge, the nomination of Mr. T. Roles, electrical engineer to the Bradford City Council, emanated from without the I.E.E. Council.

The Council has issued a memorandum, pointing out that the articles of association do not contain any provision for proxy voting, and explaining the procedure. It is proposed to adopt this practice, and a special general meeting has been called for the purpose of passing the necessary resolutions, to take place on May 17th at the Institution of Civil Engineers, at 7 p.m., following the annual general meeting, which commences at 6 p.m.

Royal Institution.—The annual meeting was held on Tuesday last, when the report of the Committee of Visitors for the year 1916, testifying to the continued prosperity and efficient management of the Institution, was read and adopted. Twenty-three new members were elected in 1916. The following gentlemen were unanimously elected as principal officers for the ensuing year:—President, the Duke of Northumberland; treasurer, Sir James Crichton-Browne; secretary, Colonel Edmond H. Hills.

On May 15th a special course of evening lectures on "Some Industrial Applications of Electricity" will be commenced at the Municipal Technical Institute, West Ham. A notice respecting the ground to be covered by the course appears in our advertisement pages to-day.

Wiring with Tough Rubber Compound Cables.—The following letter arrived too late for inclusion in our "Correspondence" columns:—

"I have read with much interest the article by Mr. W. Ellerd-Styles, A.M.I.E.E., on the above subject which appeared in your issue of April 27th, as I also have used 'C.T.S.' in my business as a contractor, and appreciate many of its merits. Most of the fire insurance companies, however, appear to adopt the 'sitting-on-the-stile' attitude towards its use in private houses and similar situations, waiting for experience to be gained in time from results (from the fire insurance standpoint), and leaving all responsibility on the shoulders of the contractor who ventures to recommend the 'new system' to the customer.

"They generally recommend, when asked, 'screwed conduit,' and, rightly or wrongly, seem to fear trouble in the event of a fire of its being extended with C.T.S., owing to the latter's sheathing not being fireproof. I have personally found that customers are very loath to accept a C.T.S. installation, which does not seem to have the whole-hearted backing of the fire insurance companies, in spite of their general acceptance of the I.E.E. rules.

"Where C.T.S. is run down the walls, flush in plaster, to switches, &c., I suggest that the best plan is to enclose it in short lengths of light gauge steel conduit of ample size, which would act as a wire-way only, to enable the wires to be withdrawn or added to later (as, for instance, where an extra switch is required to control an existing electrolier), without disturbance to walls or decorations. Where C.T.S. wires are run below floor boards, I have found the best procedure is to thread them through holes, drilled in the joists, sufficiently low down to avoid risk from nails.

"If the use of C.T.S. is to become general for house and similar lighting installations after the war, it is essential, I agree, that the manufacturers very considerably reduce their prices; and further, the fibre-covered junction box, which they supply for use in dry situations, should, in my view, be replaced by one of a more substantial and better design, preferably fireproof, and with terminals that will not be liable to loosen through vibration or when used with alternating current.

"I suggest that a suitable four-way junction box, for fixing under floors or on the surface, of moderate cost, is material to the avoidance of waste of wire with the 'loop-in' system, and, to ensure a good mechanical job, the sheathing should be gripped in position when the cover is on, to prevent any strain on the wires where fixed under the terminal screws.

"The manufacturers do not seem to be keen on recommending C.T.S. (without special treatment) for use out of doors, where exposed to the sun's influence, and I have heard that under such conditions the sheathing has been found to crack open in a very short time.

"Some further information as to the use and limitations of C.T.S. in other situations, say, for power work in factories, underground work, and in connection with motor wiring, would be useful. I presume the I.E.E. rules permit of C.T.S. cables being 'grouped' with pressures up to 'medium.' (Home Office definition.)

"If Mr. Styles would further favour us with the benefit of his experience in connection with the above, and similar practical details, he would add much to our indebtedness.

"This lengthy reference to methods of switching and details of circuits, of course, applies equally to conduit systems, and does not appear to be peculiar to the adoption of C.T.S.

"Another Member of the E.C.A."

Navy Employment Agency.—This admirable institution devotes its attention to finding employment for men of the Royal Navy and Marines on their leaving the Service, only men of the highest integrity being enrolled on its books; amongst the numerous trades concerned are those of stoker, engineer, electrician, and mechanic. Application for men should be made to the Secretary, 25, Victoria Street, S.W. 1.

Manslaughter of Woman Tramcar Conductor: Sentence.—Alfred E. Ryman, engineer, Greenwich, charged with the manslaughter of Elizabeth Mitchell, tramcar conductor, by pushing her off the car, was at Lambeth last week sentenced to six months' hard labour, the case being dealt with as one of aggravated assault.—*Daily Mail.*

Medal for a Female Conductor.—A medal is to be presented to a woman tramcar conductor, of Blackheath, Staffordshire, who by promptly applying the brake on a runaway car averted a serious accident. She is the wife of a wounded soldier.—*Times.*

Puncture Voltage Indicator.—In testing cables, &c., to breakdown, the occurrence of a puncture naturally causes the voltage to drop, and destroys the reading of the maximum voltage. To avoid this drawback, Dr. Clayton H. Sharp, director of the Electrical Testing Laboratories, New York, has patented the use of a Fleming valve in series with an electrostatic voltmeter, connected in shunt to the testing voltage. As the capacity of the electrostatic voltmeter may of itself be insufficient, it is desirable to connect a condenser across its terminals. The instrument being then charged unidirectionally, will indicate the maximum voltage of the wave continuously, but when puncture occurs with the accompanying drop of pressure, the voltmeter reading will remain near the highest point attained, the rate at which it falls depending upon the rate of leakage of the charge and the capacity of the condenser.—*Electrical World.*

America at War.—Believing that electricity will play a very important part in the preparations for, and conduct of, the war, President H. A. Wagner, of the National Electric Light Association, has officially tendered the services of that Association to the Government.

Mr. Paul M. Lincoln, commercial engineer of the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., has been appointed a captain of the Engineers Corps in the United States Army. This announcement comes with that of the appointment of a number of prominent engineers in the country to positions in the Army, all made by President Wilson in his appreciation of the importance of securing the ability and training of the country for use in national defence measures. Mr. Lincoln has for 24 years been associated with the Westinghouse Co. He is a past president of the American Institute of Electrical Engineers.—*American Electrical Review.*

Decimal Coinage and the Metric System. — The following extract is significant of S. African opinion : Many times in these columns has been urged the need for the introduction of a decimal coinage and of the metric system of weights and measures. Perhaps that is the reason why the lately-formed Manchester and District Decimal Association—an influential body of manufacturers and other business men—has addressed us on the matter. . . . We reprint elsewhere the case as made out by the Association for a decimal coinage, and next week we hope to print the longer case for the adoption of a metric system of weights and measures. There is nothing we can add to the presentation of both cases, unless it is to say that nowhere is it more clearly recognised than in this country that if the British manufacturer is to hold his own after the war he must begin now to prepare by reforming his systems of currency and weights and measures. That is the reply of South Africa to the progressive people who are at the back of the Manchester and District Decimal Association. No more useful work could be done for the future of British overseas trade than the successful fruition of the task they have set themselves.—*South African Mining Journal.*

Lord Balfour's Committee on After-War Trade has been strengthened by the addition of Sir William Pearce, Sir Charles Henry, Sir Archibald Williamson, and Sir William Priestley. The Committee is now investigating the question of the possible substitution of the metric and decimal systems for our existing coinage, weights, and measures. It has already heard a great deal of evidence on the working of the metric and decimal systems in various countries, but hasnot yet come to a decision.—*The Times.*

Appointments Vacant. — Working foreman, for the Curragh Camp power station ; senior charge engineer, for the North Metropolitan Electric Power Supply Co. ; assistant electrical engineer (£360), for the Government Electrical Department, Federated Malay States ; switchboard attendants, teacher to train disabled soldiers (£4), for the West of England Joint Executive Committee, Bristol ; two switchboard attendants (37s. 6d.), for the borough of Burnley electric lighting department ; overhead lineman, for the Burnley borough tramway department ; power-house staff, for the Military Camps in the Western Command ; overhead lineman (45s.), for the Walthamstow U.D.C. Tramway Dept. ; charge engineer (£130), for the Llandilo U.D.C. See our advertisement pages to-day.

Inquiries.—A correspondent urgently requires flash-lamp bulbs, 2½ or 3½ volts, with flattened tops, V-shaped filaments, half opal glass, and miniature Edison screw caps ; makers of the Hopkins speed indicator are asked for ; also makers of "Mirror" electric lamps, and round tins of 3 to 12 lb. capacity.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Mr. G. W. Humphreys, chief engineer of the L.C.C., has accepted a commission in the Engineer and Railway Staff Corps, R.E. (T.F.).

The Highways Committee of the L.C.C. has granted extra duty pay to the following officers for special services rendered during 1914, 1915, and 1916 :—Mr. T. L. Horn (resident electrical superintendent) and Mr. J. Terry (district traffic superintendent), £25 each ; Mr. H. S. May (assistant rolling stock superintendent), £50 ; Mr. F. H. Wigner (second-class assistant), £20, Mr. H. R. Docker (second-class assistant), £35.

General.—Mr. W. Haydon has resigned his membership of the L.C.C. Highways Committee. The Committee recommends the appointment of Mr. W. C. Bersey in his place.

The Highways Committee of the L.C.C. has re-appointed the following special sub-committees in connection with the tramways department :—Tramways Organisation : Mr. G. M. Gillett, Mr. H. H. Gordon, Mr. F. C. Harrison, Mr. Jas. Little, and Mr. W. J. Squires. Tramways Operation : Mr. H. H. Gordon, Mr. F. C. Harrison, Mr. W. J. Squires, and Mr. H. Ward, together with the *ex officio* members in each case.

At Werneth, Oldham, on April 16th, the marriage took place of Lieutenant Bertram Hoyle, R.N.V.R., A.M.I.E.E., and Miss Florence E. Dowd, of Oldham.

Mr. Thomas Pratt, head of the firm of Chr. Pratt & Sons, Ltd., electrical furnishers, Bradford, who is vice-president and chairman of executive of the National Chamber of Trade, and Mrs. Pratt, have had the unique good fortune to have their eight sons—seven soldiers and the other in charge of an aircraft department—and their daughter, a trained nurse, all home together.

Mr. R. B. Pilcher, Secretary of the Institute of Chemistry, has been presented with a silver rose bowl on the completion of 25 years' service.

Dr. J. F. Crowley, who has for some time had charge of the textile department of Messrs. Siemens Bros. Dynamo Works, has been appointed to represent Ireland on the Board of Trade Committee on Electric Supply. He is a native of Co. Cork.

Roll of Honour.—Leonard Strugnell, who joined up in October, 1914, when he had just completed his apprenticeship with Messrs. Laing, Wharton, Ltd., has been awarded the Military Medal for bravery at the Front, and has been recommended for a Commission.

Second-Lieutenant Fred W. Corner, a former station engineer at the works of the Oxford Electric Co., Ltd., has fallen in action in France whilst with the Australian Light Infantry.

Private Hugh Devlin, who was formerly engaged at Siemens Bros.' Works, at Stafford, has died of wounds received in action.

Private W. Fishwick, North Staffs. Regiment, who was before the war with Messrs. Bullers, Ltd., electrical china manufacturers, of Hanley, has gained the Military Medal for gallantry.

Sec.-Lieut. V. A. Hunt, South African Infantry, killed on April 9th, aged 25, was a member of the South African Civil Service, Department of Posts and Telegraphs.

Major Howard C. Symmes, South African Infantry, who was killed on April 9th, aged 43, was, according to the *Times*, Inspector of Machinery and Electricity for the Orange River Colony Government, Mines Department, and J.P., B.A. McGill University, Fellow of the South African Institute of Engineers, and Assoc. Inst. of Mech. and Elect. Engineers (Eng.). He fought through the German South-West African campaign, on the conclusion of which he came to England with the South African Infantry.

Sergeant-Major A. W. Tinsley, an employé at Manchester Corporation electricity department, has been awarded the Medaille Militaire.

Private H. Hampson, killed in action, was employed at the Liverpool Corporation electric power station, Lister Drive.

Rifleman W. Wilkinson, Rifle Brigade, killed in action, was employed at the British Westinghouse Works, Trafford Park.

Private John W. Sugden, killed in action, was employed at Messrs. Ferranti's Works, Hollinwood.

Private W. Whitehead, Lancashire Fusiliers, reported killed in action, was employed at the Lancashire Electric Power Co.'s station at Radcliffe, Lancs.

Bombardier J. Woodford, R.G.A., who was injured whilst engaged in moving guns, and is in hospital at the base in France, was employed at the L. & Y. electric trains depôt, Southport.

Gunner Ewart Doodson (19), who has been killed whilst making an adjustment connected with a "Tank," was an employé at the Yorkshire Electric Power Co.'s station at Thornhill.

Corporal W. E. Bass, R.F.A., who was severely wounded on Good Friday, and died the following day, was with Mr. E. Arthur Pinto, A.M.I.E.E., of Hythe and Ramsgate, and enlisted early in the war. He was twice promoted for gallantry in the field, and won both the Military Medal and Bar, and had been previously wounded.

Miss Ivy Thorncroft, who was killed in last week's bombardment of Ramsgate, was employed at Mr. Pinto's Margate branch.

Obituary.—Mr. Rankin Kennedy.—The death of Mr. Rankin Kennedy, which we briefly announced in our last issue, occurred somewhat unexpectedly in his sleep from heart failure, after he had been in failing health for some time, though not confined to bed. He was 63 years of age. He served his apprenticeship in the engineering works of Messrs. Andrew Barclay & Sons, Ltd., Kilmarnock. He gained a Queen's Scholarship, and studied science and physics at South Kensington Science School, London. In 1880 he designed and constructed the first practical dynamo-electric machine in Scotland, which was installed in Clarke's Thread Mills, Paisley. In the following year he became chief engineer to the Railway & Electric Appliances Co., and in that capacity invented certain dynamos and motors. He also published the discovery of self-regulating electrical transformers, but, on the advice of Lord Kelvin, he did not patent it, Lord Kelvin holding that it was not subject matter for a patent. It is believed that had he done so it would have become a valuable master patent. In these early days, Mr. Kennedy carried out many pioneer electric light and power installations in sawmills, ships, mines, factories, and engineering works. In 1888, to the order of Lord Kelvin, he designed the dynamo for the electrical laboratory at Glasgow University. He installed the first electric light in the old Glasgow Corporation Picture Galleries. The wiring was run on the three-wire system, and Mr. Kennedy claimed that this was the first use of that system, and that it anticipated Hopkinson's and Zipernowsky's patents. He paid two visits to the States—once expressly for the purpose of inspecting the Westinghouse works, and on the other occasion he went as Electrical Review special commissioner to the Chicago Exhibition. He contributed many articles to the technical Press, especially the Electrical Review, and raised many interesting discussions. He also wrote many books, including "Electrical Installations" (five volumes), "Modern Engines and Power Generators" (six volumes), and others on electrical distribution, marine propellers, aeroplane construction, &c. In conjunction with his consulting work, and assisted by one of his sons, he devoted himself assiduously to experimental and research work extending over a wide field, including electric meters, petrol motors, exhaust ejector-condenser silencers, ignition magnetos, and air-cooled petrol motors. For the past ten years he had not undertaken consulting work, but devoted all his time to experimental work on marine hydraulic jet propellers and flying machines. He believed that ultimately the present design of aeroplane would be abandoned for the "helicopter" type. He carried out many experiments on this type of machine. He had been engaged recently perfecting an automatic electric indicating log for ships, also a compass for aeroplanes, and a compass for submarines. On the last of these he was engaged at the time of his death. Mr. Kennedy leaves two sons, to whom we desire to express our deepest sympathy in their loss.

Mr. V. M. Dunsford.—The *Daily Mail* records the death, on May 1st, of Mr. V. M. Dunsford, Deputy Controller of the Central Telegraph Office, London. Mr. Dunsford began life as a telegraphist in 1881.

Wills.—Mr. Ernest Ruffer, chairman of the Spanish Telephone Co., Ltd., left £256,853 net.

The late Mr. James Forrest left £13,574 net personalty. According to the *Times* he left to the Institution of Civil Engineers a number of testimonials presented to him by past presidents and others, and he asked the Council of the Institution to have the articles exhibited every year on the occasion of the James Forrest Lecture. He also left £500 to the Institution, to be added to the "James Forrest Lecture Trust Fund."

NEW COMPANIES REGISTERED.

Modern Electric Welding Co., Ltd. (9,840).—Private company. Registered in Edinburgh, April 19th. Capital, £5,000 in £1 shares. To carry on the business of welders of iron, steel, and other metals, &c. The subscribers (each with one share) are: Wm. Slack, 119, Albert Road, Langside, Glasgow, engineer; John Maxwell, 113, St. Vincent Street, Glasgow, solicitor. The first directors are: W. Slack, W. Stewart, H. Slack, and J. Maxwell. Solicitor: J. Maxwell, 113, St. Vincent Street, Glasgow.

Russian Industries, Ltd. (147,167).—Private company. Registered April 17th. Capital, £30,000 in 28,500 ord. shares of £1 each and 30,000 management shares of 1s. each. To carry on the business of engineers, contractors, concessionaires, financial agents, merchants, shippers, explorers, miners, financiers, &c., in relation to Russia and the British Empire. The subscribers (each with one share) are: H. W. Thornton, general manager, Great Eastern Railway; A. D. Rutherford, 40, Queen Victoria Street, E.C., retired bank manager; L. Oury, 3, Thames House, Queen Street Place, E.C., director and manager, Mozambique Co. The first directors are not named. Solicitors: W. R. Russell, 3, Lombard Street, E.C.

R. Armstrong & Co. Ltd. (147,182).—Private company. Registered April 18th. Capital, £5,000 in £1 shares. To carry on the business of merchants, importers, exporters, contractors, brokers, and suppliers of materials in connection with the manufacture of cable and wire, electrical, telegraph, telephone, engineering, rubber, and rubber goods, &c. The subscribers (each with one share) are: H. C. Rose, 123-5, Cannon Street, E.C. 4, merchant; H. D. Douglas, St. Moritz, Ogmont Road, Sutton, Surrey, electrician. The first directors are: H. C. Rose (chairman) and H. D. Douglas. Registered office: 3, Cloak Lane, E.C.

Railway Phonopores, Ltd. (147,251).—Private company. Registered April 24th. Capital £5,000 in £1 shares. To carry on the business of electrical and mechanical engineers and merchants, manufacturers of phonopore and other induction coils, &c. The subscribers (each with one share) are: C. Isaac, Brockley House, Slough, Bucks., engineer; Irene M. Randall, 82, Huxley Road, Leyton, E., typist. The first directors are F. W. Smith and C. Isaac. Solicitors: Frank Simmonds & Carters, Broad Street House, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Underground Electric Railways Co. of London, Ltd.—Trust deed dated April 3rd, 1917, to secure £700,000 5 per cent. three-year secured notes, charged on £681,000 London Electric Railway 4 per cent. debenture stock, £412,000 4 per cent. perpetual debenture stock of the City and South London Railway Co., and £120,000 London Electric Railway 4 per cent. pref. stock. Trustees for note holders: Union of London & Smiths Bank.

W. A. & R. J. Jacobs, Ltd.—Issue on April 4th, 1917, of £700 debentures, part of a series of which particulars have already been filed

CITY NOTES.

Brush Electrical Engineering Co., Ltd.

The report for 1916 states that large contracts are in hand, the current order list being well above the average. The profit and loss account shows that after providing for general charges, maintenance of plant and buildings, and interest on the company's debenture stocks and loans, there remains a balance of £21,635, and, with the amount of £9,321 carried forward from the previous year, a total available balance of £30,956. The directors recommend that £8,000 be applied for depreciation of property, patents, and goodwill, that £2,044 be applied in payment of the further 4 per cent. interest to which the holders of the company's 6 per cent. prior lien participating second debenture stock are entitled out of the first net profits available for dividend in any year, that £7,055 be placed to general reserve, and that the balance of £13,857 be carried forward. The reserve account had been increased during the year by £2,979, the profit on purchases of the company's debenture stocks for sinking fund purposes, and by £608, the profit on the sale of land at Cricklewood. The further sum of £7,055, which the directors now recommend be appropriated to this account, will raise the reserve fund to £20,000.—*Financial Times.*

British Westinghouse Electric and Manufacturing Co., Ltd.

Mr. J. Annan Bryce, M.P., presided, on April 26th, at Hamilton House, over the annual meeting. He first dealt with the items in the balance sheet, and said that on the debit side the first item of capital remained unchanged. The item "sundry creditors and credit balances" stood at £621,113, showing an increase of £212,046 over 1915, owing partly to increase in the volume of business and partly to the rise in the prices of materials. The item "reserve for employers' liability" had been increased this year by £10,000, an amount double that appropriated last year. It was considered advisable to make the larger appropriation in view, not only of the larger number of persons employed, but of the present character of the labour. The number of workpeople employed in the factory was at the outbreak of war 5,223, of whom 4,720 were men, and only 513, or about 10 per cent., women. At the end of 1915 the number was 6,679, at the end of 1916, 7,284, and at present the number was 8,037, of whom 5,505 were men, and 2,532, or about 31½ per cent., were women. There had thus, since war began, been an increase of 785 men and 2,019 women, making a total increase of 2,804. The old skilled labour had almost entirely disappeared, and the present *personnel*, the result of continual dilution by less skilled, or entirely unskilled, elements, was necessarily less experienced. As a consequence, accidents had unfortunately increased, though every possible safeguard that could be devised was provided against them, and the number of accidents was nearly a third greater in 1916 than in the preceding year. His remarks on the character of the labour were made in relation to the advisability of increasing the reserve for employers' liability, and in no way involved any complaint of the new labour itself in the abstract. Though it was at the outset entirely unskilled and inexperienced, it was anxious to learn, and did its best. It was gradually becoming experienced and acquiring skill. The women had been most willing even to tackle work requiring physical strength apparently in excess of their powers, and they were becoming proficient in many kinds of difficult work. In addition to the factory hands, there was an office staff of about 2,000, of whom 600 were women. The total number of employés was, therefore, about 10,000, of whom about one-third were women. Special depreciation had been increased by £9,000 to cover additional wear and tear due to the present conditions of operating the machinery, such as the character of the labour, necessity for night shifts, &c. The item "stock and material on hand" showed an increase of £158,537, due partly to the growth of the business, partly to the higher cost of material, and partly to the fact that, from the difficulty of obtaining some particular material at the proper time, work on orders had to be suspended and their completion postponed, often for a long period. The item "completed work on contracts" showed the considerable increase of £60,000, owing largely to delivery being delayed by lack of transport by rail or ship. This difficulty was becoming accentuated every day. By the end of March in the current year, there had been since January 1st a further accumulation of completed goods awaiting dispatch of something like 600 tons, representing roughly £100,000 in value. This difficulty was likely to increase, and was entailing a serious lock up of funds. The French company had done well, but the Italian company had made some loss, due to the rise in wages and materials since the contracts were taken. These factors affected both countries, but while the French Government recognised and made allowance for them, the Italian Government did not. In France recent legislation had imposed taxation on excess profits, but all the principles upon which it would be applied had not yet been settled in practice, and the extent to which the company would be affected was therefore still uncertain. The Norwegian company had made a small profit. There was reason to believe that after the war there would be a good field for these companies, and preparations were being made by reorganisation and reconstruction of buildings, in so far as was possible under war conditions, for taking advantage of an increased demand which, at any rate in France, where destruction had been so great, was likely to be large. The gross profit for the year was £311,198, an increase of £17,210. The net profit was £199,346, an increase of £22,595. The relative increase in the net profit as compared with that in the gross profit, viz., £5,385, was mainly due to the smaller amount written off for ordinary depreciation. The tonnage output in 1916 was 22¼ per cent. greater, and the value, owing to higher costs, 40 per cent. greater than in 1915, but the aggregate gross profit was in 1916 only 5.8 per cent., and the aggregate net profit only 13 per cent. greater than in 1915. There had thus been a great fall in the rate of profit. There had been great advances in wages and materials which could not be foreseen when the orders were estimated for, and their effect had been accentuated by the unavoidable delays in the completion of orders, prolonging, as these delays did, the period during which the adverse causes were in operation. A further cause of the diminution of rate of profit had been the continual dilution of labour. It would, however, have been possible to increase the dividend if it had not been necessary to carry over a much larger sum than in 1915. With the still uncertain effects of the Munitions Act and Excess Profits taxation it was absolutely necessary to provide a large sum, and the amount of the carry over, £89,735, was none too great, though he hoped it would prove adequate. During the year under review their orders had been more than maintained, as, excluding the large railway contract mentioned last year as taken in 1915, the normal business of 1916 showed a considerable increase both in volume and value, while in the current year there was also a considerable increase in orders as compared with the corresponding period of 1916. There had been a satisfactory addition to their trade with the Continent, particularly in France and Russia, while the business with Australasia and South America had considerably improved. On the whole, their exports, in view of the difficulties of transport, must be considered satisfactory. He had referred to the constantly increasing lock-up of funds, and though at the end of the year the financial position was quite easy, it might be that before long, under present conditions of high wages, dear materials, delays in completion of orders with consequent longer and larger locks up of capital, and a growing business necessitating fresh manufacturing facilities, they might have to contemplate an addition to their capital. So far they had been able to meet the position out of revenue, but it would probably not be possible to defer much longer a request for permission to raise fresh capital. He was not alone in thinking that the policy of the Treasury in increasing the direct taxation of industry had gone far enough, and in one respect a great deal too far. He described fully last year the highly inequitable effect upon them of the Excess Profits Tax, and since then the injustice had been enhanced by the policy of the Treasury in the last Finance Act, in virtue of which it not only exacted an additional 10 per cent.—that was 60 per cent. in all—of the profits, but reserved to itself the right to claim either this 60 per cent, or the 80 per cent., calculated on a different system, exactable from controlled establishments under the Munitions of War Act, whichever might give a better result to itself. It was not, however, so much the injustice on which he had to insist. What he was quarrelling with at the moment was the policy of killing the goose which laid the golden egg, the policy which prevented an industrial concern from providing for expansion out of savings. How was industry going to provide after demobilisation for the employment of the vast additional mass of labour which would be thrown on the market by the return of the troops, and the cessation of munition requirements? Remember, that to meet the colossal taxation to be borne by the present and rising generations, there must be an immense increase in production. Where was the money to finance it to come from? There was much talk of trade banks and of industrial banks. They were excellent things, but even if they were to be provided in unimaginable numbers, who was to provide their funds? Not the income-tax payer, whom the late Secretary of the Treasury menaced with 10s., or the super-tax payer, who already paid 10s., and was threatened with an increase. Not the excess profit taxpayer, who already, in many trades, was being sucked dry so far as the chance of providing for expansion was concerned, and who also was being threatened with a rise to 80 per cent. He could not believe that the present Chancellor of the Exchequer, who was himself a business man, would fail to recognise the disastrous effects of the excessive taxation of industry. So far, other belligerent countries had shown more consideration for industry than this country. Some of them had followed their example in imposing taxes on excess profits, but none of them were anything like so severe as Great Britain. In some cases they were graduated up to a maximum of 50 per cent., while in others, as, for instance, in France, there was the wise provision—and this was the point he wished to emphasise—that profits devoted to expansion were allowed to escape altogether. Germany, their principal trade, as well as war, enemy, had not, so far as he knew, imposed any excess profits tax, and had not even increased the income-tax. As a result, the great German concerns in the electrical trade had accumulated vast sums in cash—it was true it might prove to be only paper cash—for the inevitable fight after the war. He had lately seen the balance sheets of three of these companies for the year 1915, the Allgemeine, the Siemens-Schuckert, and the Bergmann. The first had by that time accumulated a cash reserve of 7½ millions, the second 2½ millions, and the third 1½ millions—sterling, not marks—funds which were expressly mentioned as available for operations after the war ended. It seemed to be assumed by some well-meaning people that when peace was declared there would be an end of economic war also, and they deprecated any measures tending to perpetuate it. They wished them to receive back Germany into the comity of nations—to kiss and be friends, as after a lovers' quarrel. It was forgotten that this war was as much a war for commercial and industrial as for military domination, and that there were no more enthusiastic advocates of it than the heads of the great German industries and financial establishments. It was forgotten that the military war was only the complement of the economic war, which, started half a century ago with the two hundred million indemnity robbed from France, had been waged ever since with the purpose, as they now knew, of dominating the trade of the world. He had before him lately a striking instance. A great German firm had maintained a factory in England entailing for the last ten years an annual loss of some £100,000, with the express object of keeping prices in this country low and so preventing that particular industry from being able to compete abroad. The economic war Germany would renew more savagely and more unscrupulously than ever, if she could, and it must be their aim, if they were not to go under, to use every means to defeat her. As it was, they were urged by the Government to capture her trade, but bereft by it of the wherewithal. The first essential was money. Where was it to come from? Government had been taking the savings of industry, and the manufacturers of this country would have no means to undertake the immense business which the world would offer after the war, while the vast mass of labour set free in this country would be short of employment. There must be a catastrophe unless Government, which had taken the manufacturers' money, stepped in behind him with its credit. Take their own case—they had daily evidence of immense business open to them in every country where they traded, in France, Italy, Russia, Spain, and the Dominions, business demanding great extension of their works and the employment of masses of labour, but which they would be unable to undertake without large additions of capital. Meanwhile others were stepping into the breach. America, with her vast resources, had started a powerful organisation which was already securing business in every quarter. Happily they knew that she had no ulterior objects, and if they could not live alongside friendly competition which was the life of business, they did not deserve to survive. But they could not fight even friendly rivalry without money, and this brought him back to the point with which he started, that not only for their immediate necessities, but for post-war opportunities, if they were to avail themselves of them, they must obtain fresh capital, if they could get it. The Chairman next referred to the excellent progress being made with the company's educational scheme under the able guidance of Mr. Fleming, and also dealt with the number of men who had joined the Forces. Up to the end of February 2,469 had joined, of whom 168 had been killed. In conclusion, he said that while they were faced now and in the future by many and serious problems, they looked hopefully to the future, confident of the loyal support which they had had in the past from their staff and workpeople. Such labour difficulties as they had had it had been found possible to settle by tactful handling, and he was happy to say that in this respect their works manager, Mr. Mensforth, had ably continued the policy of Mr. Lang, now their managing director, who formerly occupied Mr. Mensforth's post. The future of British industry depended upon the loyal co-operation of employer and employed. The interests of the shareholder and of the workman were the same. The one could not be happy without the other. The directors would strive to maintain this identity of interest, and as they had surmounted many difficulties in the past, they looked hopefully to the future.

Mr. Skeel pointed out that the board was doing the same thing as the Government. The company was making money, but it was putting it carefully out of the shareholders' reach. He hoped next year the board would do better for the preference shareholders.

Mr. Birks thought the shareholders were eminently satisfied with the figures. At the same time the question of the return on the preference shares had an important bearing on the raising of new capital.

The Chairman said he entirely sympathised with the remarks made, but so long as they did not know what they had to pay the Government they must have a large carry-over. They could probably easily pay an additional 2½ per cent. on the preferred shares if only they knew what sum they had to pay the Government.

Willans and Robinson, Ltd.

Mr. J. C. Peache, presiding at the annual meeting held on April 24th, at Rugby, said that it was proposed to pay a dividend of 10 per cent. on the small ordinary capital and, after carrying £10,463 to reserve, to pay a bonus of 2s. 6d. per £100 "B" stock and 1s. per share on the ordinary shares. With £10,463 now added to the reserve fund that fund would stand at £34,812, subject to the payment due to the Government under the Controlled Firms Act. In addition to this there was the special reserve of £7,467 against the "A" and "B" preference dividend accounts. The energies of the company were still directed to special operations, and considerable extensions of plant and to the number of employés had been made. The necessarily increased expenditure had been partly provided for out of revenue and partly by a further advance from the company's bankers. The value of orders on the books was sufficient to ensure full pressure of work for the rest of the year. Included in the orders were some for such items as turbines and Diesel engines, which, being items that formed the chief part of the company's pre-war business, provided a valuable connecting link for the resumption of normal business after the war. It was satisfactory to note that the profit for the year, after allowing for excess profits, was sufficient to maintain the same rate of dividend on the share capital as in the previous year. About 300 of their employés were now serving with the Forces, and 21 had laid down their lives. To these must be added the name of the late Mr. Leslie Robertson, a director, who gave his life for the country at the sinking of H.M.S. *Hampshire*.

Indo-European Telegraph Co., Ltd. Mr. J. H. Tritton, presiding at the annual meeting, on April 24th, said that owing to general postal delays and staff shortage they were at present unable to submit the report and accounts for the past year. Having regard, however, to the figures that were available, they saw no reason why the final dividend should not be paid on the usual date. The accounts would be circulated at the earliest possible date. They were pleased to be able to pay the final dividend and distribution for the year without encroaching upon reserves, and without diminution of the total amount, and they believed that there would remain sufficient to allow of the provision again out of earnings of an adequate sum of money on account of depreciation. Their holding in British Government securities was large—58 per cent. of the company's capital. The new arrangement with the Eastern Co., which would secure to the Indo-European Co. a sufficient sum after payment of all expenses to provide a dividend of 7 per cent. on the share capital, did not come into force until August, 1916, and the company benefited very considerably by revenue derived from the first seven months of the year. At the last meeting he stated that the directors had decided to enter into a combination of interests with Creed & Co., Ltd. for the development of the wireless patents owned by the Indo and Galletti Companies. That arrangement had fallen through. It became apparent that the interests of Creed & Co., Ltd., were not compatible with this company's interests, and the agreements that had actually been entered into had, by mutual consent, been cancelled. This did not in any way affect the future development of their wireless assets, and he hoped to give fuller information on the extension of the wireless side of the business next year. They had fulfilled important contracts for wireless material. The company's telegraph through service remained interrupted owing to the conflict raging in Europe, but they continued to handle considerable local traffic, which was of great importance just now. They had done their utmost to assist the Russian Government, and believed that their assistance had been of considerable value to them. With the victorious conclusion of the war, and the restoration of their through communication, they would be able to offer to the Government and to the public as efficient a service as in the past. Thirty-seven of the company's English staff were serving with our Armies. Four had laid down their lives. A large proportion of the company's Russian staff were with the Russian Armies.

Johnson and Phillips, Ltd. Mr. R. W. Blackwell presided at the annual meeting on April 25th. After going through the accounts, he said that the board had considered it advisable, having in view the conditions prevailing at the present time, to carry £10,000 to general reserve, and to place a further £10,000 to special reserve account. They had also thought it best to reduce the book value of their patents by £2,575, inasmuch as they had not been able to fully utilise their patents under existing circumstances, and could not clearly see when normal conditions of trade would be restored. It was the opinion of the board that it would be unwise to make any larger distribution than that recommended (5 per cent., free of tax). In their reserves, and in the carry-forward, it was indispensable that they held a considerable cash reserve. The figures certainly demonstrated that the concern was in a thoroughly sound position. The gross profit for the year under discussion was £13,000 less than that of the preceding year, although the amount at their disposition was only some £3,000 less. The decrease was not a matter which need trouble the shareholders. It was anticipated by the board, and justified the considerable carry-forward provided for at the last meeting. The fact was that their manufacturing and contracting business in times of peace had now been practically wholly shelved, and much of their more elaborate manufacturing plant was necessarily idle. For work of national importance they did not realise any great percentage of profit. Looking at the business in general, he could only confirm what he said at the last meeting. They had not been advantaged by the war; they had merely held their own. They had had great difficulties to meet, and had met them with fair success. It had been no small matter to adapt their plant to meet the special calls that had been made upon them. They had had to lay down much new plant and, to a great extent, they had run it to death. They had lost many of their experienced hands, and had had to bring in substitutes and to considerably employ female labour. Their costs had been greatly increased thereby, for, as they would readily appreciate, the wear and tear upon machinery, and the waste in manufacturing processes when teaching new hands, had been most substantial items of expense. Material had been difficult to obtain, and, in consequence, they had had to buy well ahead and carry much larger stocks than could possibly be required in normal times. To sum up, under existing conditions they had no reason to complain. To the best of their ability they had accepted their share of the national responsibility, and he did not doubt but that the shareholders would be quite content to accept a not excessive return from the year's working of their property.

In reply to a shareholder, the Chairman said he was not a prophet, and therefore could not say exactly how they would stand when the war was over. However, he had not the slightest doubt that the position of the company would be certainly no worse than it was at the present moment, and he had every reason to suppose that it would resume the rate of improvement which it had shown during the few years prior to the war. The reserves that had been made, both last year and the year before, had been made with a view of meeting any possible contingencies that might arise out of the war.

Chiswick Electricity Supply Corpn.—The report for 1916 states that the profits earned, after writing off £933, and paying sinking fund premium and trustees' fees, were £7,647. Interest on first mortgage debenture stock amounting to £3,600 has been paid, leaving a balance of £4,047. The directors recommend a dividend on the shares of the corporation of 5 per cent., less tax, and that the balance of £907 be carried to depreciation reserve fund account. The increase in the cost of production continues, consequent on the advance in the price of coal, of fuel oil, of other materials, and of labour. The directors have endeavoured to meet these adverse conditions by making an advance in the price charged for current.

North of Scotland Electric Light & Power Co., Ltd.—Considering the conditions, the results for 1916 are satisfactory. At Montrose the connections decreased from 1,163 KW. to 1,091 KW., owing to the closing of the Manure Co.'s works. At Brechin they increased from 776 KW. to 815 KW. At Inverness they increased from 1,452 KW. to 1,597 KW. Total connections for the three towns, 3,503 KW. Gross profit £7,550, as against £7,038 for 1915. After meeting interest on debentures and loans amounting to £2,781, writing £138 off suspense account, and adding £2,046 brought forward, the net profit is £6,677. A dividend of 3 per cent. is to be paid, placing £2,000 to renewal reserve account and £1,000 to general reserve account, carrying forward £2,177.

Woking Electric Supply Co., Ltd.—At the annual meeting recently, Mr. Ashby said that owing to the extra cost of fuel, the outlay for generation increased by £4,168; it would have been heavier but for the action of Mr. H. W. Bowden, a director. Rates and taxes—extraordinary to relate—had decreased. A shareholder asked the board to consider the new Labour situation that would arise after the war. It would be a serious matter, and workmen would not be satisfied with what they were having to-day. After paying 5 per cent. dividend the workmen should have a certain percentage; there should be a sort of co-partnership in a limited way.

Indian Electric Supply & Traction Co., Ltd.—The accounts for 1916 show that the surplus on working at Cawnpore was £20,220, against £15,932 in 1915. The net revenue credit is £20,314. London expenditure was £2,410, debenture interest £3,900. Including £800 brought forward, the balance is £14,803. There has been placed to general reserve £3,000, to depreciation and renewals reserve £3,000, written off debenture issue expenses £1,000; a dividend of 7½ per cent. for the year is recommended, leaving £1,757 to carry forward.

Kaministiqnia Power Co.—The directors have declared a quarterly dividend of 1¾ per cent., or at the rate of 7 per cent. per annum, for the quarter to April 30th.

Eastern Extension, &c., Telegraph Co., Ltd.—The directors announce that in consequence of delays arising from the war in obtaining the necessary returns from foreign stations and administrations, it will be impossible to present the accounts and balance sheet duly audited in respect of the year to December 31st, 1916, during May, when it has been usual to hold the annual general meeting. Having, however, satisfied themselves that the net earnings of the year will be sufficient for the purpose, the directors have decided to make an additional payment to the shareholders, free of income tax, of 7s. per share (equal to a dividend of 1½ per cent., and a bonus of 2 per cent.), making the distribution for the year 1916 8 per cent., free of income tax.

Eastern Telegraph Co., Ltd.—The directors announce that, in consequence of delays arising from the war in obtaining the necessary returns from foreign stations and administrations, it will be impossible to present the accounts and balance sheet duly audited in respect of the year to December 31st, 1916, during May, when it has been usual to hold the annual general meeting. The directors, however, having satisfied themselves that the net earnings of the year will be sufficient for the purpose, have decided to make an additional payment on the ordinary stock equal to a dividend of 1½ per cent. and a bonus of 2 per cent., making the distribution for the year 1916 8 per cent., free of income-tax, the same rate as was paid for the previous year. The usual distribution at the rate of 3½ per cent. per annum, less income-tax, on the preference stock for the first quarter of 1917 will also be paid.

Oriental Telephone & Electric Co., Ltd.—Owing to the delay in arrival of the mails from the East, it was impossible to complete and issue the annual report and accounts for 1916 by the end of April, as usual. These are now in course of completion, and the annual general meeting of the shareholders will be held about the middle of May.

Ramsgate & District Electric Supply Co., Ltd.—Including £1,146 brought forward, the gross profit for 1916 is £3,878. After allowing for interest at 5 per cent. per annum on outstanding accounts due to contractors, the balance is £2,660. A dividend of 4 per cent. is recommended, placing £1,000 to reserve, leaving £860 to be carried forward.

Calcutta Electric Supply Corporation, Ltd.—The number of units sold during the four weeks ended February 23rd, 1917, amounted to 1,763,149, compared with 1,362,833 units in 1916.

West India & Panama Telegraph Co., Ltd.—Dividends for the last half of 1916: 6s. per share on the first and second preference shares, and 6d. per share on the ordinary (free of tax).

STOCKS AND SHARES.

TUESDAY EVENING.

WRITING on the eve of the introduction of the Budget, it is difficult to steer clear of comment which the Chancellor's speech may render nugatory, if not ridiculous, before the end of the week. The Stock Exchange is closed to-day (May Day), and members are looking forward to a Budget that will introduce heavy taxation in various directions.

Prices are comparatively little affected. Buyers are certainly holding aloof, pending the speech on Wednesday night; and a slight weakening in the War Loan, Consols, and similar stocks is an omen of what the House looks for. It is a platitude to point out that increased taxation spells a lowering of investment prices and a corresponding improvement amongst speculative issues, although the present occasion may prove an exception, so far as the former are concerned, inasmuch as there is so much money available for investment that the floating supply of stock is inadequate to meet it, and we see no reason why this state of affairs should change after the introduction of the Budget.

One of the London electric lighting companies has recently made a new issue of capital in the shape of short-dated debenture bonds; and there is an aggrieved feeling in certain circles that the bonds should have been offered in a provincial city instead of the issue coming to London. It may be inferred from this that the terms are tempting, and probably would have attracted all the money that the company requires had the issue been made in London.

Of course, it was necessary to obtain the sanction of the Treasury to fresh money being raised; and we understand that the ground-floor price was 90 for 4½ per cent. bonds, redeemable in 14 years, drawings to commence very shortly at par. The complaint is that, being a London company, the natural course would have been for the issue to be offered in London in the first place.

The Home Railway market is dull and inert, and the reasons advanced are the proximity of the Budget, together with the increased destruction notified last week by submarines, and the persistent official warnings with regard to the food problems. The last two reasons have a direct bearing, of course, upon domestic stocks and shares; and the Underground division is dull with the rest. Districts drooped to 16, but Underground Income bonds keep reasonably steady at 81, the firmness being helped by the recent announcement with regard to the possibility of substituting coke fuel for petrol. The National Steam Car Co. has just made a new issue of shares, partly with the object of providing for this new departure, the development of which will be watched with great interest.

Electric Lighting shares are uniformly good. For the ordinary there are buyers in nearly every case; and holders decline to sell, notwithstanding the advances which have been made in quotations. The market is still a limited one, so that at one time it is difficult to sell, while at another time it is no easier to buy. But for the present, at all events, there is a strong demand, with very few shares to meet it. Charing Cross, Metropolitans, City ordinary and preference, and County preference show rises ranging from 1s. 3d. to 5s.

Mexicans are the star market in the Stock Exchange. The telegram in the *Times* on Monday, quoting the *New York Times*, to the effect that it would not be more than a few days before Mexico threw in its lot with the Allies, had a remarkable effect upon prices. Rises of 2-5 points were common in the bonds of the utility and railway companies. Mexican Electric Light Fives rose 3 to 31. Pachuca Fives at 26 were 2 points up. Monterey first mortgage debenture at 17½ gained 5. Mexico Tramways first bonds are 7 points up on the week

Not much stock has been tempted out by these violent advances; and there is a disposition to await events before believing entirely that Mexico has joined the Allies against the Central Powers of Europe. However, it is now possible to realise bonds which have been practically unsaleable for months past. Brazil Tractions, too, have recovered 3½ points after their drop of 6 last week; the preferred at 84½ are also better. Anglo-Argentine Tramways 5 per cent. debenture continues to improve, and other foreigners are generally firm.

The telegraph market has no such long string of rises to its credit as was the case last week, but the previous improvements are being well held; and Indo-Europeans are 25s. better, allowing for the dividend deduction. The reports of the various companies are almost uniformly good, and the payment of dividends free of tax by several of the leading companies again brings their stocks into prominence by reason of the new Budget.

The manufacturing group is quiet. Brush issues are unchanged on the issue of the report, which is regarded as good; the ordinary stock is quoted about 25, and the three debentures at 80, 60, and 52, in the order of their precedence. Rubber shares gave way sharply on consideration of Budget possibilities, which brought in profit-takers. The armament group is hard, but business in most markets has been held in check by the uncertainties surrounding the coming speech of the Chancellor of the Exchequer, the details of which will have been digested before these notes are.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price April 30, 1917.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	9	6½	—	£6 18 6
Charing Cross Ordinary ..	5	5	8½	+ 1/16	7 2 10
do. do. do. 4½ Pref..	4½	4½	8¼	—	6 18 6
Chelsea	4	3	2⅞	—	5 4 4
City of London	8	8	11⅝	+ ⅛	6 17 8
do. do. 6 per cent. Pref.	6	6	10	+ ¼	6 0 0
County of London	7	7	10¼	—	6 16 6
do. 6 per cent. Pref.	6	6	10	+ ¼	6 0 0
Kensington Ordinary	7	10	5¼	—	5 11 7
London Electric	8	8	1	—	Nil
do. do. 6 per cent. Pref.	6	4	8¾	—	5 6 8
Metropolitan	8	8	2½	+ 1/16	6 0 0
do. 4½ per cent. Pref.	4½	4½	8⅝	—	7 4 0
St. James' and Pall Mall ..	8	8	6½	—	6 8 0
South London	5	5	2¾	—	7 5 6
South Metropolitan Pref. ..	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	5⅝	—	6 5 9
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	95	—	6 6 2
do. Def.	33/6	1½	22½	+ ½	6 13 4
Chile Telephone	8	8	7	—	5 14 4
Cuba Sub. Ord.	5	5	8½	—	5 17 8
Eastern Extension	8	8	14	—	*5 14 4
Eastern Tel. Ord.	8	8	141½	—	*5 13 1
Globe Tel. and T. Ord.	7	7	12¼	—	*5 14 8
do. Pref. ..	6	6	10	—	6 0 0
Great Northern Tel.	22	22	88	—	5 15 9
Indo-European	13	13	50½ xd	−1½	6 8 9
Marconi	10	10	2⅞	—	8 9 7
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord. ..	10	10	2⅛	—	4 14 1
United R. Plate Tel.	8	8	6⅝	—	*6 0 9
West India and Pan.	6d.	6d.	1	—	2 10 0
Western Telegraph	8	8	14	—	*5 14 4
HOME RAILS.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	24	—	4 3 4
do. District	Nil	Nil	16	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A" ..	Nil	Nil	5/-	—	Nil
do. do. Income	6	6	81	— ½	*6 8 8
FOREIGN TRAMS, &c.	Dividend 1914.	Dividend 1915.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	3⅛	—	8 16 0
do. 2nd Pref. ..	5½	5½	2⅝	—	—
do. 5 Deb. ..	5	5	68½	+ 2	7 6 0
Brazil Tractions	4	4	45	+ 3½	Nil
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	61	—	8 4 0
do. do. Preferred	—	Nil	46	—	Nil
do. do. Deferred	—	Nil	89½	—	Nil
do. do. Deb.	4½	4½	64	+ ½	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	33½	+ 7	Nil
do. 6 per cent. Bonds	—	Nil	27	+ 2	Nil
Mexican Light Common ..	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	17½	—	Nil
do. 1st Bonds ..	Nil	Nil	33½	+ 3½	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	14	15	2⅞	—	5 4 4
British Aluminium Ord. ..	5	7	27/8	—	7 6 10
British Insulated Ord.	15	17½	12¾	—	6 17 3
British Westinghouse Pref. ..	7½	7½	2 5/16 xd	—	6 9 10
Callenders	15	20	13¼	—	7 11 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	8 5/16	—	6 13 0
Edison & Swan, £3 paid ..	Nil	—	5/16	—	Nil
do. do. fully paid ..	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	69½	—	5 15 2
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9¾	—	6 3 1
do. Ord.	10	10	14½	—	6 18 0
Henley	20	25	15½	—	*8 1 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11⅞	—	*8 8 4
Telegraph Con	20	20	87	—	*6 9 10

* Dividends paid free of income-tax.

PROMOTION IN ELECTRICITY SUPPLY UNDERTAKINGS.

[COMMUNICATED.]

This subject is one of great interest to every employé—manager or apprentice—in an electricity supply department. As viewed from the manager's chair, the question of filling-up vacancies on the staff usually requires much time and thought, and hasty decisions are possible only in cases where it is obvious that a particular employé is the one man specially fitted to fill the vacant post. But this condition is the exception rather than the rule, as it is generally found that the claims of several members of the staff have to be taken into consideration before a final decision is arrived at. What, then, are the qualifications which weigh most in the selection of candidates for vacancies on the staff? Naturally these will differ in detail depending on the nature of the post, but definite rules can almost be laid down which are applicable to all appointments.

In the first place, the appointment should be made on equitable grounds after fair and reasonable consideration. The interests of the undertaking should be paramount, and all questions of kinship, favouritism, prejudice, and influence should be brushed aside. Social connections should have no weight, so far as is humanly possible. Assuming the candidates are honest and trustworthy—and no one is eligible for promotion who is not—the question becomes one of respective capabilities.

General Manager or Chief Engineer.—Much discussion has taken place at Institution and Engineering Society meetings as to the relative importance of commercial and engineering knowledge in the conduct of an electricity undertaking. It is generally agreed that the head of a large electricity supply business should be a commercial man first and an engineer afterwards, and in many cities and towns engineers have had their letter-paper designation altered from "chief electrical engineer" or "borough electrical engineer" to "general manager" or "manager and engineer."

Electricity Committees also are becoming alive to the fact that the smart commercial man with a good knowledge of electricity supply is of more use to an electricity department than the electrical engineer who has a first-class training in turbine or alternator design and construction. In these days when power stations and distribution systems are laid out on stereotyped plans, the operation of an electricity supply department is a matter of routine. But the getting of business and the general policy of the department are problems which require more than mere engineering training. Many undertakings are suffering to-day from the want of initiative and business acumen displayed by their chief engineers, while some of the largest supply systems have been built up by commercial men and by engineers who have developed their business instincts.

The successful head of an electricity undertaking should, therefore, be a good business man, possessing those qualities which usually mark the business man—namely, organisation, common sense, initiative, tact, personality, and a working knowledge of the product he deals in. He must have the knack of being able to choose the men who will be of most use to him. It might be said of the successful manager of an electricity supply department that he could manage a soap factory just as successfully. He will leave his assistants to carry out their allotted duties, and see that they do so. His principal concern will be in regard to the consumers who take the supply. The organisation should be such that, even if the head of the department should be absent from business for a month, the work of the department would be carried on as if he were there. This, however, in no wise implies that his presence is not necessary for the efficient conduct of the business, but rather testifies to the care with which he has organised the undertaking. Although he may not be in actual attendance at his post, his personality is still kept in view by the assistants, who carry on in the usual way.

Chief Assistant.—Regarding the choice of a chief assistant or assistant manager, if the appointment is left to the manager, he will select the man whose qualifications befit him to take entire charge during the absence of the manager. The chief assistant must be absolutely reliable, and in matters of policy, his first consideration should be to follow the course which his superior would have adopted had he been present. The first assistant may be a good engineer, and be able to go into details with the station superintendent or mains engineer, but his greatest asset should be his capability of answering inquiries in the absence of the manager, and his power of exercising control over the other members of the staff. Common sense and tact will go further than mere knowledge of engineering details. The chief assistant must, of course, have the practical and technical training to enable him to be of service to the manager in drawing up schemes for the extension or improvement of the undertaking.

Station Engineer.—The station engineer should be a trained mechanical and electrical engineer, with good practical and theoretical knowledge of boiler, turbine, and electrical operation. If he should have, in addition, some commercial training, he is the man who automatically steps up into the vacant position of chief assistant. While paying particular attention to the boiler house, where enormous sums of money may be wasted, he should at the same time exercise a general supervision over all his staff.

He should encourage his staff to talk over matters in connection with the efficient running of the station, and give consideration to any suggestions which may be advanced with the object of improving the conditions of operation or the reliability of the plant. He is not paid his salary for working with his hands, and it is his fault if there is no one under him who can be entrusted with any particular work. His duties are purely of a supervisory character, and his chief concerns should be the smooth, economical, and reliable operation of all the plant under his charge. Great attention should be given to the question of stand-by plant in cases of failure, and every precaution should be taken beforehand to avoid breakdowns. Many troublesome breakdown repairs have been avoided by systematic inspection and proper maintenance of plant and auxiliaries. A good station engineer will endeavour to so arrange the duties and responsibilities of his staff that he will find some difficulty in knowing how to fill up his own time, and it must be apparent to him that the manager, on visiting the works, would rather see him walking around with a placid air of contentment than discover him running round the works with a worried look in his face. To the manager, the first signifies efficient control, while the latter condition means trouble and anxiety. Breakdowns are, however, often quite unavoidable, but the station engineer should anticipate them as far as possible by insisting on a sufficient reserve of plant being installed to cope with possible untoward events. The less anxiety he gives his superiors the more is he efficiently fulfilling the functions of his position.

Boiler-House Superintendent.—The station engineer's most important assistant is the boiler-house superintendent, whose duties are to see that the boilers and boiler-house auxiliaries are in good working order. The maximum efficiency should be obtained from each pound of coal, and the boiler-house superintendent must, besides being a good engineer, have a knowledge of chemistry. Careful attention should be paid to the calorific values of fuel, grate feeds, and conditions of draught for each boiler unit. The boiler-house superintendent should have an assistant whose sole duties are the testing of coal, the reading and recording of draught gauges, CO_2 recorders, steam or feed meters, Lea recorders, temperatures of feed water, flue gases, superheat, and the tabulation and comparison of results from day to day. It should always be borne in mind that too much attention to these details is impossible, and a capable boiler-house engineer's wages—and those of his assistants—can be saved many times over by a strict and systematic check on all sources of waste heat in the boiler house.

Electrical Superintendent.—The electrical superintendent should have charge of all the electrical equipment of the power station and sub-stations, besides having an interest in the working of the steam plant in the engine room. He should relieve the station engineer of the responsibility of keeping the electrical machinery, switchgear, &c., maintained in thorough order. All electrically-driven auxiliaries should be inspected daily by his men, and attention called to weak points in any of the various motors driving air, extraction, feed or circulating pumps, stokers, economisers scrapers, or coal and ash conveyors. High-tension switchgear, control gear, relays, rotary converters, transformers, &c., should also be inspected daily by competent men who have the confidence of the electrical superintendent. Like his immediate superior in office—the station engineer—and his confrère (the boiler house superintendent), the electrical superintendent should remember that his particular sphere is the careful supervision of his men to ensure that they perform their allotted duties with precision. As a large amount of their work is of a routine nature, it is essential that its importance should be impressed upon them.

Charge Engineers, Junior Engineers, &c.—The efficient working of the plant—especially during night shifts—is left to the mercies of the charge engineers and their juniors. These members of the staff should, therefore, be selected very carefully. The charge engineer's lot is not usually a happy one, and the remuneration for his services should be on a fairly liberal scale. A good charge engineer is worth his weight in gold, and sufficient notice should be given to his value to the undertaking. From the ranks of charge engineers, capable boiler-house and electrical superintendents are recruited. It should be the object of every engineer-in-charge to qualify himself for promotion to one of these higher-paid posts.

Mains Engineer.—The mains engineer's chances of promotion rest entirely with himself. In many undertakings, the mains engineer is also the chief assistant engineer, and his claims for the supreme position, when vacant, very often have the first consideration. In his dealings with consumers, he has the opportunity of acquiring that business intellect necessary for the successful manager of an electrical undertaking. But he must first of all be a successful mains engineer, and his duties as such are most exacting. He should be conversant with the best methods of laying mains in widely-varying situations. His assistants should keep a record of maximum and minimum currents on the feeders and distributors of the system, and be in close touch with the work of the electrical superintendent in the station. He must be fully alive to the possibilities of development in any section of the distribution system, with the view of being well in advance of increased requirements by any consumer or section of consumers. Additional demands on the feeders and distributors should be anticipated by the mains engineer, and the management should at once be acquainted with particulars of probable extensions to electrical plant in consumers' premises, so that steps may be taken to fulfil the obligations of the undertaking by the provision of extra cables to cope with the additional demands. A record of costs of laying main cables should be kept, so that the work of estimating for cable requirements can be undertaken with simplicity and ease. The mains engineer's assistants should be men whose training and experience have been on lines which render them fitted to take the post of mains engineer when the position becomes vacant.

Consumers' Engineer.—From the commercial point of view the consumers' engineer holds the most consequential position on the staff of the undertaking. He is in immediate touch with the requirements of the undertaking's clients. His duties are to advise consumers regarding the most efficient and economical methods of utilising the electrical energy supplied from the undertaking. He must be fully conversant with the economics of electricity supply, and the best means of driving machinery, lighting workshops, heating and cooking. He must be familiar with every application of electricity for power, lighting, heating, and cooking, and be able to explain lucidly the reasons for charging different rates per unit for different classes of supply.

Knowledge of the electricity supply business is, of course, of the first importance, and an electrical engineering training is also essential; but the duties of the position require sound common sense, tact, and commercial experience, and on these grounds alone the consumers' engineer is the person whose qualifications befit him for the more onerous position of managing the whole electrical undertaking. As consumers' engineer, his staff should consist of a meter superintendent, an installation inspector, a foreman electrician, a public lighting foreman, and a showroom assistant. Subservient to these would be meter testers, meter repairers, meter readers, installation testers, wiremen, motor inspectors, canvassers, and salesmen.

Secretary, Chief Clerk, or Accountant.—The status of the chief clerk of an electricity department has greatly improved with the growth in size and importance of supply undertakings. This position, in the larger town and cities, now carries with it the title of secretary or accountant, and in some cases, where the individual possesses a technical knowledge of electrical engineering, a new position, under the name of commercial assistant, is created.

The duties of the chief clerk are very onerous indeed. The responsibility of the energy accounts rests with him, and all purchases, stores, &c., should come under his jurisdiction. Organisation should be his watchward, and great care must be taken in the appointment of his assistants. He has many opportunities of advancing his position which are denied to the other heads of departments, owing to the frequent consultations which he has with the general manager or chief engineer. His views often carry much weight in matters affecting the policy of the department, and it is possible to conceive that, in the light of present tendencies, the post of secretary to an electricity undertaking may be a stepping stone to the position of manager of the undertaking, just as it may be in other commercial enterprises.

General.—In the promotion of employés in any grade, certain maxims may be laid down which are applicable to almost every case. First consideration is invariably given to the person possessing, besides a fair knowledge of the business required, a large share of sound common sense. Other factors in the question are initiative—not necessarily originality—orderliness, and reliability. A man, however, may be most reliable and painstaking, and yet have very narrowed ideas, which lead him into spending a great deal of time in unnecessary detail. Originality and a mania for special systems often become a nuisance rather than a help. Some originality is necessary, and systems should only be adopted when they tend to simplification of routine work. A great point is the cultivation of a personality, so that your work and instructions carry some weight. Responsibility should be sought, not avoided. Special commendation is always given to the man who can relieve his immediate superior of a part of the latter's responsibility, especially in matters of detail. It is a good plan, therefore, for a superintendent to allow his principal assistant to become familiar with the whole work of the department, not only with the object of sharing his responsibility, but, mainly, to be in a position of recommending his assistant as his successor in office in the event of the superintendent's promotion to a higher post. Many a good superintendent spoils his chances of promotion by keeping information to himself in a selfish desire to improve his indispensability. The folly of his shortsightedness only becomes apparent when his claims to promotion are overlooked for lack of a suitable man to succeed him.

It is a fact that a good workman generally proves a bad master, unless he has cultivated a talent for arranging work and supervising its procedure. The superintendent who works himself cannot, at the same time, exercise a proper supervision over his men.

Promotion by seniority, or on account of long service, should, of course, be adopted where other considerations are equal. But prior claim should always be given to the candidate who has the faculty of being able to use his brains to the best advantage, and who can cope with difficulties which arise. In positions of commercial responsibility and in the supervision of engineering work—whether constructional or maintenance—a tactful manner, a quick understanding, and a good memory, are of great importance.

Spain.—A new company has lately been formed in Barcelona, with a capital of £4,000, and the title La Sociedad de Cobre Electrolitico, to start works for the electrolytic production of weldless copper tubes.

THE DETERIORATION OF CURTIS RATEAU TURBINE BLADING.

A comprehensive paper on the above subject was recently read before the SOUTH AFRICAN INSTITUTION OF ENGINEERS by **Mr. A. FENWICK**, who is the turbine specialist to the Rand Power Companies The paper contains a great amount of valuable information which it is not possible to reproduce *in extenso* in our pages, but the following is a summary :—

The author classifies the various turbines* as follows :—(1) 3,000 KW., 1908-10; (2) 9,600 KW., 1911-12; (3) 4,000 H.P. (compressor turbines), 1911-13; (4) 12,000 KW., 1914-15; (5) 10,000 H.P. (compressor turbines), 1914; (6) 300 H.P. (auxiliary), 1911-13; (7) 550 H.P. (pump), 1912-14. The majority of these operate with a stop valve steam temperature of 320-350 deg. C.

Table I shows the metals in use on the various turbines; some are only in the experimental stage.

TABLE I.—SHOWING VARIOUS METALS IN USE FOR BLADING.

Material.	Class of turbine.	Wheel or guide blades.
4 % nickel steel	2 and 3	Guide
Siemens-Martin steel	2, 3, 4 and 5	..
5 % nickel steel	2, 3, 4 and 5	..
3 % nickel steel	3	..
Medium carbon steel	2, 4 and 5	..
30 % to 32 % nickel steel	1, 2, 3, 4 and 5	..
25 % nickel steel	3	Wheel and Curtis segment
5 % nickel steel	All classes	Wheel and Curtis stationary segment
Aluminium bronze	1, 2, 3, 4, 5 & 6	Wheel and Curtis stationary segment
Brass	All classes	Wheel and Curtis stationary segment
Nickel brass	3	Wheel
Monel metal	3	Wheel and Curtis stationary segment

The author includes further tabulated data showing analyses of the steel and non-ferrous alloys in use..

An examination shows a variation of some thousands of running hours in the life of blades of similar material and position in the turbine, and life here represents the running period up to the time reblading was carried out; in some cases the blades could safely have been run for a longer period, and in others blades have run much longer than was dictated by safety.

3,000-kw. Turbines, Class 1.—Dealing first with the Curtis stage, and the first three low pressure stages, two materials have been tried, viz., aluminium bronze and 5 per cent. nickel steel, and the superiority of the latter is apparent. Sets 5 and 6, Simmer Pan, were fitted with steel blades, and have been running for six years. In neither case has failure occurred, the running hours up to December 31st, 1916, being 39,119 and 39,298 respectively.

The aluminium bronze blades are quite unsuitable for this part of the turbine. The aluminium content disappears from the surface of the metal, leaving a very brittle layer of copper; where the section of metal is thin, as at the inlet and discharge edge of the blades, it breaks away like glass with light tapping. With continued use, the outer layer cracks and flakes off, exposing the part underneath, which in turn flakes off until the blade is split up into several layers. Where the section of the blade is fairly heavy, as in the Curtis stage, the shape is gradually lost, but the body of the blade remains sound and seldom fails. What usually happens is, the portion which is riveted over to secure the shrouding chips off, allowing the latter to come adrift.

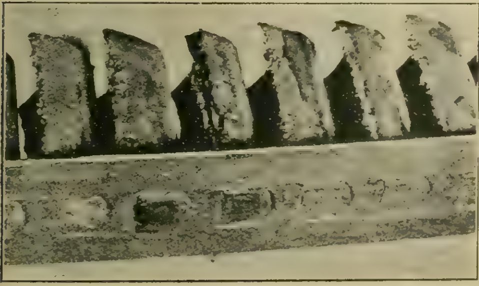


FIG. 1.

Fig. 1 is a good example of this deterioration, and is from the first row of Curtis moving blades, after being in commission for about 24,000 hours.

Fig. 2 is from the second row of Curtis blades on the same machine; the deterioration is similar, but not so far advanced, the running hours are the same.

The running time before reblading averages for the first four stages on sets 1-4, Simmer Pan, 26,700 hours. The Curtis blades have a shorter life in the later stages, due no doubt to higher temperature in the Curtis casing.

After leaving stage 4 deterioration is in the form of erosion or pitting on the back or convex portion of the blade; the inlet and discharge edges become thin and holed, and easily broken off. Fig. 3 shows typical examples. The blades (from stages 5, 6, 7, and 8) ran for 33,665 hours before renewal. The following stages, 9 and 10, also of aluminium bronze, do not suffer. No appreciable improvement in steam consumption resulted from reblading.

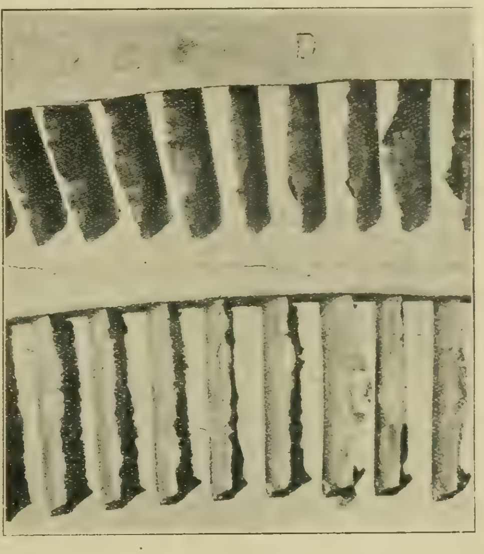


FIG. 2.

The last two stages have running hours varying from 39,000 to 46,500 at Simmer Pan, and up to 52,000 at Brakpan. The present practice is to fit the first four stages with 5 per cent nickel steel blades, stages 5-8 with brass blades, and the last two stages with aluminium bronze. The author favours nickel steel for the first eight stages and aluminium bronze for the last two.

9,600-kw. Turbines, Class 2.—The blading has with two exceptions proved satisfactory on row 3 (Curtis stage); the aluminium bronze proved distinctly unsatisfactory, becoming so brittle in some cases that the blades broke away from the wheel; in all cases the edges were very brittle. The bronze has been replaced with steel with satisfactory results. Fig. 4 shows examples of the above aluminium bronze blades which were renewed after 15,000-18,000 hours.

The aluminium bronze blades in stages 10, 11, 12, proved satisfactory, but in stage 13 breakages occurred, the fracture taking place across the neck of the tee-headed root.

The stress is not excessive (three tons per sq. in), and it it probable that vibration is responsible for the failure.

Some of these stage 13 blades have run from 20,000 to 30,000 hours and are still sound; breakages in three cases occurred after 10,600, 23,800, and 24,900 hours respectively.

4,000-h.p. Compressor Turbines, Class 3.—A 25 per cent. nickel steel was used for row 1 on the Curtis stage, and in a particular case failure occurred after running 17,700 hours, due, it is supposed, to brittleness acquired by use with high temperature steam and vibration; 5 per cent. nickel steel used for other sets has given satisfaction.

In the second row of Curtis blades, aluminium bronze and 5 per cent. nickel steel have been employed, the former proving quite unsuitable and being replaced by the latter In stages 2, 3, and 4 the aluminium bronze has a similar record (specimens are shown in fig. 5), and has been replaced by brass; in stage 5 aluminium bronze stands well, the temperature being low. Aluminium bronze was unsuitable in the stage 6, for mechanical reasons, the blades breaking off at the root after 5,000 to 7,000 hours.

Five per cent. nickel steel fractured in the same manner A material is required which is not so easily affected by vibration. "Monel" metal is being given a trial. Nickel brass is also being experimented with for stage 5. The steel blades for stage 6, just referred to, show a small amount of erosion on the inlet edge of the blades after 6,000 hours.

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* The first five classes of turbines are apparently of German make.—EDS. ELEC. REV.

Turbines, Classes 4 and 5.—Three metals are in use, 5 per cent. nickel steel, brass, and bronze, arranged in the order given, starting from the H.P. end of the turbine. Steel is also used for the last three wheels in one case, and for the last two wheels in the other case, at the exhaust end. The metals appear to be in the correct position for the best results, and up to the present no trouble has been experienced.

Erosion of the inlet edge of the steel blades at the exhaust end of the machine is noticeable in all cases after 5,000 to 6,000 running hours; in the case of the compressor turbines (Class 5) running at 3,000 R.P.M., with a blade velocity of 720 ft. per second, the erosion is very pronounced, the edge of the blade being like a fine saw.

Auxiliary Turbines, Class 6.—These turbines have a Curtis wheel only, with four rows of blades. The first two rows of blades were of 5 per cent. nickel steel, which has given good results, and the last two rows were of aluminium bronze, and where the blade section was small this proved disastrous.

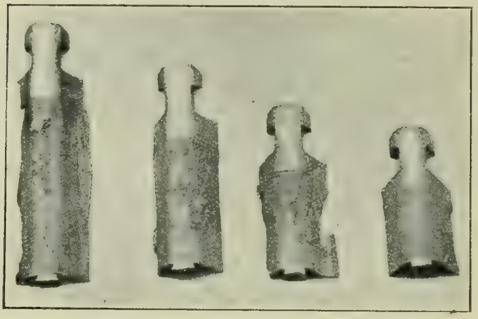

Fig. 3.

Fig. 6 shows typical examples of these blades, which would hardly be recognised as such, after 15,000 and 18,000 hours respectively.

On the later sets installed brass has given good results, being in good condition after 26,000 running hours.

Auxiliary Pump Turbines, Class 7.—This type has also a single Curtis wheel; in no case has the blade material shown deterioration, both steel and brass being in excellent condition after a maximum running period of 26,000 hours.

General.—From the foregoing remarks it is perfectly clear that aluminium bronze for use as a blade material in the high temperature stages of a turbine is totally unsuitable. While brass might do as well in the low temperature stages, one would not expect as long a life owing to the soft nature of the material.

Five per cent. nickel steel has given good service. Experience with brass blades covered 30,000 running hours, and no renewal owing to deterioriation has taken place; it is possible that it may outlast steel due to absence of oxidation.

Inlet Nozzles.—These are of cast-iron on all the turbines dealt with, and as supplied by the makers were quite unsatisfactory. The nozzles are a series of ports divided by partitions, and the latter crack badly, large pieces breaking off and passing through the turbine, usually bruising the blades if no more. Blading troubles are not easy to locate, as a piece of metal frequently passes through several stages before becoming jammed.

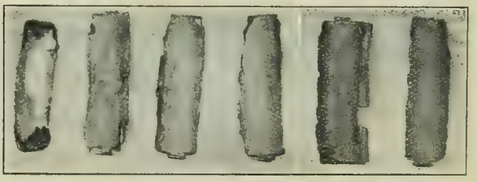

Fig. 4.

Tests showed that the damaged nozzles did not reduce the efficiency, and accordingly a V-shaped portion was cut out of the partition before fitting the nozzles, which has practically cured this trouble.

As an experiment steel divisions forged from mild steel bar and cast into an iron body have been tried on a large turbine with very good results. Two small turbines with steel nozzles gave quite satisfactory results; bronze castings have been used by some makers; brass would probably be too soft.

Curtis Stationary Segments.—Four metals have been used as follows:—Aluminium bronze disintegrated rapidly owing to temperature; 25 per cent. nickel steel becomes brittle in time, and one breakage has occurred; 5 per cent. nickel steel is now used exclusively for all main turbine stationary segment blading, and stands up very well. Brass is sometimes used for the second row of the auxiliary turbines, and always for the third row; it stands well, the maximum hours in use so far being 30,673.

Guide Blading.—The material in general use is 30-32 per cent. nickel steel. The nature of the deterioration is the same in all cases, but the results, taken over a given period, are quite inconsistent. The first visible indication appears in the form of a fine crack on the inlet side of the blade, and frequently close to the outer retaining ring, but sometimes near the centre of the blade. Before these cracks are actually visible, they can be produced by a few light hammer taps. These cracks extend over the surface of the blade, cobweb fashion, until pieces become detached, and pass through the succeeding stages, severely bruising and closing up the wheel blading on the inlet side, but seldom causing a strip. Ultimately, the whole of the blades crack, and if not attended to the guide ring collapses, causing heavy fouling and serious damage to the wheels and blading.

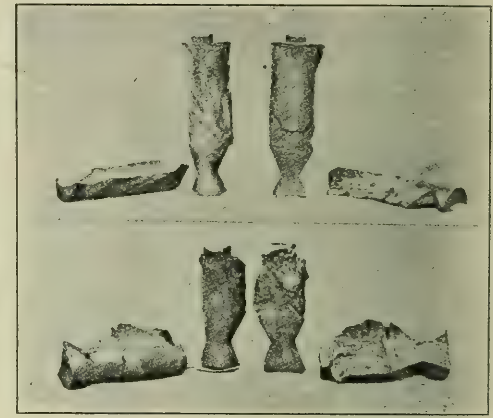

Fig. 5.

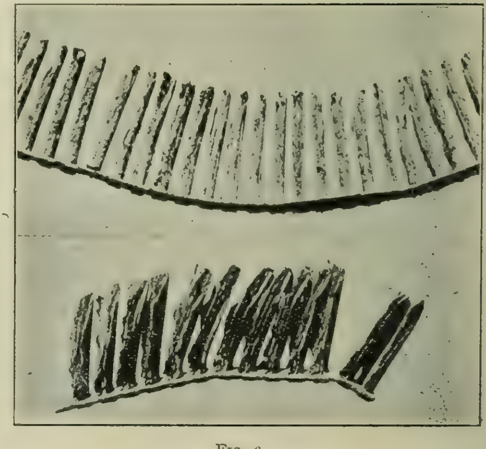

Fig. 6.

There is little danger when the cracks first appear, as several months elapse before pieces of guide blade break away. Examination at intervals of 3,000 hours allows one to follow the condition and judge when the ring should be renewed.

In the case of the guide blade diaphragms as fitted to Class 4 and 5 turbines, they become unsafe as soon as cracks appear, and movement of the diaphragms in the direction of the following wheel has taken place on different occasions. This tendency to displacement of the diaphragm is probably due to the circumferential pitch of the blades in the *guide blade diaphragm* construction being greater than in the *guide ring* construction, with a consequent increase of diaphragm area per blade.

Experience shows the great disparity in the running hours between the various stages at the same station, and the same stages at two different stations.

Influence of Material on Deterioration.—The evidence is hardly sufficient to state definitely the relative advantages of high or low percentage nickel steel, but the results obtained in No. 4 set, Rosherville, point to steel containing no nickel as being more suitable.

On the Class 4 turbines, steel, containing no nickel, has been supplied for some stages, and has so far shown no deterioration, while other stages, containing 30 per cent. nickel in the same machine have shown marked deterioration.

In the case of the guide ring renewed on No. 4 set, Vereeniging (stage 10), some of the blades were badly cracked, and others appeared to be in perfect condition; one of each was analysed, and both were found to be 30 per cent. nickel steel, the inference being that the presence of a high percentage of nickel does not necessarily cause the blades to crack.

Mechanical Stresses Imposed on the Blades by Expansion and Permanent Growth of the Retaining Rings and Diaphragms and by Sudden Changes of Temperature in the Blades.—We have ample evidence of the exceedingly heavy stress imposed on the blades from this cause, particularly at the high temperature end of the turbine.

When the machines were first erected, the guide rings were fitted to a groove in the casing, and secured thereto by means of screws; the C.I. diaphragm, of dished formation, is grooved round the periphery and fitted snug to the inner retaining ring of the guide ring, there being a corresponding tongue fitting the groove of the diaghragm to prevent lateral movement. The convex side of the diaphragm is toward the high pressure end of the machine, and is designed to resist the difference of pressure between the inlet and discharge side of the guide rings. It is found that the clearance between the diaphragm boss and the preceding wheel gradually diminishes. It, however, does not relieve the blades sufficiently to prevent severe buckling of the first two rings.

It is seldom the blades are *buckled* beyond the third guide ring, the expansion of the guide rings and diaphragms being naturally less as the temperature decreases, until at the exhaust end it is comparatively low, seldom exceeding 50 deg. C. If we assume heavy pressure on the blades to be the cause of the cracking, it seems strange that where the pressure is heaviest the blades are least affected. It may be a contributory cause, but in any case it is obviously better to relieve the blades of this stress as far as possible, and this has been accomplished in the case of the guide rings by machining a 3 mm. clearance between the guide ring and diaphragm and resting the diaphragm on two short fitting strips on the lower half. A few copper pins are fitted on the upper half of the guide ring, with about .5 mm. clearance between the pins and diaphragms, so that the latter cannot rise too much and foul the shaft gland. It is found that after a time these pins are crushed by the diaphragm, and they are eased periodically.

In the case of the guide blade diaphragms, these are suspended on lugs at each side of the turbine casing, 3 mm. clearance being left all round the casing groove, so that the diaphragm is free to move when fitted, but gradually tightens sideways in the groove as the growth of metal takes place.

In the case of the guide blade diaphragms on turbines, Classes 4 and 5, which were fitted to relieve blade stresses, 1 mm. clearance was left round the circumference by the erectors. This was absorbed during the first year of running, and, in addition, in some cases, very heavy distortion has taken place.

We have cases on record where long life has been attained without the rings being eased at all. On one of the 3,000-KW. sets installed at Brakpan some of the blading was renewed after 46,890 hours (stages 2, 6, 7), and on the adjoining set the blading was eased after over 40,000 hours, and is still in commission and in good condition after 59,000 hours, with the exception of the guide ring for stage 2, the blades of which are now cracking. In both machines the blades are of 30 per cent. nickel steel. Some makers use steel castings for turbine diaphragms, and this material is not subject to permanent growth like cast iron.

With regard to the sudden expansion of the blades themselves when starting up a set from a cold state, the blades are thin and will temporarily attain a higher temperature than the retaining rings; they will be subjected to compression stresses on this account, although 30 per cent. nickel steel probably has a very low coefficient of expansion. 36 per cent. nickel steel (Invar), used for instrument work, has no coefficient of expansion.

In this connection, the number of starts over an extended period have been examined on the various 9,600-KW. sets, but this does not seem to have any bearing on the life of the blades, and it is probable that these stresses are not so serious as others which the blades are called upon to withstand.

It having been decided to cast these guide blade rings locally, their manufacture presented some difficulty at first. Ordinary steel plate, 2 and 3 mm. thick, was used, cut to shape and bent round a former. The blades were then flanged and riveted between the retaining rings, a fairly neat job being made. It is significant that the turbine in which these re-bladed rings are fitted is less efficient than the others of similar type. This may be due to the rivet heads and flanged portion of the blades, which project into the steam passage and obstruct the steam flow.

Other Stresses, Vibration, Impurities in the Steam, &c.—If we assume the drop in pressure across each diaphragm to be 6 lb. per sq. in., and the diameter of the diaphragm to be 60 in., the guide blades have to withstand a lateral force of 8.4 tons, which divided between the blades may not be excessive. A certain amount of vibration will take place, due to the rotation of the parts, and passage of steam through the blading. This vibration acting on the guide blades while under stress from the diaphragm pressure, and perhaps at a critical temperature, may cause cracks to develop and ultimately break down the material. Another factor is impurities carried over from the boilers with the steam. For instance, on the 3,000 sets at Brakpan, where exceptionally long life has been attained, oil occurs as a greasy deposit on the guide blades, and may have acted as a protective covering.

(*To be concluded.*)

SOME POINTS IN CONNECTION WITH ENGINEERING SPECIFICATIONS.

THE paper by Mr. J. SHEPHERD was read and discussed at a meeting of the SCOTTISH LOCAL SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS at Glasgow.

Mr. ARCH. PAGE (Glasgow) agreed with the author that in the majority of cases there was great need for engineers to specify thoroughly and exactly what they wanted when purchasing, and he cited instances to show that if a standard apparatus was bought the purchaser was sometimes left with undesirable features. He particularly instanced the necessity for having steel fittings with a standard turbine on the high-pressure side for the superheated steam they had now to deal with. It was criminal to use anything but steel. On the condenser question, if they did not specify the friction drop from the condenser they might get pumping plant which would take twice the power necessary, while, as to starting gear, if they did not distinctly specify the fittings wanted they would probably get the ordinary brass-finisher's product, which would be unsuitable. Mr. Shepherd had advanced points to be included in a specification as general conditions, detailed technical requirements, and bills of quantities. Another very important heading was technical data, which ought to be supplied by the contractor, and asked for in the specification, because otherwise they would probably require to spend a day with the contractor's representative before they had any proper idea of what was being submitted. General conditions had been a very thorny subject for several years, and in the I.E.E. General Conditions, which Mr. Shepherd suggested should be more or less accepted, there were some points which required consideration. For instance, it was said that the testing should be done by the manufacturer; the purchaser was not at all likely to accept a piece of apparatus which had been tested by the manufacturer only. Another point related to solicitors or town clerks drawing up general conditions; in Mr. Page's opinion it would be better for the engineer to draft the specifications first, and then give the legal experts their turn at improving matters. There appeared to be some contradiction in the suggestion that the lowest offer should be accepted on a clear and concise specification, and that the results would be generally satisfactory, if the engineer was allowed to select a firm of known excellence and ripe experience.

Mr. SHEPHERD explained that his point was that if the engineer was allowed to select a well-known firm of ripe experience there would be little doubt of the excellence of the plant, though they might take it as a general rule that the tender usually accepted was the lowest.

Mr. PAGE proceeded to deal with the coal specification, pointing out that the method which had worked all right in his experience was to buy from pits from which they were in the habit of purchasing—the pits extending over large areas, and the engineer making tests over considerable periods. The contractor was usually left in the dark as to what was considered the value of the coal. When the tenders were received the calorific values were tested and compared with the calorific values of the previous tests, and the orders were placed accordingly. He disagreed with Mr. Shepherd that the duct system of cable laying was the best. Nowadays the procedure was not to work through a nest of ducts, but to carry cables along routes around which they were likely to pick up business.

Mr. E. SEDDON (Edinburgh) said it seemed very necessary for every engineer to define clearly the conditions and results he wished to obtain with the plant, but to try and design the respective parts would hinder engineering generally. It was folly for the purchaser to be too definite in detail in specifications, because then the manufacturer did not get a fair chance to experiment with his own particular kind of apparatus. As to heat transformation, there was a wide field open for the fuel engineer to secure a greater efficiency in the relation of coal to the output from the generator. He agreed with Mr. Page that if the colliery proprietors would not conform to the practice of selling by B.TH.U.'s the purchaser had simply to get the values of the coals from each particular pit. He hoped the colliery owners, however, would see the reasonableness of selling on the B.TH.U. basis.

Mr. Morgan (Glasgow) gave it as his experience that it was better to get coals from adjacent pits and strike the relative values between the different collieries. The coal which had the highest calorific value might not necessarily suit them best.

Mr. M'Leod (Glasgow) thought it was an extraordinary thing that, while most engineers recognised the importance of drawing up a sharply worded specification for capital plant, there were too few who took the trouble to extend the system to cover consumable stores. Very often the purchaser of consumable stores was left with some non-technical clerk who might allow himself to be led away by a plausible traveller into purchasing an unsuitable oil for use in turbines which might lead to the ultimate wrecking of the plant. Sometimes specifications were purposely left vague, and some local authorities had reason to regret signing free wiring contracts which were sometimes drawn up in a very crude way. Many engineers in this country had been influenced by the supposed economy effected by using small coal. One could understand that attitude being taken some years ago, when the colliery owners were pleased to get rid of this material at 5s. or 6s. a ton, but at the present price of 15s. it was not worth it. Greater economy could be effected by purchasing large coal and crushing it suitably for their grates. He suggested in cable laying the use of armoured cables laid direct in the ground as economical, particularly in rural districts, where transport was scarce and expensive.

Mr. J. M. Munro (Glasgow) argued that every specification, no matter how carefully prepared, provided openings for the contractor, who was at least as clever a man as the engineer, who desired, and perhaps was rather compelled, to find some way of escape from the position in which he found himself. In the end, client and contractor alike must trust the engineer. The "lowest tender" was a fetish before which local authorities had bowed for years, and it had much superficially to recommend it; but, after all, it was an insufficient, insecure and shallow defence, and one of the benefits in having a competent engineer was that they could come out into the open and accept any tender. Whatever any large number of consulting engineers might ask for, they should not cease to contend for a big measure of freedom when the choice of tender, not necessarily the cheapest, came to be decided. In one case, out of nine or ten tenders he got for a generator, he accepted the dearest of the lot. He also supported the purchase of coal by the B.TH.U. principle as being the only sensible and practical one.

In his reply, Mr. Shepherd said he would go further than Mr. Page, and say it was criminal to use cast-iron for superheated steam for anything over 500 deg. for permanent work. He agreed that it was very necessary to go into details in specifying turbo-generators. In the supply of motor starters there appeared nothing more iniquitous than the action of some contractors, who seemed to see how cheaply they could manufacture their apparatus without much regard to design, fitness, or robustness. He agreed with Mr. Page that transformers and other plant might be perfectly suitable when placed in small power systems, but when placed in large systems, with unlimited power behind them, such plant utterly failed, hence the necessity of detailed specifications. In his opinion, it was necessary to specify with some detail, so that they could accept the lowest tender with some degree of comfort. He agreed with Mr. Seddon that it was better to buy coal direct if they could get the mineral of a fixed value, but if they compared deliveries from the *same* colliery for the *same year* they would get anything but uniform value. He submitted the following figures in this connection actually obtained from analysis:—Highest moisture, 14.1 per cent.; lowest, 9.5 per cent; highest small, 32.4 per cent.; lowest, 13.5 per cent.; highest calorific value, 13,500 B.TH.U.'s; and lowest, 12,294 B.TH.U.'s. If engineers were going to buy their raw material at fixed prices, and varying so much in value, they were not buying economically. From his general experience, the accepting of the lowest tender was a course which had seldom ended in difficulties when tendering to a proper specification. The question of how varying tenders and varying qualities of coal could be adjusted was answered if they put in the specification for coal of standard value, and that standard value a calorific value, of, say, 12,500 B.TH.U., moisture 9 per cent., small 20 per cent., ash 10 per cent. They could then arrive at a point when they could say which particular coal was the cheapest. Sampling was an easy matter, and he never knew of a case where a contractor asked for an independent analysis during 10 years' buying by this method.

Birmingham Electricity Department.—Female Labour.—The Electricity Supply Committee has decided to employ women in the power stations, particularly in the switch-rooms and engine and boiler houses.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

5,315. "Sparking plugs for internal combustion engines." A. G France. April 16th.

5,333. "Wireless receiving circuits." A. J. Martin. April 16th

5,349. "Electric lamps." L. W. Cox. April 16th.

5,354. "Construction and manufacture of electric incandescent lamps, caps, and sockets." K. Sassulitz. April 16th.

5,358. "Electrical insulators." Butters, Ltd., & G. V. Twiss. April 16th.

5,363. "Audion or lamp relay or amplifying apparatus for wireless telegraphy and telephony." M. Latour. April 16th. (France, April 15th, 1916.)

5,365. "Thermostatic apparatus, especially applicable as relays and circuit interrupters." E. A. Graham & W. J. Rickets. April 16th.

5,401. "Transformers for alternating electric currents." O Loras. April 17th. (France, June 9th, 1916.)

5,410. "Electric heating of metallic bodies for forging, &c." D. F. Campbell. April 17th.

5,411. "Magneto or dynamo-electric machines." Soc. Anon. de Magnetos et Appareils Electriques Sama. April 17th. (France, May 17th, 1916.)

5,412. "Electric contact-breaker." Soc. Anon. de Magnetos et Appareils Electriques Sama. April 17th. (France, May 26th, 1916.)

5,413. "Storage batteries." Sir C. S. Forbes. April 17th.

5,431. "Plug for telephone switchboards, &c." P. P. Craven. April 18th.

5,448. "Manufacture of metallic tungsten and its alloys." O J. Stannard. April 18th.

5,451. "Protective devices for electric apparatus." British Thomson-Houston Co. (General Electric Co., U.S.A.). April 18th.

5,481. "Sparking devices." F J. Turquand. April 19th

5,482. "Sparking plugs." B. D. Howarth. April 19th.

5,494. "Constant-current motor and dynamo without commutator." M. C. Tiarks. April 19th.

5,503. "X-ray tube, stand, and table." E. E. Greville. April 19th.

5,519 "Wireless signalling systems." British Thomson-Houston Co. (General Electric Co., U.S.A.). April 19th.

5,528. "Electric lamps." S. Yuyama. April 19th. (U.S.A, April 19th, 1916.)

5,576. "Spark control in combustion engines." J. G. Heaslet. April 20th.

5,588. "Ignition system and starting apparatus for internal-combustion engines." G. Dolce. April 20th. (Italy, July 4th, 1916.)

5,617. "Ignition magnetos for internal-combustion engines." E. Malivert. April 21st. (France, April 28th, 1916.)

5,632. "Process for electrolytic deposition of metals." N. H M. Dekker. April 21st.

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

4,104. Route Indicating and Signalling Devices for use on Railways and the like. R. G. Berry & H. W. Moore. March 20th, 1916. (104,902.)

4,138. Radio Luminous Sights. G. Panerai. March 20th, 1916. (Patent of addition not granted.) (104,905.)

4,177. Indicator or Signalling Apparatus for Indicating the Turning of Motor Vehicles. H. O. Faulkner. March 21st, 1916. (104,908.)

4,275. Burglar Alarm Systems. C. A. Carpenter. March 22nd, 1916. (104,918.)

4,351. Lamps. Quarx-Lampen Ges. February 12th, 1915. (100,287.)

9,667. Motor Ploughs, Cultivating Implements, Cable-laying Machines, and the like. W. E. Martin. July 8th, 1916. (105,000.)

2,861. Receivers for Wireless Signals. Marconi's Wireless Telegraph Co. & F. P. Swan. February 25th, 1916. (105,081.)

4,407. Telegraphy. Muirhead & Co. and G. O. Squier. March 24th, 1916. (105,089.)

4,596. Portable Electric Battery Lamps. H. F. Joel. March 29th, 1916 (105,100.)

4,629. Electric Ignition of Explosives. R. Miller. March 29th, 1916. (105,104.)

4,703. Thermostatic Circuit-breaking Apparatus for Electric Heaters. J. E. Harvey. April 3rd, 1915. (100,252.)

5,104. Enclosure for Switchgear. A. H. Curtis & Igranic Electric Co. April 6th, 1916. (105,124.)

6,121. Process and Apparatus for Effecting Chemical Reactions by means of Electric Arcs. A. V. Lipinski. April 28th, 1916. (105,135.)

9,020. Dynamo-electric Machines. Crompton & Co. and N. Pensabene. June 27th, 1916. (105,165.)

10,920. Magneto-electric Machines. F. R. Simms. August 2nd, 1916. (105,180.)

10,939. Electric Motor-starting Switches or Controllers. F. Newton and Newton Bros. (Derby), Ltd. August 2nd, 1916. (105,181.)

11,240. Means for Connecting Pipes, Electrical Conduits, and the like. F. W. Uren. August 9th, 1916. (105,182.)

14,767. Vapour Electric Systems for Conversion of Direct Electric Currents into Alternating Currents. British Westinghouse Electric and Manufacturing Co. November 29th, 1915. (102,484.)

Electrically-Propelled Battle Cruisers.—The U.S. Navy Department has decided to build five battle cruisers with electrical propulsion machinery. The vessels will cost about $76,000,000 for hulls and machinery. There will be another expense of about $5,337,810 for arms and armament on each ship. These will be the first battle cruisers built by the United States, and the first equipped with electric propulsion, although the collier Jupiter, electrically driven, was built by the United States some time ago, and has proved a great success from a naval viewpoint. The details of the electrical machinery have not yet been worked out; several months' time will be needed for this work. The generators will be driven by steam turbines. Four new battleships are also to be equipped with electric drive. -*Electrical World.*

THE

ELECTRICAL REVIEW.

VOL. LXXX. MAY 11, 1917. No. 2,059.

ELECTRICAL REVIEW

Vol. LXXX.] CONTENTS: May 11, 1917. [No. 2,059.

Page
The I.E.E. Report 505
Engineering Labour and the War 506
Electro-Culture and Crop Production: Results during 1916 (*illus.*) 507
High-Tension Overhead Transmission Lines, by G. V. Twiss (*illus.*) 508
National Insurance Acts, 1911—1915 511
War Items 512
Recent Investigations of Tractive Resistances to Motor Trucks on Roads and Pavements 512
Legal 513
Reviews 514
Business Notes 515
Notes 518
City Notes 522
Stocks and Shares 525
Market Quotations 526
Electric Tramway and Railway Traffic Returns 526
High-Pressure Electric Railway Systems 527
An Approximate Formula for Magnet Coils (*illus.*) 528
The Deterioration of Curtis Rateau Turbine Blading (*illus.*) (*concluded*) 528
Electrical Industries in China 529
New Electrical Devices, Fittings and Plant (*illus.*) 529
Correspondence—
  Wiring with Tough Rubber Compound Cables 531
  Electric Vehicles 531
The Institution of Electrical Engineers 531
New Patents Applied for, 1917 532
Abstracts of Published Specifications 532
Contractors' Column ... ... Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE :—4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson, & Co., Gresham Street.

AUCKLAND N.Z: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.

BRISBANE: Gordon & Gotch, Queen St.

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LAUNCESTON: Gordon & Gotch, Cimitiere Street.

MELBOURNE: The Mining & Engineering Review, 90, William Street; Gordon & Gotch, Queen Street.

MILAN: Fratelli Treves.

NEW YORK: D. Van Nostrand, 25, Park Place.

PARIS: Boyveau & Chevillet, 22, Rue de la Banque.

PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Loescher & Co., Corso Umberto 1° 307.

SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.

TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE "ELECTRICAL REVIEW'S"

ELECTRICAL & ALLIED TRADES DIRECTORY

(THE RED BOOK),

1917 EDITION

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THE I.E.E. REPORT.

THE publication of the annual report of the Institution marks the approaching termination of the session so far as meetings of members are concerned, but by no means signifies the end of the year's work to the Council and Committees. Last year, according to the report, the Council met 16 times, and the Standing and other Committees held no fewer than 122 meetings; as many of the members sit on several of the Committees, and on the Council as well, it will be seen that service on these bodies is no sinecure, but, on the contrary, calls for considerable personal sacrifice. While no very remarkable events have characterised the period covered by the Report, the Council is to be congratulated on the solid work accomplished during the year, and on the progress which it has made in the direction of serving the interests of its members and of the electrical industry more effectively, under the energetic guidance of the President, Mr. C. P. Sparks, whose term of office has been, perhaps, the most strenuous and exacting of any in the history of the Institution.

Amongst the principal events of the past year have been the consummation of the movement towards the expunction of the names of alien enemies from the list of members; the lamented death of Dr. S. P. Thompson, a misfortune that cannot be repaired; the appointment of the Committee on Electricity Supply; and the adoption of the important series of recommendations submitted by the President on behalf of the Council to the Electrical Trades Committee of the Board of Trade.

The Committee on Electricity Supply has been awaiting the publication of the report of the Electrical Trades Committee in order to "work as far as possible along the lines which it was anticipated would be indicated therein." In this remark is clearly implied an expression of surprise at the inexplicable delay in publication of the report, which was understood to be practically ready weeks ago; veiled protests may be appropriate to the report of the Institution Council, but do not go far enough for us—we regard it as extremely unfortunate that this important matter should be held up so long. Who is responsible for the delay? It may be that some hidden influence is at work to hinder the publication of the report or to obtain some modification of its terms, and we trust that every effort will be made by the Council of the Institution and other bodies concerned to bring the matter to a head. On the other hand, we fail to see why the I.E.E. Committee should mark time so patiently; so far as we can see, while the National Electric Supply Joint Committee appointed by the I.M.E.A. and the I.A.E.P.C. has been getting on with its work of organisation, and has set the machinery in motion towards linking-up in various districts, the I.E.E. Committee has apparently effected little beyond selecting standard frequencies for certain districts (50, 40, and 25, at a guess), and has now adopted the discredited "Wait and see" policy which so nearly lost the war for us. The Committee will "proceed with their deliberations"—truly an apt expression; surely we may hope for something more definite, more energetic, than is suggested by the present attitude of the Committee. This is a time not for "deliberation," but for prompt and vigorous action.

We congratulate the Council and the Committees of Local Sections upon the excellent work that is being done towards enabling disabled sailors and soldiers to secure employment as sub-station and switchboard attendants. Our hearts go out to these brave fellows who have paid so heavy a price for the freedom of their country, and we are especially pleased to see that the efforts of our leaders are being so well supported by central-station managers that the applications for men out-number the candidates for employment by more than two to one. Before the return of peace the number of men to be provided for will be far greater, and increased facilities for training them will be urgently required. This is a work which deserves the heartiest encouragement from all who are in a position to assist in pressing it forward.

We are glad to see, too, that the Institution took prompt action in the emergency created by the memorandum of the Reserved Occupations Committee, which threatened to cripple the supply of electricity to factories engaged upon the manufacture of munitions of war. It is, no doubt, difficult for laymen to appreciate the exceptional conditions obtaining in the electricity supply industry—the extremely small number of men employed in comparison with the magnitude of the operations carried on, and the imperative necessity of their being highly skilled men who cannot possibly be replaced by unskilled labour, still less by women, except in minor posts. An excess of zeal on the part of the military authorities might easily lead to irreparable consequences if not checked before the mischief was done, and it was fortunate that the Institution, in alliance with the I.M.E.A. and other representative associations, was able to secure the reconsideration of the Committee's ill-advised decision.

Lastly, we pay a tribute of respectful admiration to the 1,671 members of the Institution who have joined the Colours in defence of the Realm—more than a quarter of the total membership. This is indeed a splendid record, which is enhanced by the long list of distinctions already awarded to members, and the sad but glorious Roll of Honour engraved upon the memorial panels in the hall of the Institution.

Engineering Labour and the War.

Nobody who is closely following the course of industrial controversy and negotiation in these days of continued strain and anxiety anticipates freedom from unrest for long at a time. The ever-changing demands of the war give rise to new situations every few weeks or months, and all of these new situations have to be negotiated with tact and sympathy in order that we may avoid the ugly rocks. It is useless to regard each new demand from Labour as an act of disloyalty, as a want of patriotism, or as treachery endangering our fighters in the field. Of course, there are, as always, even now, most unworthy elements at work which seem to aim at causing disaffection and in that way endangering the Allied cause, but, on the whole, we believe that their influence is not extensive. Indeed, considering everything, and observing the worse conditions obtaining in other countries, we have reason to be thankful that things have gone on as satisfactorily as they have during the past two or three years. What are needed above all, in these very irritating days, are coolness, calmness, and composure; if we have not these qualities we cannot expect to keep our heads and deal reasonably with difficulties which, we suppose, are more or less inevitable under the unparalleled circumstances of the times. Those who have been responsible for simultaneously maintaining the supply of men for the Forces, and maintaining or increasing the output of munitions, have had to deal with a host of problems, some of them very delicate in character, and possibly, when their wishes have inclined them in one direction, they have felt it to be more judicious to take another course because the main interests of the Allies were at stake. Step by step, as the situation has altered, has Labour been drawn from industry, and latterly workers on munitions have been called upon to take up the less remunerative, but more immediately necessary, duty of training for military service. The Trade Card system, introduced at one critical period to tide over an emergency, answered for a time, but its own inherent defects were soon revealed, for they caused disaffection between the men themselves. And now, in connection with the call for the half-million men that must be with the Colours by July in order to maintain our fighting forces against the wastage that the attacks on the Hindenburg line have necessarily brought, the Trade Card system has had to be abolished and other measures introduced for protecting the really indispensable worker in the factory. The past ten days have not unnaturally been an anxious period in this respect, but we trust that, by the aid of British good sense and general determination to defeat the enemy speedily, the new arrangements will be found to work smoothly.

Last Saturday night the Amalgamated Society of Engineers announced that its delegates had reached agreements with the Government, and that arrangements had been come to in connection with the schedule of occupations providing adequate protection for skilled men and apprentices. As a result, there has been no stoppage of work. In addition, the strike of engineers in South Lancashire, which was due to difficulties arising out of the dilution of private commercial work at a Castleton factory with female labour, and out of the question of the recognition of the engineering Trade Union, has also been settled. Whatever the terms of settlement in these cases, we suppose we must be thankful that the anxious period has again been successfully negotiated, so that we may get on with the war, recruiting the needed young men, and continuing the output of *matériel*. The engineering workers are essential to the conduct of the war, and, of course, they know it. A hundred times has it been stated by our leaders that the work being done in the engineering workshops is vital. Sir Edward Carson's message to the London Association of Foremen Engineers last Saturday put the matter very forcefully. He showed once again how the dauntless gallantry of our sailors, soldiers, and merchant seamen was of no avail without the assistance of the shipyards and the engineering shops, and that the answer to the latest German barbarism lay in those yards and shops. His appeal to all to redouble their effort until victory is won was timely, and very necessary at such a juncture, however familiar it may have become. "Until Victory is won"! But what after? The present anxieties, stress, and strain will have passed away, and the causes for irritation may be changed, but all of these experiences through which we pass now tell us very plainly that we may anticipate when there is Peace between the nations, new anxieties which will call for the most careful negotiation. Indeed, were it not for the strain of war-time conditions, and all that they mean to all of us, being largely responsible for prevalent disaffection, we should feel disposed to despair of a happy issue ever being arrived at in such a matter as Industrial Peace negotiations. The new spirit of the Trenches, of which we hear and say so much, does not seem to have reached Home yet. Will it arrive when "the boys come Home"? We trust that it may, and in order to perpetuate it, if it does, we need to continue now all the useful schemes and negotiations that we can produce designed to prepare the way. We will hope and prepare for the best, whatever we may conscientiously fear.

ELECTRO-CULTURE AND CROP PRODUCTION: RESULTS DURING 1916.

In view of the more extended knowledge of the effect of overhead electrical discharge on plant growth, which careful investigation has rendered available during the last year or two, the results obtained experimentally at Lincluden Mains Farm, Dumfries, during 1916, are of particular interest; more especially is this so, in view of the excellent record of the previous year.

Electrified Oat Crop. August 8th, 1916.

These 1916 results were recently described by Prof. V. H. Blackman and Mr. Ingvar Jorgensen in an article in the *Journal of the Board of Agriculture*, and the authors acknowledge their indebtedness to Miss E. C. Dudgeon in the carrying out of the experiments.

Oat Crop on (Unelectrified) Control Area. August 8th, 1916.

The experimental crop, as in 1915, was oats; the soil of the field was a sandy loam, and the field (of 9 acres) had been in pasture without manure for the three previous years, having been grazed over.

One acre was chosen as the electrified area, and two half-acres as controls; one control was near, but measurement showed that it received only a slight discharge, while the other control was out of the track of the prevailing westerly winds, and at such a distance that even with north-west winds it received practically no discharge.

The difficulty of confining the discharge to the area to be electrified is much reduced by keeping the wires low, and an earthed screen of wire netting was found unnecessary, owing to the low position of the wires and the position and distance of the controls.

Clover-hay Crop on Unelectrified Ground.

The overhead discharge was applied by means of a series of 21 wires running parallel to the short sides of a rectangular area (88 yards × 55 yards), the wires being about 4½ yards apart, and supported at their ends about 7 ft. from the ground, though towards the end of the experiment they sagged down to 6 ft. at the centre.

Clover-hay Crop on Ground Electrified the Year Before.

The current supplied through the primary circuit was about the same as in previous years, *i.e.*, 3 amperes at 50 volts, but owing to the lower level of the wires (7 ft. as compared with 10 ft. in 1915 and 15 ft. in 1914), and the closer arrangement of the wires (13½ ft., as against 15 ft. in 1915 and 20 ft. in 1914) the intensity of the discharge received by the crop was much increased.*

The crop was sown on March 27th, appeared above ground on April 13th, and the discharge started the next day : by May 16th the electrified plants were markedly deeper green in colour and taller, and later measurements of the average heights of plants were as follows :—

	Electrified.	Control 1.	Control 2.
June 18th	19 in.	14 in.	12 in.
June 25th	24 in.	19 in.	18 in.
July 3rd	32 in.	21 in.	20 in.

After the latter date it was not possible to obtain measurements without damaging the crops.

It was clear that the electrification extended some little distance from the trial area, for the height of the crop round the area was above the average, and gradually decreased with distance.

The discharge was continued until August 17th, being used only in the day time and discontinued during actual rain ; the discharge time was 848 hours during the season.

It was generally agreed that the oats were the finest crop in the district ; unfortunately, heavy rain storms towards the end of August caused damage to the crop, and loss of grain occurred before harvesting. The yields obtained were as follows :—

	Grain.	Straw.	
Electrified, Area, 1 acre.	2,637 lb.	Quality 1, 1,942 lb. Quality 2, 695 lb.	4.924 lb.
Control (1), ½ acre.	840 lb.	Quality 1, 630 lb. Quality 2, 210 lb.	1.218 lb.
Control (2), ½ acre.	924 lb.	Quality 1, 714 lb. Quality 2, 210 lb.	1.401 lb.

The electrified area, as compared with the controlled areas, gave an increased yield of 873 lb. grain, or 49 per cent., and 2,305 lb. straw, or 88 per cent.

The farmer who works the land estimates the loss from climatic conditions at 420 lb. ; if this is accepted, the grain increase works out at 73 per cent. In 1915, when the oats were subjected to a weaker discharge, a 30 per cent. increase occurred in grain, and a 58 per cent. increase in straw.

The authors refer to the difficulty of accurately estimating the fianancial results ; but based on market prices in the district, the increased value of the crop works out at £6 7s. per acre.

The energy used, about 130 KW.-hours, if reckoned at 1d. per unit, works out at only 11s.

The cost of an installation on a large scale cannot be predicted at present, but the profit shown above would permit of a heavy expenditure on an installation.

The authors conclude by pointing out that a new and important aspect of the problem has been disclosed by the discovery that *the application of the discharge one year may increase the size of the crop the next year*—*i.e.*, there may be a marked after-effect. The difference between the crop of clover-hay produced in 1916 on ground previously electrified and that on the non-electrified area was very marked, and an increased weight of crop was obtained from the electrified area. Two views show the areas in question, with the *second* crop of clover on the hay stubble in September ; the first crop was cut in July.

If in addition to an immediate increase of the treated crop a succeeding crop is benefited, it is obvious that the agricultural value of the application is very much enhanced.

Much, however, still remains to be investigated in connection with the electric discharge ; the conditions under which the effect is produced—its relation to light and humidity ; the most suitable strength of discharge has to be discovered, as the experiments suggest that with a greater intensity of discharge still bigger yields might be obtained. Manurial conditions and effect of soils have to be investigated, also electrical engineering problems. The question of the manner in which the electric discharge influences the growth of a crop is still quite unsolved.

HIGH-TENSION OVERHEAD TRANSMISSION LINES.

By G. V. TWISS, A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

Several recent large power schemes abroad embodying transmission lines of the highest voltages have been engineered from this country, and our share of such engineering is likely to increase. Moreover, in view of the necessity for conservation of the coal resources of this country, and the fact that we must hold our own in industry against countries possessing abundant and very cheap power—derived from water and transmitted by high-tension transmission lines—it is quite possible that we may yet have transmission lines working at 100 kilovolts or so in this country. The present movement in regard to the linking-up of power stations may, indeed, necessitate transmission lines at voltages much higher than those used at present; and there is still the possibility of developments such as the transmission of power in bulk at high voltages from coal areas, as foreshadowed by Dr. Ferranti in his presidential address to this Institution. Hence the subject of transmission lines at the highest pressures is of increasing concern to us.

Transmission lines abroad and in the British Dominions, including those engineered from this country, show marked differences from those at home, as is shown in fig. 1. The respective voltages, whilst accounting for the length of cross-arm, do not entirely account for the other differences. If, therefore, a 100-kilovolt line had to be built in this country, upon which practice would the design be based?

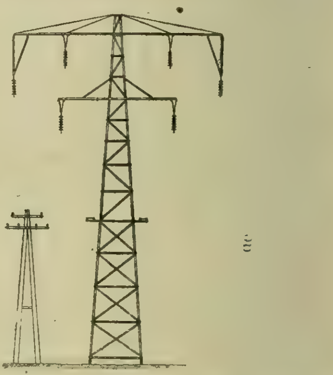

Fig. 1.—Comparison of Transmission Lines at Home and Abroad.

General Design of Transmission Lines.

Arrangement.—Conductors may be arranged in any of the ways shown in fig. 2. The diagrams show arrangements for double circuits, but for single circuits half of each diagram may be read.

The considerations which influence the choice of arrangement of conductors are as follows :—

(*a*) Electrical considerations.
(*b*) Mechanical considerations, such as :—
Possibility of wires swinging together.
Leverage on the cross-arms and poles.

Snow, either unevenly weighing down the conductors, or falling off and causing the conductors to foul one another or to come too close together.

From the electrical point of view, the A and B arrangements in fig. 2 are equally satisfactory. In any case, however, the maintenance of an equilateral triangle is not of the greatest importance, and on some of the largest modern transmission lines no attempt is made to obtain a triangular arrangement.

From the point of view of swinging together, C1 is the best, and B1, B2, and B3 come next, whilst as regards snow effects C1 is the worst, and the A arrangement is the best. The B arrangement, however, is equally good if the base of the triangle is tilted slightly as in B3.

It would appear, therefore, that the B arrangement with the base of the triangle slightly tilted is the best arrangement for double circuits, as it gives the shortest poles and the shortest cross-arms compatible with the absence of swinging together and snow effects, and incidentally maintains the triangular arrangement—which is desirable if nothing is lost thereby.

For pressures in the neighbourhood of 100 kilovolts this arrangement makes the top cross-arm somewhat long, as shown in fig. 1. The triangular members to which the insulator is fastened at the extreme end of the cross-arm are, however, pivoted and form a sling* which, having no movement laterally, is free to swing in the line direction; hence, in the event of a conductor being broken on one side, the sling and the suspension insulator swing into the span, thereby materially reducing the tension.

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* The intensity of the discharge received can be increased by (1) lowering the wires, (2) reducing the distance between the wires, and (3) reducing the thickness of the wires. No. 24 gauge silicium bronze wire was used.

For single-circuit construction the horizontal arrangement (C2 in fig. 2) appears to have advantages, as the pole is the shortest possible, and there is no possibility of the conductors fouling owing to snow. It requires, however, the maximum length of cross-arm, and triangular spacing as A or B is more frequently used in practice.

Clearance between Conductors.—The considerations affecting clearance between conductors are as follows:—

1. Mechanical, *i.e.*, the possibility of wires swinging into contact or dangerously close together.

2. Electrical considerations, which with the very high voltages must include the possibility of corona loss.

There seem to be no definite rules in regard to the clearance necessary for mechanical reasons, and the following discussion is given tentatively with a view to arriving at some basis.

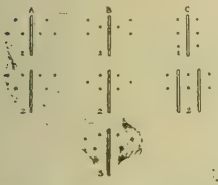

Fig. 2.—Arrangement of Conductors.

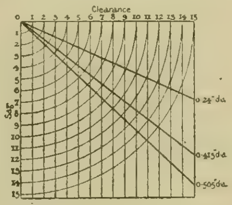

Fig. 3.—Curve of Clearances.

Clearance with Horizontal Arrangement.—Wind may blow at any angle to the conductors, and with different velocities at different points in any span; hence a set of sagging conductors of small weight relatively to their wind area (for instance, very small wires, especially if of light material, such as aluminium) will tend to swing irregularly, *i.e.*, out of phase, and might touch or come dangerously close unless well spaced apart. Wires having a greater weight relatively to their wind area (*i.e.*, large wires, especially of heavy material such as copper) will have a more dead-beat action, and will tend to swing more synchronously, and consequently need not be spaced so far apart to obtain the same security against short circuits.

The curve of clearances shown in fig. 3 appears to give clearances which are comparable with the best practice.

Clearance with Vertical Arrangement.—Here the chief point to be taken into consideration is the possibility of the wires being unequally borne down by ice or snow, or of the wind lifting or depressing the wires unequally. The clearance will therefore bear a relationship to the span, and a clearance of 1 ft. per 100 ft. of span would appear to be a good rule.

Clearance with Triangular Arrangement.—If the base of the triangle is horizontal the clearance would be settled as above for horizontal clearance; if vertical, then the vertical clearance would settle it, and for all other cases the clearance could be adjusted accordingly.

In regard to (2) above, namely, electrical considerations, formulæ are already available.

The final clearance chosen for a given case would be whichever proves to be the greater, that indicated for electrical or for mechanical considerations; and in certain cases the necessary clearance between the conductors and the pole may necessitate a greater clearance between the conductors than that above obtained.

Clearance between Conductor and Cross-arms or Pole. Pin Insulators.—The clearance between a conductor and the cross-arm on a pin insulator is, of course, dependent upon the length of the pin. It is advisable that the distance from the conductor to the cross-arm should not be less than the distance from the conductor round the insulator sheds to the pin. Fig. 4 shows how the correct length of pin to provide this clearance may be determined.

Suspension Insulators.—As suspension insulators swing out of the vertical, the conductor may come close to the cross-arm and thereby reduce the clearance as measured from the conductor to the cross-arm over the insulator. In order to maintain this clearance the sling previously referred to has therefore been used. Fig. 5 shows a mast with these slings and the clearances thereby obtained. As a matter of fact, however, on the majority of transmission lines where suspension insulators have been adopted no such refinement has been used for the purpose of maintaining this clearance, and it is evidently considered that trouble from this source is so unlikely as not to justify special provision to prevent it. This theory is largely justified by the fact that an arc would always tend to strike in the path of the strongest electrostatic field, which would generally be that over the insulator.

Tension and Loading of Conductors.

Comparison of Assumed Wind and Ice Loadings.—The Board of Trade Regulations assume the maximum conditions of loading to be a wind of 25 lb. per sq. ft. at a temperature of 22 deg. F. without snow or ice on the conductors; and a factor of safety of 5 is required on the conductors under these conditions.

Other countries make different assumptions and stipulate other factors of safety. The factor of safety of 3 is the one most favoured on the Continent, in fact, by most countries.

Economical Span Length.—In this country we find span lengths of the order of 150 ft., with a maximum of, perhaps, 300 ft., while abroad we find a usual span length of 500 ft., and in America and Canada as high as 700 ft. This is, of course, excluding abnormalities such as crossing valleys, rivers, and the like, which are common to all, and require special treatment. One can design to get equal safety with any reasonable length of span, and economy should be the only consideration.

A set of curves given in the paper for different sizes and different tensions and loadings of conductors provides a definite basis to work upon. From the curves it appears that:—

1. The larger the conductor the longer is the economical span, and *vice versa*.

2. The higher the tension of stringing, the longer is the economical span, and *vice versa*.

3. The larger the conductors the greater is the difference between the economical span lengths for U.S.A. and Great Britain conditions respectively (this is due to the ice loading on the U.S.A. conductors).

4. The higher the tension of stringing the less is the cost of the transmission line.

5. The greater the number of conductors the shorter is the economical span length.

6. The economical span length is never shorter than 250 ft. for the cases taken.

7. A wooden pole is impracticable for an ultimate strength of 24,000 lb. and over, whereas for ultimate strengths up to 6,000 lb. wooden poles have always the advantage over steel poles.

8. Wooden poles are the more economical up to the points of divergence shown on the curves.

Span lengths of 600 to 700 ft. for U.S.A. and Canadian conditions are, in certain cases, shown to be justified. On the other hand, spans of 150 ft. appear never to be justified on economic grounds, even with the low tensions of stringing used in this country.

Under Board of Trade requirements the cost of supports for spans of 150 ft. is shown to exceed the cost of supports for the economical span lengths by as much as £100 per mile. Similarly, for the economical span lengths the cost of supports under Board of Trade requirements is shown to exceed the cost of supports under Canadian and U.S.A. requirements by as much as £100 per mile.

Consequently, the cost of supports for spans of 150 ft. under Board of Trade requirements exceeds the cost of supports for the economical span lengths under U.S.A. requirements by as much as £200 per mile. This is on the cost of supports delivered, but the cost of erection will be partly proportional to the number of poles, and consequently to the span lengths, so that the above-mentioned differences in cost when taken on such transmission lines completely erected will be greater.

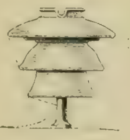

Fig. 4.—Method of Determining Length of Pin.

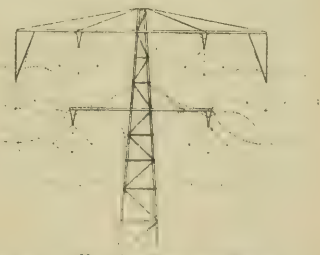

Fig. 5.—Clearances with Suspension Insulators.

From the foregoing it will be seen that it is expensive to obtain the factors of safety adopted in this country, especially on large conductors.

If any change were made, we could do with a higher factor of safety than that required by the Board of Trade Regulations for the smaller conductors, and a lower one for the larger.

Earth and Lightning Wires.

The use of a wire or wires to maintain a uniform earth potential throughout the line is desirable. Atmospheric disturbances may manifest themselves in the transmission line either as a direct lightning stroke or as an induced charge, in either case setting up a surge in the wires. Earth wires will never completely protect the line, and consequently the insulators may still be called upon to withstand surges due to lightning; nevertheless, they provide a considerable amount of protection.

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* This is attributable to Mr. C. W. Kay, and is patented.

On transmission lines with the design of which the author has been concerned, earth wires have usually been adopted as lightning shields, and in common with most transmission lines they have always been of galvanised steel. The use of steel for these wires, particularly when placed above the conductors, has been deprecated on the theory that owing to the shorter life of steel compared with, say, copper, such wires may break and, by fouling the conductors, interfere with the supply. The shorter life of steel earth wires may be made still shorter by crystallisation. Steel is much cheaper than copper or bronze, and before abandoning it in favour of more expensive metals its life might at least be made a maximum by fixing the wire with the same regard to crystallisation as in the case of any other wire. A flexible clamp for this purpose is described later.

Loads at Terminals, Angles, and Intermediate Positions.

The poles upon which a transmission line terminates must deal with the maximum load due to the tension in the wires under the severest conditions. Such load is, however, in the longitudinal direction, and the maximum load in the transverse direction is only that due to the wind on the wires under the worst conditions, which is generally very much less than in the longitudinal direction.

With wood poles the terminal pole is often designed for the transverse load and stayed in the longitudinal direction, this method dealing exactly with the stresses. Lattice-steel poles used as terminal poles are generally designed to carry the maximum load in the longitudinal direction without staying, and are almost invariably made of equal strength in both line and transverse directions—in other words, there is a waste of strength in the transverse direction.

A transmission line generally deviates from the straight at various points, thus necessitating poles to deal with these angles. The load on these poles will, of course, be the resultant of the maximum longitudinal loads due to the tension of the wires. The wind cannot be blowing in a direction normal to the wires in both the spans adjacent to the angle at the same time. Hence, when calculating the resultant angle load it would appear that the longitudinal stress in the two adjacent spans should be taken as the maximum stress that can occur in each adjacent span simultaneously.

At all points of the line other than terminals and angles, the stresses in the longitudinal direction are balanced, or very nearly so, excepting when a wire breaks. It is therefore unnecessary to have poles capable of dealing with the maximum longitudinal loads—hence the use of a third class of pole, generally known as intermediate poles, capable of dealing with the transverse load due to wind on the wires. There is, however, a considerable divergence in practice as to the strength of such poles in the longitudinal direction.

If pin insulators are used, the means of attachment to the insulators will generally permit of the conductors slipping; and if suspension insulators are used, then the insulator string can swing out into the span, so that in the event of a break in either case the full tension in the conductor will not be transmitted to the support. Moreover, almost any pole will deflect to some extent, which will further reduce the stress. In fact, the remaining load would not be much more than, say, equal to the transverse load in the conductor.

If provision be made for the breaking of one wire out of three, this would indicate that the intermediate poles should have a strength in the longitudinal direction of one-third that in the transverse direction. Thus, in the remote event of all wires breaking, the load would still be within the strength of the poles by virtue of their factor of safety plus their ability to deflect. This is about the strength of the wooden A-pole upon which excellent results have been obtained, and, in the author's opinion, it provides a good basis of design for all intermediate poles.

To be concluded.

Discussion in London.

Mr. A. P. **Trotter**, in opening the discussion, said that after the war important developments in overhead transmission were probable, both at home and abroad. He thought that the author's comparative diagram of transmission structures at home and abroad was scarcely fair, as the large tower construction was dictated by considerations not applicable here; there was no particular advantage in the equilateral triangle spacing unless it was wanted, and arrangements of wires in a vertical plane were open to objection if the upper wires sagged too much from any cause. The factors of safety as between this country and abroad were as 5 to 2, and he thought this was probably the ratio of the class of work in the two cases. As regarded the Board of Trade regulations, in some cases a lower wind pressure had been admitted; it was distinctly stated that no allowance was made for snow or ice; the regulations were dictated by the special conditions obtaining in this country, and there was no limit to H.T. spans mentioned, while the 200-ft. limit for L.T. spans could be exceeded if that course were justified. He found that 120 ft. was a standard span for Canadian L.T. wires, and in this country the standard was often 240 ft. for our pressures. There was no limit, however, and in one case a span of 1,426 ft. was in use. It did not necessarily result that the long span was the cheapest constructionally.

Mr. Alfred **Dickinson** deprecated the suggestion of the previous speaker that transmission work abroad, in the Colonies, was less efficiently carried out than at home. He complained that the Board of Trade regulations were too inflexible, and it should be understood and stated that they were to be modified on occasion. It was not possible to lay down any hard and fast rule for factor of safety, and design must be dictated by the conditions to be met.

Sir Wm. **Slingo** said that heavy Post Office spans, with 40 to 60 wires, reached 180 ft. in length to-day, and shorter spans were rarely used, while 10 or 20 years ago spans of up to 300 ft. were used. In the recent gales over £300,000 worth of damage had been done to Post Office wires, but not a single wire of 600 lb. weight fell through snow or ice. Where wires of over 400 lb. weight fell, it was always due to the structure failing. There had been many cases where the accumulation of snow and ice was in the form of a flat horizontal band, which did not offer much wind resistance: it was also noted that the size of wire did not affect the accumulation of snow, and 400-lb. wire or heavier would stand almost anything.

Mr. A. **Jacob** said he quite appreciated the gradual growth of Board of Trade practice, but, on the other hand, American practice could not be ignored, and modern examples compared well as regarded breakdown with lines in this country. Countries dependent on hydro-electric power used overhead transmission lines to a far greater extent than here, and were dependent on such lines. No doubt ultimately long-distance transmissions would be adopted here. As the cost increased rapidly with higher factors of safety, he asked why in worse conditions abroad was it possible to employ a factor of safety of 3, while we required one of 5. He thought it was as much the business of the Institution as of the Board of Trade to frame the required regulations. The author had omitted all reference to aluminium; the latest development was the use of steel-core aluminium cables, which got over the trouble of excessive sag. As regarded the possible redrafting of the regulations, he drew attention to the work of Mr. Evan Parry, for the New Zealand Government schemes, and suggested that it was well worthy of study. He also drew attention to the aluminium-reinforced steel catenary employed for traction purposes by the Canadian Northern Railway at Toronto.

Mr. J. S. **Highfield** agreed with Mr. Trotter that it was well to err on the side of security, which he thought would become increasingly important. The cost would necessarily be higher, but the annual charges were always less, and he thought in the end the cost was no greater. The arrangement of wires in a vertical plane resulted in short cross-arms of similar length, and was satisfactory: if tubular poles were employed, the insides had to be painted to prevent corrosion, and the Cornwall Power Co.'s engineers had introduced a method of pumping the pole full of paint and letting it run out again. Long spans decreased possible trouble with landowners, and excessive testing of material was a mistake: it was better to trust in good material than to indulge in excessive testing.

Mr. **Richards** asked what temperature was taken by the author in his curves of sag: the whole question turned on this temperature. He thought Mr. Welbourn had taken 60 deg. F. In connection with later curves, he noticed that the author took a temperature of 132 deg. F., and asked why: he (the speaker) usually took 122 deg. F. It was necessary to assume something to calculate the length of pole. The author's curves did not take into account maintenance and life; it was well known that in this country steel did not last as long as wood for poles.

Mr. J. C. **Wigham** said the enormous tower shown as used abroad, for comparison with poles used here, did not seem to be justified by the data in the curves which appeared in the paper. It was not appreciated that the factor of safety must be higher with small wires; that was why the Post Office wires came down and the power wires did not.

Mr. W. M. **Mordey** asked for some definite information as to the comparative adherence of snow to copper and aluminium wires, and Mr. Jacob mentioned that the latter metal had a greasy oxide skin, and snow did not adhere to it to the same extent as to copper.

The **President** (Mr. C. P. **Sparks**) remarked that the last two papers had been brought forward in view of the importance which the Council attached to electric supply developments in this country. Some 30 years ago he (the President) had assisted Dr. Ferranti in the Bond Street installation, where they were forced to go overhead because they could not go underground, and it was found that the wires were safer uninsulated. Dr. Ferranti was intending to use 10,000 volts, but this was stopped by the 42 years' franchise coming in, which made it possible to use underground cables, otherwise they might have had overhead wires through London to-day. He then referred to the electrical installation of the Powell-Duffryn Co., which turned out some 75 million units a year, and used a 30,000-volt, 3-phase overhead transmission on the Merz-Hunter split-phase system. The average pole spacing was 350 ft., and the maximum spacing 750 ft.; the Kay type of steel pole was employed, with screens over railway, telegraph, road, or other power line crossings. The ends of the line were connected through 30,000-volt paper-insulated cable, and no lightning arresters were used, the transformers being specially designed for the work.

The Author, in replying, said that high towers were employed because of the great span lengths. Despite the higher factor of safety adopted in this country, he could not agree that American and foreign transmission work was much less reliable; the Ontario Hydro-Electric Commission were satisfied with a lower factor of safety than usually adopted in American practice. The Board of Trade regulations did not result in an equal factor of safety with large and small wires. Many people were prejudiced against long spans under the mistaken impression that this lowered the factor of safety. He agreed with previous speakers on the evil of over-testing materials, and pointed out that under some conditions adequate insulation was almost impossible.

Mr. E. S. Byng, in a written communication, drew attention to the latest development in reinforced concrete poles. In the case of wood poles, the cost of timber was going up by leaps and bounds, and in view of the rapid depletion of the forests, particularly on account of the abnormal demands during the past two and a half years, it was exceedingly doubtful whether stout wooden poles above 45 ft. would be obtainable after the war at anything like a commercial figure. The weight of concrete had hitherto practically prohibited this system from being utilised more generally for overhead transmission routes. In the latest development of ferro-concrete poles there were at least two or three manufacturers in this country who had adopted a hollow form of pole. These were of various cross-sections, some being square, some round, and others triangular, but in each case the object was the same, namely, to leave out the concrete where it was not required in the structure. The weight of concrete as compared with a solid pole up to about 45 ft. was thereby reduced to approximately one-third, and in poles of greater height this reduction would be even more. Some three or four weeks ago he had an opportunity of inspecting some ferro-concrete poles at Fulham which had been erected in 1910. They had not depreciated in any way, and, in fact, appeared to have improved through age. The poles in question were of hollow construction, 45 ft. in height, 16 in. square at base, tapering to 8 in. square at the top. A similar pole had been tested to destruction, and withstood a horizontal pull at the top of 90 cwt. before collapsing. One of the chief points about these ferro-concrete poles was the density and uniformity of the concrete. This was obtained by a special method of manufacture, consisting of an oscillatory-vibratory motion applied to the moulds whilst the poles were being manufactured, but before the "initial set" occurred. The patentees of this system contended that the concrete was perfectly homogeneous and impervious to moisture, and the pole after erection was practically indestructible. A further advantage claimed for hollow poles was that the design and construction allowed for any number of brackets or arms to be attached after erection. There would appear to be no difficulty in now obtaining poles to any height required for power transmission, as one firm (The British Improved Construction Co.) were preparing designs for wireless telegraph masts upwards of 700 ft. high for use after the war. Over 3,000 concrete telegraph poles had been recently erected in New Zealand, and had proved a great success, although one objection to their extended use was the question of transport. This difficulty had been overcome to some extent by the reinforcement being designed so that it could be put together and the structure made on site. The amount of steel reinforcement was approximately only one-third of the weight of steel used in an equivalent pole of all-steel construction, therefore, the weight of material (steel and cement) to be transported to convenient places for manufacture at intervals along the route would be considerably less than that of an all-steel pole (either tubular or lattice-work). A suitable aggregate for the concrete could generally be found in the immediate vicinity, and as this represented by far the greater proportion of the material required the freightage was thereby reduced to a minimum. In these circumstances the initial cost of ferro-concrete poles now compared favourably with that of any other type of construction, although this would not be of first importance if the annual charges were equated when working out the economics of the alternative proposals. In the case of the former, the maintenance and depreciation charges would be practically nil, but in either wood, tubular or lattice-work poles these were quite an appreciable item, particularly in the case of the latter, where the framework had to be painted at frequent intervals in order to prevent corrosion, which would otherwise quickly occur.

Mr. G. V. Twiss's paper was read and discussed at a meeting of the Birmingham Local Section of the Institution of Electrical Engineers on April 25th, 1917.

Dr. Kapp said it was very satisfactory to find from the paper that English engineers had been so successful in extra-high-tension transmission work, which subject had up to the present been generally considered to be the special province of American engineers. He thought the author's allusion to the so-called "cheap water power" required qualification: as far as the cost of energy was influenced by capital outlay, water power was by no means cheap. The average of Italian hydro electric works was about £30 per kw. The new electricity works at Walsall cost a little under £8 per kw. Whether the cost of energy was actually less in a hydraulic works than in a steam works depended on the load factor and the utilisation of the by-products from the coal. If the recommendations recently brought before the Institution by Messrs. Paton and Cramp were carried out, the cost of energy produced in a thermic works would under all the circumstances be less than that produced by water power, and this country could compete with any country where there was abundant water power, so that the author's paper would be found of great importance in the future development of home industries. In discussing the potential gradients in a string of insulators the author alluded to the effect of series and shunt capacity; it was interesting to note that the influence of shunt capacity had also been found to constitute a difficulty in the so-called Wurtz lightning arrester. These appliances could not be used for very high voltages because the potential gradient between the first few cylinders close to the line was extremely steep, and the addition of more cylinders at the earth end of the series did not materially flatten it. This was due to the shunt capacity. An Italian engineer, Mr. Moligniano, had overcome this difficulty by artificially increasing the series capacity between the cylinders so as almost completely to swamp the shunt capacity. By this means he obtained an almost straight-line potential gradient, with the result that the Wurtz arrester could be used on lines of very high voltage. The author advocated the arrangement of wires shown in fig. 2, B3, for duplicated three-phase lines because no wires were in a vertical line, presumably in order that in the event of an upper wire breaking it should fall clear of all the others; a wire broke generally under wind pressure and then, it seemed to him, the broken end would be blown sidewise and would foul other wires whatever might be the geometrical disposition. Hence, an arrangement which would be electrically preferable might be adopted, such as the hexagonal disposition so frequently used in Switzerland. It had the advantage of shorter cross-arms and less inductance. With the very high voltage for which the author's lines were designed the reduction of inductance was not of much importance, but with moderate voltages, this reduction, combined with the increase of capacity, had a beneficent effect on the power factor of the line.

Mr. A. Goldie Engholm said that it was very important that the cost of maintenance for overhead transmission poles should be kept as low as possible. He had frequently found that Sherardising the iron fittings was better than galvanising, as very often the metal was eaten away underneath the galvanising, leaving only the outer skin, so that it was difficult by casual observation to detect such action.

Dr. C. C. Garrard said the subject would be of very greatly increased importance in this country in the near future. It had been imagined by some people that transmission lines at very high voltages were only necessary or desirable in connection with water powers; with a rational use of coal, however, it was possible that we could produce electricity at a total works cost (excluding distribution costs) of £2 per kw.-year with a load factor of 60 per cent. This approached the best results attained by water powers. Under these conditions extensive overhead transmission lines at high voltages would be very numerous. It followed from this that it was very desirable that the standardisation of British overhead equipment should be taken in hand by the Institution and the Engineering Standards Committee, in order that while maintaining the British reputation for high quality in this branch of engineering, as in others, the development of the industry should not be hindered by the survival of obsolete official regulations. With regard to the testing of line insulators, Dr. Garrard directed attention to the method recently worked out in the United States by which the actual resistance of H.T. insulators was measured. By this means insulators having a slight degree of porosity, which would break down after several years' service, were eliminated before being put into use.

NATIONAL INSURANCE ACTS. 1911—1915.

An application has been made to the Umpire for his decision as to liability in respect of platelayers employed in establishments carrying on any insured trade, involving reconsideration of decision 1,419.

Representations may be made to the Registrar, Office of the Umpire, 47, Victoria Street, London, S.W., on or before May 16th, 1917. The decision will be given on or after May 14th.

The following decisions have been given:—

Contributions are payable in respect of:

2,183X. Workmen engaged in the manufacture of gas-testing apparatus.

2,185X. Stablemen or other workmen employed in an establishment carrying on any trade insured under the National Insurance (Part II) (Munition Workers) Act, 1916, and engaged in tending horses which are used mainly on the premises of the establishment.

2,186X. Workmen employed in the manufacture of electrical appliances for railway signalling and for electric control of railway signalling installation.

2,187X. Workmen employed in the repair of coke oven bye-product plant.

2,188X. Workmen engaged in making incandescent oil lamps.

2,189X. Workmen engaged in adapting gas and candle fittings for electric light.

2,190X. Workmen engaged in making band saws and band knives.

2,193X. Workmen engaged in making (1) steering indicators, (2) fire control apparatus for large guns, and (3) stokehole indicators and danger signals.

2,191X Workmen engaged in drilling, filing, and riveting small iron castings such as caster horns, wardrobe hooks, &c.

2,197X. Workmen engaged wholly or mainly in the work of making metal, leather or rubber cycle and motor accessories.

2,202X. Workmen employed in the manufacture of metal barrels, drums, and tanks which are not intended to form part of the structure of buildings, ships, or vehicles.

2,217X. Workmen engaged in making and repairing steel barrows.

2,218X. Workmen employed in the manufacture of taximeters.

2,220X. Workmen engaged in the manufacture of brake blocks for cycles from vulcanised fibre, if intended for use in war.

2,221X. Workmen engaged in the installation in buildings or ships of accumulators for use in connection with electrical machinery.

2,222X. Metal workers engaged in the manufacture of kinematograph apparatus.

Contributions are not payable in respect of:

2,204. Workmen (other than those included under decision A.2,084X) (*Board of Trade Journal* of December 7th, 1916) engaged in the manufacture of asphalte and bitumen at works.

2,205. Workmen employed by a wireless telegraph company and engaged (1) in superintending and assisting in superintending the erection and maintenance of stations, and not employed wholly or mainly by way of manual labour, and (2) as works manager and assistant and foreman.

2,207. Workmen employed in the repair of coke oven plant (other than buildings, machinery, or bye-product plant).

2,208. Workmen employed by an electric supply company, and engaged in cleaning electric arc and incandescent lamps.

2,212. Workmen employed by gas companies, and engaged in the repair of gas retorts and retort settings.

2,213. Persons engaged in the manufacture of emery wheels which are not made in a mechanical engineering establishment solely for use in that establishment, and which are not for use in the manufacture of munitions of war.

WAR ITEMS.

Exports to China.—The "London Gazette" for May 8th contains further names of persons in Siam to whom exports may be consigned.

An American Searchlight Corps.—Forty-eight of the students at the Bliss Electrical School in Washington, U.S.A., have been formed into a searchlight unit under the Engineer Corps of the U.S. Army. The Corps, located in Washington, has recently been equipped with nine motor vehicles, four of which are fitted with 36-in. searchlights, four are travelling electricity generating plants to furnish the current for the projectors, while one is a supply vehicle.

Information Concerning Traders in Neutral Countries.—It is announced that information is being collected by the Foreign Trade Department of the Foreign Office from His Majesty's Consular officers abroad relating to firms in neutral countries with whom British houses could trade in place of firms of enemy origin or association which have been placed on the statutory list. The reports from His Majesty's Consular officers will give the names of firms desirous of trading with the United Kingdom, with references, bankers, commercial reputation, general nature of business, method of transport, principal goods immediately required, and whether the firm trades on own account or on commission basis. The following bodies have agreed to disseminate the information:—

The Association of Chambers of Commerce of the United Kingdom, Parliament Mansions, Orchard Street, S.W. 1, and its associated Chambers of Commerce.

The London Chamber of Commerce, 1, 2, and 3, Oxford Court, Cannon Street, E.C. 4

The Federation of British Industries, 39, St. James's Street, S.W. 1.

Certain approved trade associations and federations not associate members of any of the above organisations.

(Firms who are members of the associations enumerated above should apply for the information through one of these channels. The Foreign Trade Department reserves the right to refuse the information, in consultation with the Board of Trade, to any firm not British in character or dealing largely in articles competing with British manufactures. His Majesty's Consular officers have also been instructed to send duplicates of their reports to the Board of Trade, and the information will therefore also be available at the office of the Department of Commercial Intelligence of the Board of Trade, 73, Basinghall Street, E.C. 2.

Exemption Applications. At Blackpool, the Military Representative asked for the review of exemptions given to 10 employés at the Corporation electricity works, and the Mayor said the borough electrical engineer would have to make out a strong case for men between the ages of 31 and 36. Mr. Furness said he was not representing the men, but the service. The works had to run 24 hours a day, 365 days a year. The certificates of two switchboard attendants, one 28 and the other 31, were cancelled (not to be called up until substitutes were found), and the others were allowed temporary exemption to June 30th. The certificates of two electrical fitters on the tramways were also cancelled, a month being allowed.

Cambs. Tribunal refused exemption to H. J. Diver (41), electrician at Milton Hall, Milton, appealed for by Mr. W. B. Redfern.

At Sevenoaks, the Electricity Co. appealed for P. H. Topping (27; Class B 3), engineer; J. J. Wickenden (31, B 2), cable jointer; and J. A. Shaw (30, Class A), engine fitter. The manager stated that without the men they could not continue the work. Mr. Topping was refused exemption, and the others were given three months each.

Hastings Tribunal has refused exemption to Mr. W. P. Gower (34), electrician, in Class B 1, who stated that he was voluntarily assisting in hospital radiographic work, and had enrolled for National Service.

Weybridge Tribunal has granted conditional exemption to G. Whittle (40), second fireman, appealed for by the Urban Electric Supply Co., Ltd.

Brighton Tribunal, on April 27th, reviewed the cases of 38 men engaged on the Corporation tramways, those concerned being a traffic superintendent (39, Class B 1), three traffic inspectors, 26 motormen, seven skilled mechanics, and a night foreman. The exemption certificates were withdrawn, the Class A and B 1 men were each given three months, and the others six months. A similar decision was arrived at in the cases of eight men engaged at the Corporation dust destructor.

Nine men engaged in the Corporation electricity works were appealed for at Brighton. Two were given a final month, provided they are classed up to B 2, and the others were each allowed three months' open exemption.

At Aldershot, a renewed appeal was made by Mr. J. J. Vertue (37), electrical engineer and contractor, who stated that he had a large number of electric motors to keep in order, these being used by firms for industrial purposes. He also maintained fire alarms, and the electric light and bells at various public institutions. His partner had been taken over for Government work in connection with work on the high-tension wires. A final month was granted.

Southend-on-Sea Tribunal has refused exemption, with 14 days' grace, to seven tram drivers appealed for by the Corporation. Six are in Class A, and the other in B 1.

West Kent Appeal Court has refused exemption to W. H. Brown (36), and E. Wicks (27), electricians, appealed for by Messrs. Oswald Jones & Co., electrical engineers, of Maidstone. Both are passed for general service.

Messrs. Hill, Upton & Co., electrical engineers, Oxford, appealed to the County Tribunal for W. G. Payne (29), electrician. It was stated that 90 per cent. of the firm's business consisted of direct war work, and that Payne was engaged on work of national importance. At present he was engaged on installation work at an aerodrome, and did no private work. Only four out of the pre-war staff of 30 remained, and women had been tried with success. The appeal was refused.

At Chipping Norton, the Electric Light Co. appealed for the retention of Mr. W. H. Hellyar, manager of the undertaking. He was temporarily exempted for two months for a substitute to be obtained, there to be no further appeal without leave.

RECENT INVESTIGATIONS OF TRACTIVE RESISTANCES TO MOTOR TRUCKS ON ROADS AND PAVEMENTS.

An experimental investigation was carried on in the research division of the electrical engineering department, at the Massachusetts Institute of Technology, during the year 1915, under a fund contributed for researches on motor trucks, for the purpose of determining the tractive resistance of a motor delivery wagon with four wheels and solid rubber tires on various level urban roads and pavements.

Our contemporary *Science*, from whose pages we reprint this article, mentions that the complete report on this research was published in the *Proceedings* of the American Institute of Electrical Engineers, June, 1916.

By "tractive resistance" is meant the horizontal force necessary to apply to the truck in order to keep it at a constant speed in still air after deducting axle frictions and internal-mechanism losses. It is, therefore, the reactive force offered by the truck, assumed internally frictionless, in overcoming the road, tire and still-air resistances on a level surface. It may be expressed either in pounds weight per short ton of total moving mass, or in kilogrammes per metric ton, or in per cent. equivalent grade. Thus a 1 per cent equivalent grade tractive resistance means that a car without axle friction or other internal mechanism losses would require to be pulled on a level road at a constant stated speed by a force of 20 lb. per short ton of 2,000 lb. in order to overcome the resistance of the tires, road-bed, and still-air displacement. This force would obviously serve to propel the same vehicle up a 1 per cent. grade in the absence of tire, road-bed, still air, and internal frictions. At a given speed, therefore, this tractive resistance depends upon the wheel, the tire, and the road, and also on the air-displacement resistance of the truck.

The truck tested was a 1,000-lb. (450-kg.) electrically-propelled delivery wagon equipped with single solid rubber tires, one on each of the four wheels—the tire rating being 36 in. by 2½ in. (914 mm. by 63.5 mm.). The tests were made by running the car at, as nearly as possible, constant measured speed, in alternate directions, over selected lengths of standard roads in and near Boston. From the observed storage-battery outputs during these runs, the corresponding tractive resistances were evaluated after correcting for all losses internal to the truck mechanism, wind losses, grade, and incidental accelerations. The internal losses of the truck mechanism from battery terminals to wheel spokes were determined from laboratory tests with the car raised from the ground on jacks, and by driving tested dynamos from the rear wheels.

The following is a summary of the results obtained as applying to urban roads with this truck between the speed limits of from 13 to 25 km. per hour (8 to 15.5 miles per hour):—

1. The over-all efficiency of the test-truck mechanism between battery terminals and rear-wheel treads reached a maximum value of about 78 per cent., under the most favourable conditions.

2. The mechanical efficiency of transmission from motor shaft to rear-wheel treads, for the truck tested, shaft-driven through a single-reduction worm gear, was found as high as 90 per cent.

3. Under the conditions of these tests, the tractive resistance on level roads, in the absence of wind, is composed of (*a*) displacement resistance, (*b*) impact resistance, and (*c*) air resistance.

By "displacement resistance" is meant that portion of the tractive resistance which depends on the lack of resilience of a smooth road surface and of the wheel-tire material; *i.e.*, on the energy losses due to inelastic displacement of tire and road-surface materials.

By "impact resistance" is meant that portion of the tractive resistance which depends on the lack of smoothness of the road surface, and which is due to the impacts given to the moving vehicle by the irregularities of the road.

By "air resistance" is meant that portion of the tractive resistance due to air pressure on the moving vehicle necessary to displace the air in the absence of wind.

4. The displacement resistance varied from 0.85 per cent. equivalent grade, for a hard smooth asphalt or bituminous concrete, to 1.6 per cent. for a very soft tar-macadam road, and was practically constant, for all speeds considered, on any given road.

5. The impact resistance increases with the velocity, with the total weight of vehicle, and with increasing road-surface roughness. In these tests, the impact resistance of good asphalt or bitulithic or other smooth pavement was practically negligible, and reached its highest values (about 1.5 per cent. equivalent grade at a speed of 20 km. per hr.—12.4 miles per hr.) on granite-block roads with sand-filled joints, and on badly worn macadam pavements. The rate of increase of impact resistance with speed was most marked on the roughest roads.

6. At the vehicle speed of 20 km. (12.4 miles) per hour, the air resistance for the vehicle tested, assumed to be dependent only on the speed, was roughly 0.11 per cent. equivalent grade, *i.e.*, from 4 per cent. of the highest to 12.5 per cent. of the lowest total tractive resistance.

7. The following urban pavements are enumerated in the order of their desirability for vehicle operation from the point of view of tractive resistance at 20 km. (12.4 miles) per hour, as found in this investigation: (1) asphalt, (2) wood block, (3) hard smooth macadam, (4) brick block, (5) granite block with cement-filled joints, (6) cinder, (7) gravel, (8) granite block with sand-filled joints.

8. The equivalent grade at 20 km. (12.4 miles) per hour of a badly worn city macadam road was found to be nearly three times as great as that of the best asphalt road tested. This means, at this speed, a consumption of energy at wheel treads of nearly three times as much on level poor macadam roads as on good level asphalt roads.

9. Increasing the gross weight of the vehicle by 12 per cent. through load was found to have no effect on tractive resistance within the observed speed limits for smooth roads in good condition; but on rough roads a distinct increase in tractive resistance with this extra weight was observed.

10. The presence of a layer of dust, say, 1 cm. thick, on a fair macadam road was found to increase the equivalent grade of tractive resistance, at a speed of 20 miles (12.4 km.) per hour, from 1.17 to 1.32 per cent.

11. A freshly tarred, and therefore very soft, tar-macadam road was found to have an increased tractive resistance equivalent grade, at substantially all tested speeds, of about 0.5 per cent. The tires in this case sank about 0.8 in. (2 cm.) into the road bed, the gross car weight being 2,140 kg. (4,718 lb.).

12. The total range of tractive resistance equivalent grade covered in the tests was from 0.93 per cent. on the best asphalt road, at lowest speed, to 2.7 per cent. on the worst macadam road, at nearly the highest speed.

13. The results indicate, as has already been pointed out by other observers, the importance of constructing and maintaining smooth, hard, and clean roads from the point of view of tractive resistance. Low tractive resistance means small gasoline consumption for gasoline trucks, and a reduced electricity expense or greater daily mileage with electric trucks.

14. Other problems which are of practical importance to vehicle designers and operators, and which require further investigation, are the following:

(*a*) Tractive resistance on country roads.

(*b*) Tractive resistances to vehicles with different wheel tires.

(*c*) Tractive resistances of urban roads at low speeds from 0 to 10 miles per hour (16 km per hour).

(*d*) Tractive resistances at speeds higher than 15 miles per hour (24 km. per hour).

(*e*) Tractive resistances for high-capacity trucks.

15. The results of the tests here reported have been found to be in substantial agreement with those obtained by other observers employing somewhat different methods; but the analysis of tractive resistance into its components here presented appears to be new, and is recommended for use in similar investigations or tests.

The authors of the report, Messrs. A. E. Kennelly and O. R. Schurig, express their indebtedness to Mr. Thomas A. Edison, and also to the Gould Storage Battery Co., for funds by which the research was made possible.

LEGAL.

North of Scotland Electric Light and Power Co., Ltd., *v.* North of Scotland Fish Guano Co., Ltd.

In the Court of Session, Edinburgh, Lord Cullen allowed proof some time ago in the action in which plaintiffs, of Montrose, sued the defendants, of Aberdeen, for £93 14s., said to be due and resting owing, and for £1,000 as damages for breach of contract. The pursuers stated that in April, 1913, they entered into an agreement with the defenders, who had a manufactory in Montrose, to erect certain plant for defenders in Montrose, and the defenders undertook to pay the pursuers £500 for electrical energy in addition to charges for hire of plant. In December, 1915, the defenders intimated that they were closing their Montrose works, and asked the pursuers to dismantle and take away the motors. The pursuers contended that the defenders had no power to terminate the contract in such a manner, and stated that, in order to carry out the contract with the defenders, they had found it necessary to increase their plant at a capital cost of £3,420. The defenders maintained that the difference between the parties fell to be decided by arbitration. They explained that the termination of the contract was occasioned and justified by the actions of the King's enemies and the existence of a state of war, in respect that the whole fishing trade of the North and East of Scotland and the import of raw material for the defenders' works and business at Montrose had been stopped. It was, therefore, impossible for them to carry on business there, and the contract had become impossible of performance. The action has now been taken out of Court by joint minute, having been settled by a payment to the pursuers of a sum in name of damages and expenses.

Laycock *v.* South London Electric Supply Corporation, Ltd.

Horace Scott Laycock made an application to the Lambeth Court to determine the nature and amount of security to be given by him to the defendants in respect of the supply of electrical energy to the premises known as Khaki Hall, Acre Lane, Brixton.

Mr. Laycock said that he was leaseholder of the Khaki Hall. On March 12th, 1915, he entered into an agreement with the company for the supply of electricity on special terms. It was agreed that his account should be paid weekly, and no security was asked for, as under that arrangement the company had power to cut off the supply if he failed to pay. On April 18th last the company wrote to him demanding a deposit of £20 on the ground of the difficulty of obtaining payment of his accounts. He replied that the weekly payments had been regularly made, and refused to make a deposit of £20, seeing that he had made a claim of £39 against the company in respect of alleged overcharges. The yearly consumption amounted to about £250, and that had been regularly paid for. After he refused to make a deposit the company cut off the supply, and he had to deposit £20 under protest in order to get it restored.

Mr. Parsons (an official of the company): The company's case is summed up in the letter of April 18th :—"Owing to the difficulty which is always experienced in obtaining payment of your account." There are always two or three weeks owing. The company were only able to obtain payment of their accounts by threatening to cut off the supply, and Mr. Laycock was liable to be called up at short notice. Although the company did not ask for any deposit when the agreement was entered into, they were entitled to ask for one at any time they thought it necessary.

Mr. Laycock said it was nonsense to suggest that the company were only able to obtain their money by threatening to disconnect the supply.

Mr. Biron came to the conclusion that, in all the circumstances, £20 was not an unreasonable amount for the company to require as a deposit.—*Morning Advertiser.*

British Power, Traction, and Lighting Co., Ltd., *v.* Hodgson.

This protracted litigation was settled on an appeal by Mr. A. E. Hodgson from a judgment of Mr. Justice Peterson of November last, the hearing of which was concluded before the Master of the Rolls and Justices Bankes and Warrington on Tuesday last.

The order appealed from declared that Mr. Hodgson was liable to bring into Court a sum of £7,000 odd found due from him on taking an account ordered by a consent judgment in May, 1905, in an action brought against him in respect of dealings in 1901. In answer to the claim the defendant set up his bankruptcy and discharge, but the plaintiffs contended that the original action was based on fraud, and therefore bankruptcy was no answer.

The Master of the Rolls, in giving judgment, said the matter was so complicated as to be almost beyond endurance. That Mr. Hodgson had no right to the money for which the company sued, was beyond question: but he failed to see that it had been established that it was agreed that the consent judgment should be a judgment for a debt incurred by fraud or fraudulent breach of trust. For that reason, Mr. Hodgson must succeed, and the appeal must be allowed in so far as the judgment of the Court below held the defendant outside the provisions of the Bankruptcy Act.

The other Lords Justices concurred, and the appeal was allowed accordingly.

REVIEWS.

Some Modern Methods of Ventilation. By R. Grierson, A.M.I.Mech.E. London: Constable & Co., Ltd. Price 8s. 6d. net.

The ventilation, like the heating, of buildings is a subject which until recent years has not received a fraction of the investigation that it undoubtedly merits. Heating and ventilation are two of the three fundamental factors which make or mar our personal comfort, and, unfortunately, are by no means easy to control; lighting is the third factor, but has been so exhaustively studied that it presents no great difficulties to the engineer who has provided himself with the proper qualifications, and as for the minor features of our indoor environment, such as furniture and decoration, they are comparatively elementary matters. Even in the case of public buildings of the most modern construction grave errors are frequently met with in respect of the arrangements made for heating and ventilation, errors, moreover, which it is almost impossible completely to rectify when the building is finished and occupied. Hence, we cordially welcome this book, based upon a wide experience, which should afford valuable assistance to architects and engineers responsible for the design of ventilating systems.

The author begins by pointing out the illusion under which we have laboured in past times with regard to the supposed deleterious effects of carbon dioxide, and lays stress on the fact proved by Dr. Leonard Hill and others that "*the physical effect upon the skin is the supremely important thing for us, not its chemical effect.*" He then gives data as to the quantity, &c., of air required in stated cases, together with the principles to be followed in designing a system of ventilation. He advocates the "balanced" system in which one fan pumps fresh air inwards and another removes the vitiated air, and shows how the apparatus and air ducts should be arranged, with the aid of numerous plans and half-tone illustrations. The design of air ducts and registers is adequately dealt with, various types of fans are discussed, apparatus for "conditioning" air as regards humidity and temperature are described, and methods of control are explained. The use and production of ozone forms the subject of a brief chapter, after which the instruments available for measuring the qualities of the air supply are described, and the tests to be made are discussed. For driving fans the electric motor is, of course, recommended, and information is given to assist the purchaser in selecting suitable apparatus; sample specifications are also provided. The last chapter briefly describes the use of wet air filters for cooling electrical machinery. We have no hesitation in commending this practical and instructive book to those who are concerned with the subject of ventilation.

Principles of Alternating Current Machinery. By Ralph R. Lawrence, Assoc. Prof. of Electrical Engineering of the Massachusetts Institute of Technology and Harvard University. London: Hill Publishing Co. Price 18s. 9d. net.

This is an excellent general text-book of the subject indicated by the title—indeed, the reviewer thinks it is, on the whole, the best book of the kind which has appeared for some years.

Too many of the text-books in general use are based on the types of machinery which were "modern" 10 years ago, or even more, and, although they have perhaps been "brought up-to-date" by the addition of sections dealing with turbine generators and commutator motors, the general plan is still the same as that which appeared to be the best to follow when the field to be covered was much more restricted than it is at the present time.

Although the author modestly disclaims the use of new methods in his treatment, and only professes to have collected material from existing sources, his work deserves recognation for the judgment used in the selection of material and in its excellent arrangement, which constantly displays a freshness and a breadth of view which makes the book highly instructive and helpful.

Prof. Lawrence has written a text-book on the principles of electrical machinery as it is at present developed. In doing so, he has kept constantly before him modern developments, modern problems, and modern points of view. Thus, even in the earliest chapters he has approached the subject with only modern types of machines in view, and with constant reference to the modern conditions which determine their output and performance.

A good example of how this method of treatment has profited by taking a wide view, instead of keeping to the older conventional methods, is his treatment of the subject of alternator armature reactions (Chapter IV). After a general explanation of the nature of armature reaction (or armature magnetomotive force), he proceeds to discuss the reaction for the case of an alternator with non-salient poles and a distributed winding. He is thus able to arrive at a result which is fairly simple and, at the same time, practically accurate. The consideration of the armature reaction in alternators having salient poles is next treated as a more complex example of the principles already explained.

The induction of voltage in the armature, taking into account the shape of the flux curve and the angle of embrace of the coils, is concisely and clearly explained. This is followed by a simple, but adequate, discussion of the effect of the spacing of the armature winding on the resultant voltage and wave-form.

After discussing the principles of armature reaction, the author deals with the calculation of the regulation of an alternator by the synchronous impedance, magnetomotive force, Potier, American Institute, and Blondell's two-reactance methods.

Methods of obtaining values for the leakage reactance from the short-circuit test and zero power-factor characteristic are followed by the determination of effective armature resistance.

Further chapters deal with the experimental determination of losses and heating tests, and are followed by a detailed calculation of the constants of a 1,000-K.V.A. machine from the constructional data.

Altogether 150 pages are devoted to the alternator, and it will be gathered that the most important principles of the machine receive very comprehensive treatment so far as they are concerned with construction, behaviour, and operation, as distinguished from actual details of design.

In completing our analysis of the contents of the book, it will be unnecessary to enter equally fully into the treatment of other types of machines, as the treatment is carried out with the same thoroughness and judgment.

Transformers are next dealt with. After a description of details of construction, the magnitude and wave-form of the magnetising current are dealt with, and the reason for the current rush on switching on is given, though the stresses set up in the insulation on opening or closing the circuit are not considered in detail. Vector equations and the "equivalent circuit" of the transformer are given. Here and elsewhere the notation employed does not distinguish between vectors and numerical values of the quantities expressed. This leads to absurdities such as (see p. 192)—

$$\mathrm{I}_2 = \mathrm{I}_2\,(\cos\theta_2 - j\sin\theta_2),$$

and on page 305—

$$-\,\mathrm{A} = \mathrm{A}\,(\cos\theta - j\sin\theta),$$

and other similar expressions.

The synchronous motor is clearly treated by means of vectors, and the subject of the distribution of the load between parallel alternators as affected by various conditions, *e.g.*, the characteristics of the driving engines, is well explained. The main points characterising the synchronous converter are concisely given.

The section on polyphase induction motors contains a very full analytical treatment by means of vectors, and is well calculated to give an insight into the principles underlying their operation. The induction motor is regarded as a special form of transformer, which enables the vector equations to be obtained in a simple manner. Here again, however, the notation appears to be much less clear than is desirable, and a student might easily be led astray by using it; for instance, in obtaining power as the product of a current and voltage, seeing that it is never very clear where a symbol used for a current or voltage denotes a numerical value or a vector.

The single-phase induction motor is dealt with in rather general terms without any very satisfactory diagram of its operation, though the student should be enabled to form a fairly clear idea of the main principles from the treatment given.

The various forms of single-phase motors with a commutator are discussed in the last chapters. Here, again, a close analysis of the operation is not given, but the underlying principles of their working are clearly explained.

In conclusion, we can congratulate the author on the production of an excellent students' text-book, which is thoroughly sound and calculated to form a substantial general foundation of knowledge on which the student can develop a specialised study in any direction without feeling that he starts with only nebulous ideas lacking a definite basis. For students of electrical engineering in universities or technical colleges the work can be cordially commended.

* * *

The Calculation and Measurement of Inductance and Capacity. By W. H. Nottage. London: The Wireless Press, Ltd. Price 2s. 6d.

This is a useful summary, in a condensed and handy form, of rules and formulæ for the calculation of the inductances and capacities of the various conductors used in wireless telegraphy, followed by brief descriptions of the apparatus and methods of measurement employed in the determination of these quantities.

The book divides itself naturally into two sections, the first dealing with the formulæ for calculation, and the second with measurement.

The formulæ are derived from many sources, published papers, &c., and are generally clearly given in a form indicating the purpose and limitations of their application, while the necessary tables of constants are also appended. The origin of the formulæ is generally stated (an important and valuable feature), and incidental examples of their application to actual problems are also interpolated in a number of cases. Little or no attempt is made to give the method of derivation of the formulæ, and, indeed, any such attempt would have completely altered the character of the book and necessitated its conversion into a theoretical treatise instead of a collection of formulæ.

To give a general idea of the contents of this section, it will be sufficient to enumerate a few of the principal formulæ given.

The inductance of a straight cylindrical wire and of a thin tape is followed by values for parallel conductors. Then follows the inductance of a coil (Nagaska's formula), with developments for various forms of winding as given by Rosa, Butterworth, and others. Mutual inductance between conductors and coils is next introduced, including a simple graphical method by the author for the mutual inductance of two single-layer coils.

In dealing with the capacity of conductors of various forms, a similar procedure is adopted, and the consideration of plates and simple line conductors is followed by that of various forms of antennæ, while the influence of the earth and of masts and buildings is also included.

While the author rightly employs absolute electrostatic units in his formulæ dealing with capacity, he makes one or two slips where other units are referred to. Thus, on page 38 he boldly makes the statement that "the absolute unit on the electromagnetic system is the farad, and the practical unit the microfarad." Of course, the farad is 10^{-9} (or one thousand-millionth) of the absolute unit of capacity in the electromagnetic system. On the same page we read: "In calculating capacity, if all dimensions be in centimetres the capacity is given in electrostatic units or centimetres." While this is perfectly true of the formulæ which follow, it is somewhat misleading, seeing that the centimetre is the unit dimension applied to conductors of both electromagnetic and electrostatic systems, whereas it is the dimensions of the unit of quantity of electricity which is the real characteristic of the electrostatic system, and which determines the unit in which capacity will be given.

On page 55 there is a mistake in the equation for V, owing to the substitution of mmfds. (micro-micro-farads) for electrostatic units of capacity. Seeing that one mmfd. is equal to 0.9 electrostatic units, the error introduced is not large.

The second part of the book deals with methods of measurement, and the author has collected together a large number of alternative methods for measuring inductances and capacities, some of which are not well known to the ordinary worker. The chapter on the measurement of inductances gives the diagram of connections and the ratios when balance has been obtained for a great many "bridge" methods. The chapter on capacity measurement deals similarly with alternative methods of carrying out capacity tests, while another chapter describes the methods to be used where high-frequency currents are employed. The last chapter gives particulars of a number of special appliances used in measurement, such as standards of inductance and capacity, high-frequency generators, wave-filters, vibration galvanometers, secohmmeters, &c.

The summary of the methods and appliances used in measurement which occupies the last chapters of the book is likely to prove useful and handy for reference. Little attempt is made to discriminate between the various methods or to point out their relative advantages, defects or limits of accuracy. Also, no detailed instructions or cautions are given for carrying out the measurement. This would have entailed considerable extension of the scope of the work and would have changed its character from that of a concise summary to that of a text-book. We may perhaps hope that at some future time the author may carry out this more ambitious scheme.

On the whole, the diagrams are clear, though the curve on page 42 has been so much reduced that the figures indicating the scales have become quite illegible. Another minor criticism is the use in one part of the book of the symbol "ω" to denote the quantity $2 \pi n$ which is later always expressed as "p."

As a compact volume of reference for those who are concerned with calculations or measurements of inductances and capacity this modest work can be cordially commended.

BUSINESS NOTES.

Russian Exhibition in London.—We have received some literature regarding the Russian Exhibition which is being held this month at the Grafton Galleries in Bond Street, W. The Exhibition has a Russian Commercial Bureau, under the care of Mr. R. A. Lenski, and a Russian Trade Section, where information can be obtained on matters affecting Russian commerce and industry. The Exhibition has the Royal patronage, and among the exhibits is a collection of Russian trade catalogues. The Russian Consul-General is daily in attendance, assisted by a staff of Russian commercial authorities. Mr. Lenski has issued a pamphlet on "The Russian Market, and How to Enter it."

Book Notices.—We have received a copy of No. 1 of "The Channel," a bi-monthly sixpenny "Clyde Shipbuilding, Engineering and Electrical Gazette," which is published at 131, Newark Street, Greenock. It contains a good deal of useful and interesting matter on such subjects as:—Lost Time in Shipyards, The Trend of Development in Marine Engineering, The Story of Petroleum, Electric Supply Costs (by Mr. F. H. Whysall), Proceedings of Societies, Technical Queries, and so on.

"*Journal* of the Institution of Electrical Engineers." Vol. LV. April, 1917. No. 265.—This issue contains the following papers:—Voltage Regulation of Rotary Converters, by Mr. G. A. Juhlin; Machine-Switching Telephone Gear, by Mr. F. R. McBerty; Determination of the Sequence of Phases from Wattmeter Readings, by Dr. G. Kapp; Chairman's Address to the Hong-Kong Local Centre; also the Report of the Council and the Statement of Accounts for the year.

We have received a copy of No. 1 of the "Windsor Works Magazine," a twopenny monthly publication issued by Messrs. G. D. Peters & Co., Ltd., of Windsor Works, Slough, manufacturers of rolling-stock supplies.

Bankruptcy Proceedings.—J. G. S. Cunnington and H. P. Allison (Laing, Wharton & Cunnington), electrical engineers and contractors, 7, Great Newport Street, London. Supplemental dividend of 5¾d. in the £.

James Brockie, mechanical engineer, 41, London Road, Forest Hill.—Trustee released April 28th.

British X-ray Industry.—It is announced in the *Daily Telegraph* that a section of the British Electrical and Allied Manufacturers' Association has been formed enrolling British manufacturers of X-ray and electro-medical apparatus, with the object of improving the status and prospects of the industry by co-operation and research. Mr. Dunlop writes to our contemporary: "Since 1914 great strides have been made by individual British manufacturers, and it is hoped that the enrolment of its members as a section of this association will further help to place and maintain this important industry in a position where it can supply not only the home trade but the whole of the Empire. British manufacturers have been at a serious disadvantage owing to lack of co-operation by which to meet the keen competition which existed in the world market. The section views most hopefully the future of the X-ray and electro-medical industry in this country, and earnestly invites the co-operation of medical men and hospitals with the object of supporting and strengthening the movement towards the exclusion of foreign-made apparatus."

Catalogues and Lists.—Sceando Lamp Co., Ltd. 7, Blackfriars Street, Salford, Manchester.—Folder giving revised prices of "Sceando" half-watt and Axial lamps. The revision is due to increased cost of raw materials and wages.

Messrs. T. W. Broadbent, Ltd., Victoria Electrical Works, East Parade, Huddersfield.—Leaflet No. 6, describing and giving weights, dimensions, and prices of their R type A.C. slip-ring induction motors. Copies will be sent on application.

Messrs. Ferranti, Ltd., Central House, Kingsway, London, W.C. —List Pa. 550/E, containing a description, with illustrations, prices, weights, and code-words of their standard H.T. interlocked, iron-clad switch cubicles.

Liquidation.—Kilowatt Publishing Co., Ltd.—A meeting is called for June 7th, to hear an account of the winding up from the liquidators, Messrs. A. Webster & E. A. Burnie.

British De-Tinning Progress.—We are pleased to learn that the British De-Tinning Co.'s scheme for dealing with old tins and the like is making satisfactory progress, despite many obstacles, mainly occasioned by war conditions. Not only does the project conserve wealth, as represented by various valuable metals, but also it creates a new British industry in place of what was formerly a German monopoly, some forty or fifty thousand tons of waste metal having been annually exported in pre-war days. Some of the Departments of the Ministry of Munitions are now showing considerable interest in the scheme, and arrangements are being made for the British De-Tinning Co. to utilise waste metals from the front and other military sources.

The company has issued a booklet entitled "Capturing a German Monopoly," which contains full reports of the proceedings at a Conference held at the Caxton Hall, London, in December last, together with reprints from the Press and other interesting matter. There is also an introductory article which deals fully with all aspects of the subject. A copy of this work will be sent free to those interested. A Committee was appointed by the Conference to investigate the processes and report on the soundness of the proposals so far as they affect municipal authorities. A building for practical demonstrations has now been completed at Wandsworth, and we understand that the Committee will shortly be asked to visit this works.

A subsidiary company has been formed with offices in Glasgow, and buildings have been acquired which will shortly be in full operation. Its operations will be superintended by the parent company in London.

LIGHTING AND POWER NOTES.

Aberdeen.—With reference to the recent sanction for borrowing £40,000 for the electricity undertaking, this is for the provision of a 5,000-KW. turbine plant, new buildings, sub-station plant, cables, &c.

Australia.—The Flinders Council (Vic.) has decided to apply for an Order in Council authorising the installation of electric light and power at Sorrento.

The Melbourne City Council electricity undertaking proposes experimenting with Victorian brown coal for the production of power.

Application has been made by the Lockhart Municipality (N.S.W.) for power to generate and supply electricity.—*Tenders.*

The report of the working of the Footscray (Vic.) electric light undertaking for the year 1915-16 shows a gross profit amounting to £6,154, and a net profit of £4,173: since the inauguration of the scheme the net profit has been £9,683. Of this £1,000 had been placed to the credit of the general revenue of the city. In addition, the Lighting Committee's credit balance, averaging £3,500 a year, had been used in the city's general financial operations, thus reducing the usual overdraft.—*Melbourne Age.*

Baildon (Yorks.).—The Shipley Electricity Committee has recently been notified by the Baildon Council, in reply to its offer to supply electricity to Baildon, that it favours the terms offered by the Bradford Corporation, and has asked the latter to forward a draft agreement.

Bradford.—The severely restricted lighting during the past year has occasioned much complaint, but some satisfaction is derived from the fact that the past year's expenditure of the city has been £10,000 less than the estimates, chiefly due to reduced cost of public lighting.

Burnley.—Wages.—The applications on behalf of the National Union of General Workers for an increase in the wages of electricity employés, bringing up the total advance to 12s. a week since the war, has been referred to a Sub-Committee. Similar applications are being made in other Lancashire towns.

Burton-on-Trent.—Subject to consent, an induced draught fan is to be fitted to increase the steaming capacity of three boilers. The cost of this is estimated at £400, and it is hoped it will meet the anticipated demand for electricity next winter.

Crewe.—Year's Working.—The electricity department has sustained a loss of £1,173 on the year's working owing to the great increase in the cost of fuel, wages, &c.

Continental.—Norway.—According to a report by the U.S. Consul-General at Washington, the Norwegian Government has recently been advised by the Committee of the Storthing not to allow foreigners or foreign companies to acquire waterfalls in Norway, except in special circumstances. The power contained in the Norwegian waterfalls has been estimated at from 6,000,000 to 10,000,000 H.P., and the development of these falls has been accomplished largely through the aid of foreign capital.

The acquisition of water power by foreigners in Norway is regulated by the Law of September 18th, 1909, by the terms of which only the Norwegian Government or Municipalities or Norwegian subjects were permitted to acquire waterfalls of more than 1,000 H.P. without Government sanction for each individual case. This Law was made more stringent by the Law of August 4th, 1911, which provided, *inter alia*, for a tax payable to the local authority and the State.

A Royal Commission, which has been at work for several years on a revision of concession legislation, has just submitted to the Storthing a new Bill. Under this Bill it will be more difficult for foreigners to invest capital in Norwegian industrial enterprises and other real property. It is also proposed that foreign subjects and companies shall not be allowed to acquire concessions except in special cases, as, for instance, when an industrial concern already in operation wishes to acquire or regulate a waterfall. Joint stock and other limited liability companies must in future have an entirely Norwegian board, with registered offices in Norway, and exclusively Norwegian capital, in order to obtain permission to acquire waterfalls.—*Board of Trade Journal.*

Darwen.—The loss on the year's working of the Corporation electricity undertaking has been £2,889; the Daylight Saving Bill is stated to have reduced the revenue by over £1,000.

Doncaster.—Price Revision.—The Electricity Committee has recommended the T.C. to revise the scale of charges in works where motors aggregating 100 KW. and over are installed, in view of applications received from several big firms for supplies of current for power. A sliding scale is to be charged, according to the load factor, from 60 per cent. down to 25 per cent., the price at 25 per cent. to remain unchanged.

Halifax.—Wages.—The Town Council, last week, adopted the recommendation of a Special Committee that the wages of all Corporation employés of 21 years of age, except those of the clerical staff and the tramways department, be increased as from April 1st, to bring them, including war bonus, to 8s. per week above the pre-war standard.

Hull.—The Electricity Committee last week considered the application of the employés of the Sculcoates Lane power station for increased wages. It was decided to refer the matter to the Board of Trade for arbitration.

Lincoln.—Referring to some remarks passed at the annual meeting of a local firm, Ald. White stated that the Corporation had supplied them with 802,000 units in the year to March, 1915, 1½ million units in 1916, and 3¼ million units in the year ended March, 1917. They had had to utilise some of their old plant, as they could not obtain the necessary permission to borrow money for new plant during the war.

Liverpool.—At a recent meeting of the City Council, Mr. Gates protested against an expenditure by the Electricity Committee on two new cooling towers at Lister Drive power station and two rotary converters and switchgear. He complained that this capital expenditure, which he estimated at £30,000, was in contravention of Government policy, and alleged that the business of the Committee was settled without tenders being invited. The Committee's recommendations were approved.

London.—The Battersea Electricity Committee recommends that an additional 5s. per week wages be granted to all employés, and 2s. 6d. per week to boys and women, the increase to date from April 1st. The recommendation will not apply to fitters and fitter's mates whose cases were dealt with previously.

Hackney.—The Electricity Committee has decided to recommend a general increase in the price of electricity for all purposes, except as regards slot-meter supply.

New Zealand.—An interim report by Mr. Evan Parry on the hydro-electric development of the North Island has been published. The best scheme involves three water-power sources to supply Hawke's Bay district, Auckland district, and Wellington district. For Auckland, the taking over of the Hora Hora works of the Waihi Co. was considered; but the best source of power, eight miles away from Hora Hora, is in the Arapuni Gorge, where 120,000 H.P. could be obtained on a 50 per cent. load-factor basis. Mr. Parry considers that this scheme would be justified if only 40,000 H.P. were developed in the first instance, and that the cost of such a plant, with transmissions for serving surrounding towns and districts, would amount to £1,200,000. The most suitable source of power for the supply to Wellington is the Mangahao River, where 25,000 H.P. can be obtained on a 50 per cent. load-factor basis: in time, another source of power in the Taranaki district might be developed to supplement this. The hydro-electric plant would cost about £420,000, while transmissions would bring the total up to £1,000,000. A modified scheme suggested would cost £448,000. It is proposed that instead of providing spare hydro-electric plant, a portion of the existing Wellington steam plant should be utilised, Mr. Parry considering that this would have advantages in security over water plant, which is subject to low-water difficulties.

Peterborough.—The T.C. has decided to extend the supply cable to the works of the Birmingham Wagon Co., who will pay part of the cost.

Rochdale.—The Electricity Committee is recommending that the price of energy for power and traction be increased by ·3d. per unit instead of the present 15 per cent., and for lighting by 25 per cent., instead of the present 10 per cent. A coal clause is to be introduced in future contracts, and it is expected to obtain an extra revenue of £10,000 a year.

Salford.—Year's Working.—The following particulars have been given in the local Press as to the working of the electricity undertaking during 1916-17:—The energy sold increased from 20,650,000 units to 24,856,000 units; the revenue increased from £115,847 to £133,764, the gross profit from £50,807 to £63,625, and the net profit from £8,406 to £16,598, as compared with the previous year. This is the largest net profit ever earned in one year, and is due more particularly to the introduction of modern plant, which has led to the reduction in coal consumption from 4·8 lb. two years ago to 3·2 lb. per unit generated, which is equivalent to a saving of 15,000 tons of coal per annum. On the other hand, increases have occurred in taxes, sinking fund, fuel cost, wages, &c.; and increased rates of charge have been made, which brought in £4,700; but as the extra output was at power rates, the average rate received per unit had not increased.

The modernisation of the plant was being carried out without increasing capital indebtedness; a 5,000-KW. turbine plant recently added was being paid for from the renewals fund, and re-covered cables to the value of £14,500 last year, and £25,000 this year, would be set off against the cost of H.T. extensions which were being made.

Sheffield.—Women Stokers.—The Electricity Committee proposes to pay women stokers 6½d. an hour for all time worked, exclusive of the war bonus of ¾d. an hour paid to all women workers.

Application is to be made to the L.G.B. for permission to raise £15,000 for the electricity undertaking, for sub-stations, &c.

Southport.—Price Increase.—An increase of 5 per cent. in charges for electrical current is recommended, to operate as from Midsummer Day.

Stockport.—Proposed Loan.—The T.C. has applied, with official sanction, for permission to borrow a loan of £27,500 for the provision of a 5,000-KW. turbine set for the electricity works.

Stoke-on-Trent.—Price Increase.—The T.C. has decided to make a further advance of 5 per cent., making in all 25 per cent. since the war began, on the charges for current from and after the end of the June quarter. The B. of T. has sanctioned the supply of current to the premises of a firm in the area of the Leek R.D.C. and to a works in the area of the Smallthorne U.D.C.

Swansea.—Linking-up.—The borough electrical engineer has reported on the suggested linking-up of Swansea, Llanelly, and Neath, which offers considerable possibilities as to interchange of load, &c. It is hoped to make some definite proposal within the next few months.

York.—The Electricity Committee recommends an advance of 1d. per hour in wages to the men employed at the generating station, who are not confined within the award of the Committee on Production regarding the engineering and foundry trades.

TRAMWAY and RAILWAY NOTES.

Accrington.—Electric Vehicle.—A new battery-driven dust van has been brought into use by the T.C.

Ashton-under-Lyne.—Tramway Purchase Scheme.—The Bill promoted in Parliament by the Corporation for the purchase of the Oldham, Ashton, and Hyde Tramways now awaits final sanction. The opposition of the Ashton Master Carriers' Association and of the Hyde Corporation has been withdrawn. The Bill gives the Ashton Corporation power to purchase the tramways after six months' notice.

Australia.—The Premier of Victoria, Mr. W. Hutchinson, Mr. McLeod, Chief Secretary, and the Railway Commissioners recently inspected the new power plant, &c., at Newport, installed for the electric working of the railways; Mr. Jones, the Railway Commissioner, stated that the only cause of the delay in the completion of the electrification scheme was the shortage of switchgear, but he hoped to have everything in readiness for a start by the due date in January next.

Tramway Arbitration Award.—The Melbourne Tramways Board has issued a summons for an order that the award of Mr. Justice Cussen in respect of the assessment of the property of the Melbourne Tramways Co. be set aside, on the ground that his Honour was wrong in law by giving effect to the principles enunciated in the award, and, alternatively, that Mr. Justice Cussen should have stated a special case on the matter for the opinion of the State Full Court.—*Melbourne Age.*

Blackburn.—Rail Shortage.—The T.C. has referred back a recommendation that the rails on the Cherry Tree section should be taken up, so as to replace the worn-out rails on the Preston Road route. It was pointed out, however, that the Committee saw no way of continuing the service unless some route was closed, and the rails utilised elsewhere. Councillor Higham said they could not get the rails, as they were not being rolled. Leeds had obtained a tender from America, at £22 a ton, with problematical delivery in 18 months' time.

The Tramways Committee has decided against the request of the Workers' Association for an increase of 10s. per week in wages.

Doncaster.—Increased Fares.—The T.C. has adopted the recommendation of the Electricity and Tramways Committee, advancing the fares on the Bentley route (as mentioned in the Electrical Review last week). Mr. Balmforth mentioning that the journeys were longer for the fares than on any other route in the town.

Glasgow.—Revenue Returns.—For the third successive week the revenues of the tramway department have reached record figures. Last week they reached £25,914, as compared with £23,174 in the corresponding week of 1916, while the passengers carried numbered 8,005,687 and 7,295,746 respectively. Since the beginning of the present financial year on June 1st, 1916, the receipts have been £1,148,840, against £1,058,550.

Leeds.—Wages.—The Government arbitrator's award in a recent application by the Tramway Workers' Union for increased wages is as follows:—The war bonus for men over 21 years of age is increased to 7s. per week all round; such increase is in substitution for all previous war bonus allowances. As regards women, the award is half of the said bonus, after three months' continuous employment, three-quarters of the bonus after nine months, and the full bonus after twelve months; this award to be in substitution for any previous award as regards women workers made in October last year. The bonus is to be paid, and to take effect, as from April 1st of this year.

Sheffield.—Arrangements have been made under which the work of car cleaning will be carried out by the extended use of female labour. The male car cleaners in the tramway department are to transfer their services to the cleansing department, on the understanding that they have the right to return to tramway work at the close of the war. The Tramways Committee reports that the estimated cost of war allowances granted to employés, or about to be granted to employés, for the current year amounts to £51,316; the estimated cost of allowances to dependents of employés on war service is £12,500, and the estimated increase in the cost of electrical energy for the current year is £15,600. In order to enable the Committee to deal with the foregoing, which make a total of £79,416, it is intended that ½d. stages for adults on all the routes be abolished.

South Africa.—The Johannesburg Municipal Council has prepared a scheme for extending the tramways to Newlands. Three methods have been considered: (1) Extending the electric tramway; (2) using motor tramways; and (3) running a 'bus service. The Committee explains that the motor tramway proposal involves the construction of a track without any electrical equipment, and the running of self-contained motor vehicles. The Committee said that there was no doubt that, with a suitable type of vehicle and under certain conditions of running, the use of motor tramways would prove a success, and such vehicles would probably be run at less cost than heavy electric cars. The proposals are still under consideration

South Staffordshire.—Wages.—The Birmingham and Midland Tramways Co.—including the South Staffs., Wolverhampton and district, and Dudley and district branches has conceded an increase in war bonus to its employés of all grades.

St. Annes.—As the result of a meeting between the Council and the Blackpool, St. Annes and Lytham Tramways Co., Ltd., a satisfactory basis for a new agreement for the supply of electricity to the tramways has been arrived at. The old agreement, concerning which there was some criticism from Lytham some time ago, terminates at the end of June.

Warrington.—Year's Working.—The tramway department has made a net profit of £2,050 on the year's working, as against a net profit of £2,620 for the previous year. The total income was £26,462 and the expenditure £18,795, leaving a gross profit of £7,667.

Wolverhampton.—The Corporation has decided to submit the question of increased wages to the tramway employés to arbitration.

York.—During the year ended March 31st last, the number of passengers carried on the city tramways was 8,500,063, the car-mileage was 829,096, and the receipts 10·47d. per car-mile. The electric omnibuses carried 642,943 passengers, the car-mileage being 77,059, and the receipts 8·01d. per mile. The Committee reports that the cost of the electricity used for the omnibuses has been £737, whereas if petrol had been used, the cost would have been considerably over £1,000.

TELEGRAPH and TELEPHONE NOTES.

German Wireless.—The Republic of Liberia has broken off relations with Germany.

The adhesion of Liberia should bring about the complete removal of German trade and influence from West Africa and the final suppression of the transmission of German wireless news in that region, Liberia being the only region of West Africa not in Allied occupation.

Holland.—It is reported that, with the co-operation of the principal Dutch shipping companies, a company has been formed at Amsterdam under the title of the Dutch Telegraph Co. Radio-Holland, and with a share capital of £83,000. The object is to substitute apparatus of Dutch manufacture for the wireless equipment used on Dutch ships, and supplied and worked almost exclusively by the Société Anonyme de Télégraphie sans Fil, of Brussels. The work is to be carried out on the expiration of existing contracts, in order to emancipate Holland from an external monopoly in its communication with the Dutch Colonies.

Illicit Wireless Telegraphy.—At Portsmouth Police Court, on May 7th, an electrical apprentice named R. G. H. Cole, employed in Portsmouth Dockyard, was charged under the Defence of the Realm Act with being in possession of wireless telegraphic apparatus without the permission of the Postmaster-General. On visiting the prisoner's residence at Southsea, a detective found attached to a 15-ft. clothes-pole, three fine wires similar to those used as aerials in wireless telegraphy. In Cole's bedroom he found a table, on which was apparatus attached to the aerials, and in working order. Prisoner, who said he could only receive messages, was remanded for a week in custody. *Daily Telegraph.*

CONTRACTS OPEN and CLOSED.

OPEN.

Keighley.—May 15th. Electrical installation at the Ward block, at present in course of erection at the War Hospital, Morton Banks. Specifications from H. Webber, Borough Electrical Engineer.

Manchester.—May 11th. Electricity Committee. Stuart Street generating station. (*a*) One hydraulic accumulator and electrically driven ram pump, (*b*) coal conveying plant. Mr. F. E. Hughes, Secretary, Electricity Department.

Warrington. — May 22nd. Electricity and Tramways Committee. Underfeed mechanical stoker. See "Official Notices" May 4th.

CLOSED.

Bolton.—The Sanitary Committee has accepted the tender of the Corporation Electricity Fittings Department for the conversion of the plant at the laundry at the Western Fever Hospital from steam to electric power.

Bradford.—Electricity Committee. E. Green & Sons, Ltd.: Improved patent fuel economiser, in place of one at Valley Road Works, £2,086.

Dewsbury.—Electricity and Tramways Committee. Coal. Crawshaw & Warburton, Ltd., 2,000 tons; J. Longbottom & Sons, 1,500 tons of Barnsley slack; J. Longbottom & Co., 500 tons of Barnborough slack.

Glasgow.—The Committee on Works and Stores recommends acceptance of the following offers for annual stores:—

Ozokerite tape.—I.R., G.P. & Telegraph Works Co., Ltd.
Trolley wire.—F. Smith & Co., Ltd.
Axles and steel tires.—Brown Bayley's Steel Works, Ltd.

Sheffield.—City Council. Accepted tenders:—

Willans & Robinson, Ltd.—Increasing the capacity of No. 3 turbo-alternator from 4,500 KW. to 6,000 KW.
G. Heathcote & Co.—14 steel ventilating shafts for coal store.
Electricity Supply Department of the Corporation.—22½-H.P. motor for the Health Department, £86.
John Brown & Co., Ltd.—500 steel tramway tires, at 78s. 6d. per tire.

Swansea.—The Electric Lighting and Tramways Committee has renewed the coal contract with the Main Colliery Co. for the ensuing year at the same price as paid last year.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, May 11th. At 7.30 p.m. At 39, Victoria Street, S.W. Paper on "Works Records," by Mr. F. D. Napier.

Friday, May 18th. At 7.30 p.m. At 39, Victoria Street, S.W. Paper on "Metric Weights and Measures and Decimal Coinage," by Mr. E. C. Barton.

Salford Technical and Engineering Association.—Saturday, May 12th. Visit to Messrs. H. Wallwork & Co.'s works, Manchester.

Royal Institution of Great Britain.—Saturday, May 12th. At 3 p.m. At Albemarle Street, Piccadilly, W. Lecture on "The Electrical Properties of Gases," by Prof. Sir J. J. Thomson, Pres. R.S.

Friday, May 18th. At 5.30 p.m. At Albemarle Street, W. Lecture on "The Complexity of the Chemical Elements," by Prof. F. Soddy, F.R.S.

Birmingham and District Electric Club.—Saturday, May 12th. At 7 p.m. At the Swan Hotel, New Street. Paper on "Electric Furnaces for Nitrates from the Air," by Mr. E. Kilburn Scott.

Illuminating Engineering Society.—Tuesday, May 15th. At 5 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Annual meeting. Discussion on "Economies in Lighting in relation to Fuel Saving."

Institution of Electrical Engineers.—Thursday, May 17th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Annual general meeting. At 7 p.m. Special general meeting to consider proposed additional Articles of Association.

(**Newcastle Local Section**).—Monday, May 14th. At 6.45 p.m. At the Mining Institute. Annual general meeting.

Institution of Mechanical Engineers.—Friday, May 18th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Paper on "The Construction of Turbine Pumps," by Mr. A. E. L. Chorlton.

NOTES.

Volunteer Notes.—First London Engineer Volunteers.—Headquarters: Balderton Street, Oxford Street, W.

Orders for the Week. Lieut.-Colonel Clay, V.D., Commanding:—

Monday, May 14th.—Technical for No. 3 Company, Right Half Company, at Regency Street. Drill No. 3 Company, Left Half Company. Signalling Class.

Tuesday, May 15th.—Lecture, 6.30, Captain Castell, "Knots and Lashing and Trestle Bridging." Physical drill and bayonet fighting, 7.30 to 8.30.

Wednesday, May 16th.—Drill, No. 1 Company, Right Half Company, 6.15.

Thursday, May 17th.—Drill, No. 2 Company, Right Half Company. Ambulance Class by M.O., 6.30. Signalling Class.

Friday, May 18th.—Technical for No. 3 Company, Left Half Company, Regency Street. Drill No. 3 Company, Right Half Company. Recruits' Drill, 6.30 to 8.30.

Saturday, May 19th.—Commanding Officer's Parade, 2.45. Uniform for Drill in Hyde Park.

Sunday, May 20th.—Special work at Bombing School. Parade, Clapham Common Station (City and S.L. Tube Railway), 9.45 a.m.

Armlets.—Members are warned that armlets must be worn at all plain-clothes parades.

(By order), Macleod Yearsley, *Captain and Adjutant.*

Books for British Prisoners of War.—The British Prisoners of War Book Scheme (Educational) is the only War Charity which provides educational books for the thousands of our men, now in enemy hands, who are craving for solid literature with which to improve their minds and relieve the tedium of their captivity, in accordance with their expressed needs, and the continued requests for books which daily reach the chairman from the camps, coupled with the regular acknowledgments of parcels, show that its consignments reach their destinations, and that never was the work it is doing in this field more necessary or more appreciated than at present. Our readers are earnestly requested to send to the Scheme a list of any volumes they can spare. They will then be advised as to which books will be of use. The organisers have no need of fiction, and no use for out-of-date technical books, or books in bad condition; they also have a sufficiency of works in the dead languages.

Those who care to know something about the really great educational work which is going on among British prisoners may be interested in reading a little booklet entitled "Student Captives," which has just been published, and which may be had on application to Mr. Alfred T. Davies, chairman of the British Prisoners of War Book Scheme (Educational), at the Board of Education, Whitehall, S.W., 1, to whom all communications should be addressed.

Education of Engineers.—In connection with the scheme of education recommended by the Council of the Institute of Marine Engineers, and noted in our pages, the following extract from the *Glasgow Herald* of March 23rd is quoted in the *Transactions* of the Institute: "Glasgow School Board, at their meeting yesterday, had an offer before them by an engineering firm, Messrs. Barr & Stroud, to co-operate in the education of their future apprentices by means of scholarships. In their letter the firm stated that as they were of opinion that it would be to the advantage of apprentices that they should stay at the day schools until they were at least 15 years old, the firm, provided the year spent at school from 14 to 15 was devoted to subjects specially suitable for, and interesting to, engineering apprentices, had resolved to institute scholarships on the following conditions:—(1) The scholarships would be 10 in number, tenable for one year, of the value of £10 each; (2) they would be awarded to boys of the age of 14 recommended by the headmasters of certain selected schools, certified as medically sound, and approved by the firm; (3) they would be tenable at a school in which a course of instruction in mathematics and practical physics suitable for engineer apprentices could be followed; (4) the boys, before taking up the scholarship, would sign an agreement to serve five years' apprenticeship with the firm to the trade of instrument-making or of engineering." The proposal was remitted to a Special Committee for consideration and report.

The Electrical Trade Position in South Africa.—The sudden stoppage of new electrical connections by the Johannesburg Municipality has given rise to the idea that relief may be obtained from the Victoria Falls Power Co. In the meantime, the Municipality is adamant. For example, an estate company, which had been negotiating before the stoppage, wanted four cottages supplied with electric light, and they were not only willing, to pay the ordinary charges, but any extras owing to the increased cost of materials, but the several answers have been that the town's cables and transformers are loaded up to the full. The Municipal authorities had reached their limits in anticipation of the new power plant, ordered in Britain, arriving shortly, but now this has been refused a permit, therefore there is no alternative but to stop new connections. It stands to reason that the Johannesburg Municipality will not remain dormant, but will look around to see what can be done to obtain the necessary power plant from other sources, as the stoppage of electrical connections will hamper building operations very considerably, as no up-to-date shop or residence can be considered complete without electric light. We cannot expect much relief from America, as their standard gauges for plant do not always fit in with those in use here. As regards Japan, they have not got over the initial troubles of catering for a new market. What happened over a year ago was that travellers offered our merchants a nice lot of Japanese assorted electrical ware, from samples, at prices that had never been heard of before in Johannesburg, but these goods have not yet materialised. However, a Birmingham house has recently supplied Johannesburg with Japanese electrical goods, but the cost is about four times as much as originally quoted from Japan. However, there is a Japanese house of representatives established in Cape Town, and it is said that representatives in Johannesburg are now guaranteeing or promising direct deliveries from Japan, delivery c i.f. Durban, which would soon enable our Municipality to carry on, much as usual. In the ordinary way, the engineering shops in Johannesburg are doing a lot of electrical work, chiefly in re-fixing and re-making, rather than new work, although quite a creditable quantity of the latter is made when specially ordered and paid for at a price about five times higher than the imported, but obviously when things are wanted, and must be had, the price is a secondary matter. Until about six months ago, the stocks of electric lamps were in plenty, but now the wholesale prices have risen, and the cheapest retail price for the ordinary house lamp is 2s. On the whole, supplies of ordinary electrical goods are plentiful, but the exceptions are always with us, and these seem enlarging of late. For example, 3/20 coils of wire have sharply risen to 30s., but within two sizes different, viz., 3/22, which can be had at 21s. 6d. There is a great shortage of heavy copper wire and cables in merchants' stores, but the mines have plenty. The smaller sizes of wire and cables, from a general standpoint, seem to be amply available.—*South African Mining Journal.*

The same contemporary in a later issue just to hand says:—"Material is getting scarce through the absence of oversea supplies, which are not sufficient to fill up the absorption. All kinds of electrical tubing are so scarce that substitutes in the shape of water and steam piping are occasionally used to complete an urgent job. Keyholders and switches are also very scarce. Much was hoped for from Japan, but some of the optimistic anticipations have not yet been realised. However, from that source we are getting ceiling roses, lamp-holders, cut-outs, counter-weights and switches. Cables are yet to come, as a bad start was made in the first orders, as it was found that the Japanese standard was different to ours, but they are now making some strictly in accordance with our requirements. One reason of the stocks being scarce in town, is that the municipalities, railways, and other big users of electricity secured quantities of stock at the first signs of a shortage. The mining companies were, however, first in the field some two years ago, when stocks were super-abundant, hence they have good general supplies, with the exception of lamps."

Mobilisation of Chemical Industries.—Sir Charles H. Bedford, secretary of the Association of British Chemical Manufacturers, delivered an address entitled "Mobilisation of British Chemical Industries for After-War Conditions," to the members of the Birmingham and Midland Section of the Society of Chemical Industry, last week. The lecturer outlined the organisation which had been developed with a view to meeting after-the-war conditions, and which had resulted from the realisation by the experience of the war of the proved and urgent necessity for some form of combination among the chemical manufacturers. Having explained the organisation and membership of the Association, he said the tendency was for the large firms to come more closely together, and it would only be through the Association that they would get the smaller firms to come into line. But when they did come into line, they would find there was a great deal to be said for the pooling of interests, and that on the balance it worked out very satisfactorily. Manufacturers would come to see that other manufacturers of their own nation were not to be regarded merely as rivals to be fought, and that the conditions after the war would be so strenuous that they would be driven to combine against their common adversaries, particularly the Germans. Co-operation would steady prices and reduce waste in production, and it must be conjoined with aiming at the highest technical and commercial standards.—*Birmingham Daily Mail.*

Educational.—The Board of Education has issued the draft of the proposed revised regulations for continuation, technical, and art courses in England and Wales, which it is intended to bring into force after the war. The draft deals especially with "Further Education," which falls outside the scope of the secondary school and the University, and relates in part to junior technical schools, "local and central colleges," &c.; it aims to provide a complete and systematic plan of further education in each area, properly related to elementary and secondary schools and universities, adapted to local needs, and particularly industrial needs, and offering to every student facilities for a graduated and progressive course of instruction. The Local Education Authority will be the body responsible for formulating and carrying out such a plan, and upon it will be devolved many of the matters at present supervised by the Board. The term "Local Colleges" is a new title conferred upon the larger and more advanced schools in recognition of their distinctive status and position, and the higher technical and research work carried on in them will be developed. The need for securing the interest of employers and workpeople in technical instruction, and for obtaining teachers with trade experience for such instruction, is recognised, and the importance of continuing general education side by side with technical instruction is not overlooked. The advantages of co-operation between Local Education Authorities are emphasised, and the possibility of promoting the adequate and efficient provision of "further education" by the formation of joint bodies working in connection with two or more Local Education Authorities is looked upon with favour by the Board.

Excess Profits Tax.—In his Budget speech the Chancellor of the Exchequer raised the Excess Profits Tax from 60 per cent. to 80 per cent. In replying to the Debate, he spoke as follows (according to the *Times* report):—

"As regarded excess profits, he had been surprised to find how little had been said by those who would have to pay the duty. He recognised that it was an extremely heavy tax, and one which would inevitably have bad effects on our trade after the war. But that was true of all taxation on this scale, and the problem which the Chancellor of the Exchequer had to face was this: Was the taxation necessary to get the additional revenue, and, if so, what was the best way of getting it both from the point of view of fairness and national interest? He had not the smallest doubt that it was better from both points of view to take the money in the form of excess profits duty than to add to the income-tax at the present time. The hon. member who spoke first in the debate (Mr. Annan Bryce) contrasted the position of companies after the war in this country with that of those in Germany, and had said quite truly that in Germany there was nothing like our excess profits duty, and assumed that German companies would be in a much better position than ours after the war. Why had Germany not been able to get taxation of that kind? He thought the explanation was the same as the cause of the war—namely, that the German Government was in the hands of a small but vocal class, and they dared not apply to that class measures in the interests of the war which they applied freely to other classes which did not control the Government of the country. What was the effect? It was quite true that they did not put on excess profits, but the hon. member had mentioned the name of a company which had a surplus of several millions sterling. He was sure that that sum was lent to the German Government. After the war our industry would not revive unless there was credit, nor would the German industry, and the basis of the credit of firms in this country would depend on the basis of the credit of the country as a whole. Therefore in his view it would probably be found that credit here would be better than in Germany, because we had had the courage to use our revenue to meet our expenditure, and therefore to improve the whole standard of our national credit. Dealing with the question of double income-tax, he said he had always thought that it was unfair as it existed now, and would have to be altered; but this was not a time to give up revenue. He had discussed the matter with the representatives of the Dominions, and it had been discussed at the Imperial Conference. While the representatives of the Dominions urged that the question should be dealt with, they suggested that it should be put right immediately after the war. If he was in a position that enabled him to have any influence then, he should certainly urge that it was one of the earliest questions to be considered."

German Union of Technical Institutions.—The Union of German Technical Institutions (Deutscher Verband Technisch-Wissenschaftlicher Vereine), which will, doubtless, be organised and administered with characteristic thoroughness, and which will, therefore, constitute an important factor in the coming industrial struggle, has lately been strengthened by the accession of five more institutions. The affiliated bodies are now: Verein Deutscher Ingenieure (Union of German Engineers); Verband Deutscher Architekten und Ingenieur Vereine (Architects' and Engineers' Society); Verein Deutscher Eisenhuttenleute (Ironworkers' Association); Verein Deutscher Chemiker (Chemical Society); Verband Deutscher Elektrotechniker (Electrical Engineers); Schiffbautechnische Gesellschaft (Shipbuilders); Deutscher Verein von Gas und Wasserfachmannern (Gas and Water Engineers); Verein Deutscher Strassenbahn und Kleinbahnverwaltungen (Tramways and Light Railways); Verein der Zeilstoff und Papierchemiker (Cellulose and Paper Chemists); Wissenschaftliche Gesellschaft für Luftfahrt (Aerial Traffic); Gesellschaft Deutscher Metallhutten und Bergleute (Metal Workers and Miners). The potentialities of a union embracing the resources of these institutions are not to be underestimated. The Administrative Committee consists of Geh. Reg.-Rat Dr.-Ing. Busley (Berlin), and Kgl. Baurat Dr.-Ing. Taaks (Hanover), as president and vice-president; Dr. Dieht (Berlin-Lichterfelde), as managing director, and Prof. Klingenberg (Berlin), Geh. Baurat Saran (Berlin), Kommerzien-rat. Dr.-Ing. e.h. Springorum (Dortmund), as members.

Central Station Employes.—With reference to the letter from Mr. W. J. Ebben, hon. general secretary of the Association of Electrical Station Engineers, appearing in our last issue, we understand from a correspondent that the national engineering awards have now been extended, and full particulars are given in a leaflet which has been issued by the Electrical Trades Union. The London Power Station Engineers' Branch of this Union is at 7, Levendale Road, Forest Hill, S.E., and Mr. H. H Morton is its secretary, from whom information may be obtained. The leaflet referred to prints in full the finding of the Committee on Production respecting the Union's application for an advance, also the memorandum of agreement between the Engineering Employers' Federation and the Electrical Trades Union, arrived at in February, 1917. There is, further, printed a copy of a letter received from the Ministry of Munitions, intimating that the Minister has decided that "he is prepared to take such steps as may be necessary to secure that any award given in the trade in question shall be applied to non-federated controlled establishments." From the foregoing it will be obvious that the awards apply to power and sub-station members who are employed in controlled establishments, and those who are interested in the matter should apply to either Mr. Morton, as above, or to any of the Electrical Trade Union's many Branches, of which there are 137 throughout the country.

The New Trade Bank.—The *Times* states that the formation of the British Trade Corporation, the title of the British trade bank which is being floated under Government auspices, has reached an advanced stage, for copies of its prospectus have now been circulated among interested parties. The nominal capital of the institution has been fixed at £10,000,000, but the first issue will be limited to a quarter of that amount, £2,500,000. Lord Faringdon, who presided over the Committee which recommended its formation, has been appointed chairman, and Mr. F. Dudley Docker, who has taken a special interest in the scheme, managing director. The Right Hon. F. Huth Jackson is a member of the board, which also includes the names of directors of certain other large banks. Our contemporary says :—"Although bankers generally are sympathetic towards the new project on account of the benefits which it is expected to confer upon British trade generally, it must be said that they are rather apprehensive as to the effect of some features of the scheme. It is understood that the new corporation intends to make a special feature of the acceptance business, a branch of banking in which considerable strides have been made by the existing banks since the outbreak of war, owing partly to the suppression of the German institutions. Bankers, therefore, are inclined to look upon the newcomer as a possible formidable competitor, and though a number of them will probably subscribe a part of the capital required, the response to an invitation to do so would, no doubt, have been much more cordial had the scope of the corporation's activities been confined to those branches of finance which are outside orthodox banking practice."

In referring to the above scheme in the House of Commons on April 26th, Mr. G. Roberts said, according to the *Times*, that His Majesty's Government had promised the British Trade Corporation their sympathy and support. The Corporation had received a Royal Charter establishing it for a term of 60 years, and Clause 4 of the Charter conferred on it the right under certain circumstances to act as agent of the Government subject to the Government being entitled to appoint their own agent in any special case in which such a course might appear to be necessary or expedient. The corporation had been brought into being with the object of assisting British trade and industry, and failure on the part of the corporation to give effect to that object would expose it to the liability of proceedings being taken to annul the Charter. The corporation was also under terms to remain British in character and free from foreign control. There would be no subsidy or guarantee, and no monopoly in any form.

It is announced that the names of the first directors of the Corporation are :- Lord Faringdon, Mr. F. Huth Jackson, Mr. Arthur Balfour, Mr. F. Dudley Docker, Mr. W. H. N. Goschen, Mr. J. H. B. Nobel, and Sir J. Hope Simpson.

The Boy in Industry.—Dr. Addison, M.P., the Minister of Munitions, states that the number of boys between the ages of 14 and 18 engaged in various occupations in this country is approximately 1,250,000, and that "their young shoulders are gallantly helping to support the burden of war." But while the war has heightened the value of the boy in the labour market, it has intensified the problem of his welfare, and the Ministry of Munitions has issued a pamphlet on the subject, which Dr. Addison commends to the attention of parents, employers, social workers, and teachers, in the hope that the problem may be brought nearer solution. "The Boy in Industry" (H.M. Stationery Office, Kingsway, London, W.C. 2. 3d. net) puts the case of the factory lad clearly and without concealment of unpleasing facts. The ordinary boy of 14 to 18 years, states the author, is "unstable, wilful, elusive"; the age is a critical one in his career, and he is receptive to influences both good and bad—"chiefly bad." To-day, various contributory causes make his position more precarious; the father's control is absent, and high wages are paid for his labour. "The boy knows nothing of the part he is to play, either in the world or in his work," and finding himself regarded as a man, he thinks that the sooner he apes man's follies, the better. Various methods have been devised to stay this national waste, but the social and recreative agencies at work are insufficient. "A more highly-developed system of engagement and control" from inside the industrial system is essential. This could be accomplished, the author insists, by the appointment in the factories of a sympathetic supervisor, who would watch the personal interests of the boys. This officer would engage all the lads, would keep in touch with them at work and at play, and would encourage them in a wholesome outlook on life. The booklet is a very interesting and timely one, and does not take long to read—an important consideration just now. We recommend those concerned with the position of boys in industry to study it, and to obtain the scheme for boy supervision in munition factories from the Welfare Department, Ministry of Munitions, 6, Whitehall Gardens, London, S.W. 1.

Hydro-Electric Power in France.—The American Manufacturers' Export Association appointed last year an American Industrial Commission to visit France for a first-hand study of present industrial conditions and future possibilities. Dr. C. O. Mailloux, a past-president of the American Institute of Electrical Engineers, was the electrical member of the Commission, and during his stay of several months abroad, prepared extensive notes on hydro-electric developments in France, with special reference to the electrochemical and electrometallurgical industries.

Before the war, the annual coal consumption in France was, in round numbers, 60,000,000 tons, of which amount about 40,000,000 tons were obtained from French coal mines, leaving a shortage of about 20,000,000 tons to be made up by importation from other countries. About 45,000,000 tons are used for producing steam for generating mechanical power, aggregating about 12,000,000 H.P., so that the full development and utilisation of 6,000,000 H.P. of water power would, theoretically, more than make up for the entire coal shortage in the whole country. This indicates the immense national importance of water-power developments for France.

Dr. Mailloux states that the aggregate power capacity of all the water powers owned or exploited by the various power companies belonging to the Water Power Association is 660,000 H.P. Of this total, 412,000 H.P. represents power transmitted and distributed for general lighting and power purposes in cities, towns, and villages; the rest (248,000 H.P.) is power consumed by electrometallurgical and electrochemical industries. The distribution systems owned by the power companies belonging to the Association constitute a network of 16,200 km., of which 13,400 km. are overhead lines, and the rest (2,800 km.) are underground. These distribution systems serve to supply electric current for light and power to communities aggregating between 4,500,000 and 5,000,000 inhabitants. The capital investment represented by all these plants exceeds 600,000,000 fr.

As there are many water powers in the Alps and elsewhere operated by companies and individuals not members of the Water Power Association, the above statistics are incomplete. The complete statistics for January 1st, 1916, for the region of the Alps are as follows :—

	H.P.	Per cent. of total.
Power used for light and power	291,000	39·4
Power used for electrometallurgical works	255,000	34·6
Power used for electrochemical works ...	147,000	19·9
Power used for electric traction	16,000	2·2
Power used for paper mills, saw mills, &c.	23,000	3·1
Power used for various industries (lime and cement works, spinning, &c.)	6,000	0·8
Total	738,000	100·0

The 1916 map of a Government Commission charged with the work of estimating the hydraulic resources of France, gives the following additional information for the same region :—Power plants under construction or for which contracts have been made, 100,000 H.P.; water powers whose development is contemplated or proposed, 700,000 H.P. The two most important new water-power projects are the Durance and the Upper Rhone projects.

Interesting figures are given on the rates charged for electrical energy in France, with special reference to Lyons and St. Etienne. At Lyons the KW.-hour is charged at 60 centimes for domestic lighting, at 55 centimes for stores, offices, and factories, at 50 centimes for hotels, cafés, restaurants, theatres, churches, schools, &c., and at 40 centimes for small power consumers. Discounts from 2 to 20 per cent. are allowed, according to the amount of the yearly bill At St. Etienne, 55 centimes are charged per KW.-hour for lighting for the first 1,000 KW.-hours, but the rate is 50 centimes for the next 400 KW.-hours, &c., and 30 centimes for all above 3,300 KW.-hours. The minimum price for metered power current comes down to as low as 5 centimes per KW.-hour in St. Etienne as well as at Lyons. This is a very low figure, which prevails only where hydro-electric power is available. At Bordeaux, where black coal is the only source of power, the power used for operating the coal and ore-handling and conveying system at the Bordeaux docks costs 12 centimes per KW.-hour. This is regarded as a low figure for electric power current derived from a steam station, even allowing for the advantage which a seaport city has of being able to get its coal supply at a lower rate than an inland city. Nevertheless, this very reasonable cost is still 2·4 times greater than the lowest cost of electric power at Lyons and at St. Etienne, which is a significant fact.—*Electrical World.*

Excess Profits Duty: Electrical Cables.—On the application of the Cable Makers' Association for an increase of the statutory percentage in respect of the business of manufacturing in the United Kingdom insulated wires and cables for the transmission of electrical current, the Board of Referees has ordered that the statutory percentage shall be increased to 7 per cent. in the case of business carried on by a company or other body corporate, and to 8 per cent. in the case of any other trade or business.

Fatality.—Archibald Thompson, 33, was killed at the Wallsend power station of the Newcastle Electric Supply Co., on April 30th. Thompson, who was works foreman for Messrs. McAlpine, contractors, was standing near a beam, which was supported on a concrete pillar. The beam slipped off the pillar, and struck Thompson on the head and fractured his skull.—*Newcastle Chronicle.*

Poster Restrictions.—The following letter has been issued by Mr. H. C. Hill, chairman, Colour Printers' Committee of the London Master Printers' Association :—

"There appears still to be some doubt and misconception among advertisers as to what is permitted under the above order as recently amended. May I, therefore, ask for a little of your space briefly to state the present position with regard to posters :—

"1. New posters may be produced up to 60 in. by × 40 in. size, or its equivalent in square inches.

"2. Posters in any size—including those advertising goods offered for sale by retailers—with or without the retailer's address, the production of which was commenced before March 2nd, may be completed and exhibited on hoardings and elsewhere, as before.

"3. There is no restriction on the exhibition of posters of any size or kind which were in stock on March 2nd, excepting those making an announcement with respect to a newspaper or periodical.

"4. Posters for export can be printed in any size.

"Official confirmation of above appears in a revised explanatory note on the Paper Restrictions Order, issued on April 18th, a copy of which may be obtained at H.M. Stationery Office, Kingsway, London, W.C., 2, or other Government publishers."

Institution and Lecture Notes.—Association of Mining Electrical Engineers.—At a meeting of the West of Scotland Branch of the Association at Glasgow last Saturday, Mr. J. P. C. Kivlen read a paper on "Some Aspects of Power Station Centralisation and Interconnecting Systems." A paper on "Electric Converting Machinery for Collieries" was read by Mr. C. S. Buyers.

Institution of Electrical Engineers.—At a fully attended meeting of the Manchester Local Section the following resolution was unanimously passed :—"The Committee of the Manchester Local Section of the I.E.E. desires to put on record its strong endorsement of the action of the Council in nominating Mr. C. H. Wordingham as president of the Institution for the session of 1917-18, and protests against the resulting attack which has been made on that gentleman in a section of the electrical Press. Being convinced that Mr. Wordingham will uphold the highest traditions of the office, the Committee wishes to assure him of its full support during his presidency."

Appointments Vacant.—Fitter-driver for the Clacton-on-Sea U.D.C. electricity works ; switchman (50s.) for the City of Birmingham electric supply department ; shift engineer (32s. 6d.) and stokers for the Borough of Gillingham (Kent) electric light and power department. See our advertisement pages to-day.

Decimal Coinage and the Metric System.—The adoption by this country of a decimal coinage and the metric system of weights and measures is one of the most important measures necessary to promote the after-war expansion of our foreign trade, as well as our internal efficiency. With Sir Richard Burbidge as chairman of an influential Executive Committee, the Decimal Association—according to the annual report just issued—has made remarkable progress during the past year in winning favour for this much-needed reform. Among the new members of the Association may be mentioned Sir H. H. Johnston, the Lord Mayor of Manchester, Sir Leo Chiozza Money, and Lord Northcliffe, who have been elected vice-presidents ; another new member of the Executive Committee is Sir Hedley le Bas.

Nearly 400 Town and County Councils throughout the kingdom, and a number of Chambers of Commerce, and various important commercial and educational associations have come forward in support of the reform ; and in response to a questionnaire of 25,000 of the largest firms in the kingdom, no fewer than 99 per cent. of the replies received were in favour of the metric system. Copies of the report can be obtained from the acting secretary of the Decimal Association, Finsbury Court, Finsbury Pavement, E.C., 2, from whom also may be had tickets for the meeting to discuss the reform, which is to be held at the Mansion House in June under the auspices of the Lord Mayor.

We have received from Mr. Harry Allcock, M.I.E.E., a reprint of the lecture which he delivered on March 27th on the above-named subject before members of the Institutions of Civil, Mechanical, and Electrical Engineers, the Institution of Naval Architects, and the Iron and Steel Institute. Being the most complete and up-to-date exposition of the problem, the lecture was of exceptional interest and importance. Applications for copies or for permission to reprint should be addressed to the author at Radbourne, Hale, Cheshire.

Sicilian Sulphur.—The Minister of Munitions makes the following announcement :—In connection with the distribution of Sicilian sulphur, the Italian Government have allotted certain specified quantities to each of the Allied Governments, and requested that His Majesty's Government should purchase direct from the Italian Government the quantity allotted to Great Britain, and be responsible for its distribution. His Majesty's Government have agreed to this course, and the following Committee has been appointed to deal with the matter : Mr. A. D. Cooper, Foreign Office ; Mr. B. A. Collins, India Office ; Mr. C. W. Dixon, Colonial Office ; Mr. R. J. Thompson, Board of Agriculture and Fisheries ; Mr. F. Gossling, Board of Trade ; Mr. R. A. Alston, Ministry of Munitions ; Mr. H. S. Mingard (secretary), Ministry of Munitions.

In view of the increased demand for sulphur in connection with the production of explosives, it was found necessary, after careful consideration, that the export of sulphur should be prohibited, but provided every care is exercised to avoid waste in the use both of sulphur and of products and compounds in the manufacture of which sulphur is consumed, it is anticipated that agriculturists and manufacturers will not experience any great difficulties. The Committee has decided to offer to supply imported sulphur in lots of not less than 5 tons for use in approved trades and industries. The prices for the present will be : Flowers of sulphur, £23 per ton ; roll brimstone, £21 per ton ; thirds, £12 10s. per ton, including delivery to the purchaser's nearest railway station.

From the prices mentioned above a discount of 2½ per cent. will be allowed to recognised sulphur merchants and dealers, but not to consumers. Applicants claiming this discount must furnish satisfactory evidence that they were recognised sulphur merchants or dealers before the war. The Committee understands that "recovered" sulphur can be procured, in the ordinary way of business, from the home producers. Application for sulphur must be made on special forms, which may be procured from the Secretary, Sulphur Committee, Ministry of Munitions, Explosives Department, Storey's Gate, S.W., 1. All applications must be accompanied by remittance of the purchase price in full.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Last week, the Mayor of Dudley presented Conductress G. Slim, wife of a wounded Coldstream Guard, with the silver medal of the B.E.T. Co., Ltd., for displaying presence of mind and resource in a trying emergency, the medal being accompanied by a gift of £5 from the company. The proceedings took place at the offices of the Dudley and Stourbridge Tramways Co., at Brierley Hill. Mr. W. G. Bond, general manager of the Birmingham & Midland Tramways, mentioned that the medal was instituted 13 years ago, and only on about a dozen occasions had it been awarded to employés on the systems controlled by the B.E.T. Co. This was the first occasion upon which it had been awarded to a woman. On March 3rd one of their cars began to run back down Canal Bridge gradient, between Blackheath and Old Hill. Conductress Slim displayed great presence of mind; she pulled down the trolley pole, applied the brakes, and, what was equally important, allayed panic, and prevented passengers jumping off. She generally did her best to prevent what might have been a disaster, with the result that no personal injury occurred.

The Sheffield Electric Supply Committee has given to the Board of Trade, Control of Mines Department, a loan of the services of Mr. W. M. Miles, analytical chemist, to assist in the preparation of a coal redistribution scheme. The Tramways Committee has loaned the services of Mr. H. C. Watson, chief assistant in the tramway department, to the Director of Shipyards' Labour Department of the Admiralty in connection with the organisation of the staff of the department.

Whitby U.D.C. has increased the salary of Mr. J. Piggott, electrical engineer, by £20 per quarter.

At Bingley, on April 30th, the marriage took place of Mr. Francis L. Pedley, manager of the Bingley District Council's electricity undertaking, to Miss Mary Read, of Bingley.

General.—Prof. John Turner Morris, of East London College, has, on his marriage to Miss MacGregor, changed his surname to MacGregor-Morris.

Mr. T. C. Parsons, M.I.E.E., of the firm of Kiltall & Parsons, engineers, Glasgow, has been gazetted second lieutenant, R.G.A.

Roll of Honour.—Corporal J. Hamilton, R.E., who has been awarded the Military Medal, was an employé of Mr. T. C. Keay, electrical engineer, Dundee.

Rifleman G. W. A. Hazeltine, K.R.R., who enlisted from the staff of Messrs. Trollope & Ills, electrical engineers, of Dorking, has been wounded in action.

Private E. A. Eves, R.W. Kent Regiment, who enlisted early in the war from the staff at Bromley (Kent) electric light works, has died of wounds received in action.

Private C. Mansfield, Essex Regiment, killed in action, enlisted whilst engaged at Marconi's Wireless Telegraph Works, Chelmsford.

Sergeant J. Rylands, who was an electrical engineer, and joined the S. African Infantry whilst holding a lucrative position at the Johannesburg gold mines, has died of wounds. He belonged to Widnes, and was trained at the works of the Electrolytic Co., Middlewich.

Flight-Sergeant J. Chetwood, who was in civil life an electrician, and belonged to Weston, Hawkestone (Salop), has been killed whilst making a trial flight with a machine at a home station.

Private A. Short, Trench Mortar Battery, killed in action, was prior to enlisting an assistant in the Stockport borough electrical engineer's department.

Private C. Franklin, Oxford and Bucks Light Infantry, who was on the staff at the Chipping Norton electric light station, has been killed in action.

Bugler A. E. Wilkins, Rifle Brigade, who was engaged in the generator department of the B.T.H. Co., Ltd., of Rugby, has been killed in action.

Private H. Wild, Devonshire Regiment, who joined up from the Rochdale Corporation tramway staff, has been killed at the Front by a shell.

Rifleman E. W. Lulham, Rifle Brigade, who was at the Weybridge electric light works, has died in France of wounds received in action.

Private A. K. Dorrity, Liverpool Scottish, who has fallen in action, enlisted in October, 1915, whilst engaged as an electrical engineer with Messrs. Campbell & Isherwood, Liverpool.

Air-Mechanic Bruce Andrews, R.F.C., who joined up five weeks ago, whilst at Rugby with the B.T.H. Co., has died from pneumonia following an attack of measles.

Second-Lieutenant E. L. Wood, Gordon Highlanders, who is wounded in a hospital near Manchester, was an engineer at the Arbroath electricity works.

Private Horace Grant, who was previously employed as a costs clerk by the Leeds City Tramways Committee, has been severely wounded.

Sergeant Jim Gavins, who has just been awarded the Military Medal for gallantry in the field, was a Leeds tramway inspector.

Lance-Corporal Norman Marsden, King's Own Scottish Borderers, who has been seriously wounded, served his apprenticeship with Mr. J. T. Foggo, electrician, of Dewsbury, just before the war.

Obituary.—Alderman Isidor Frankenburg.—We regret to record the death, which occurred on Saturday last, of Mr. Isidor Frankenburg, chairman of Frankenburg & Sons, Ltd., india-rubber and electrical cable manufacturers, Greengate, Salford. Alderman Frankenburg, who was 70 years of age, had been thrice Mayor of Salford, and he had been prominently associated with public welfare schemes at Salford from the time of his joining the Borough Council in 1897.

Herr Gustave Klein.—We read in the *Motor* that a report has been circulated that Herr Gustave Klein, late manager of the Bosch Magneto Works at Stuttgart, has been killed at the Front. "Klein may be regarded as the moving spirit of the marvellous Bosch organisation, and it was he who was responsible for the Bosch premises in Tottenham Court Road, finished just before the war broke out."

NEW COMPANIES REGISTERED.

Thames Electric Co., Ltd. (147,375).—Private company. Registered May 3rd. Capital, £250 in 5s. shares. To take over the business of an electrical and illuminating engineer, and wholesale and retail vendor of electrical and scientific goods and accessories carried on by F. P. Sexton, at 48, London Road, Kingston-on-Thames, as the Thames Electric Co. The subscribers (each with one share) are: F. M. Sexton, Warwick Lodge, Hampton Wick, Kingston-on-Thames, civil servant; F. P. Sexton, Warwick Lodge, Hampton Wick, Kingston-on-Thames, electrician. The first directors are F. M. Sexton and F. P. Sexton. Registered office, 48, London Road, Kingston-on-Thames.

Express Lift Co., Ltd. (147,366).—Private company. Registered May 3rd. Capital, £10,000 in £1 shares. Manufacturers of and dealers in hydraulic, electric, and steam elevators and lifts, &c. The subscribers (each with one share) are: F. Samuelson, 71a, Queen Victoria Street, E.C., solicitor; R. C. McC. Poulter, 71a, Queen Victoria Street, E.C., solicitor. The first directors are: E. W. J. West and J. A. Phelps. Registered office: 17, Victoria Street, S.W.

British & Allied Electrical Agency, Ltd. (147,350).—Private company. Registered May 2nd. Capital, £1,000 in £1 shares. To carry on the business of electrical engineers and contractors, manufacturers of and dealers in railway, tramway, telephone, and other apparatus, &c. Agreement with F. W. Dennis and A. W. Pollock. The subscribers (each with one share) are: A. W. Pollock, 5-6, Palace Chambers, Bridge Street, Westminster, electrical engineer; St. John Bennett, 16, Devonshire Square, E.C., incorporated accountant. The first directors are A. W. Pollock (permanent managing director and chairman) and F. W. Dennis. Registered office: 5-6, Palace Chambers, Bridge Street, Westminster, S.W.

Leon Cornelis, Ltd. (147,354). — Private company. Registered May 2nd. Capital, £1,000 in £1 shares. To take over the business of a manufacturer of electrical appliances and accessories carried on by L. Cornelis, of 5, Newcastle Place, Clerkenwell. Agreement with A. R. Robert. The subscribers (each with one share) are: L. Cornelis, 5, Newcastle Place, Clerkenwell, manufacturer of electrical accessories; A. R. Robert, 265, Strand, W.C. 2, company director; Captain C. L. Robert, 265, Strand, W.C. 2. The first directors are L. Cornelis and A. R. Robert. Registered office: 265, Strand, W.C. 2.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Sun Electrical Co., Ltd.—A memorandum of satisfaction to the extent of £275 on April 28th, 1917, of debenture stock dated March 31st, 1911, securing £7,000, has been filed.

Enfield Electric Cable Manufacturing Co., Ltd.—A memorandum of satisfaction in full on April 17th, 1917, of mortgage, and further charges dated 1914, 1915, and 1916, securing £15,000, £11,250, and £2,750, has been filed.

British L. M. Ericsson Manufacturing Co., Ltd. (79,061). Capital, £200,000 in 99,990 pref. and 100,010 ord. shares of £1 each. Return dated March 28th, 1917. All shares taken up. £1 per share called up on 50,010 ord., 8s. on 50,000 ord., and £1 on 99,990 pref.; £170,000 paid; £30,000 (12s. per share) considered as paid on 50,000 ord. Mortgages and charges: £50,000.

Johnson & Phillips, Ltd.—Land registry charge on freehold property at Charlton, dated March 23rd, 1917, to collaterally secure £102,948 (part of £175,000 owing to London General Investment Trust, Ltd.).

Altrincham Electrical Supply, Ltd.—Issue on April 30th, 1917, of £5,000 debentures, part of a series of which particulars have already been filed.

Montreal Tramways & Power Co., Ltd.—Particulars of £1,202,054 (5,850,000 dols.) gold notes created March 30th, and secured by trust deed dated April 2nd, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £1,099,315 (5,350,000 dols.). Property charged: (*a*) 6,000,000 and (*sic*) 5 per cent. mortgage debenture stock of Montreal Tramways Co., (*b*) 16,000 fully-paid common shares of 100 dols. each of said company, and (*c*) 5,333 similar shares, 10 per cent. paid. Trustees: Guaranty Trust Co. of New York.

CITY NOTES.

Bombay Electric Supply and Tramways Co., Ltd.

The report for 1916 states that the total revenue from all sources, including the amount represented by sale of current to the tramways, amounted to £373,467, an increase of £62,697, or 20.17 per cent. The total expenditure amounted to £156,688, an increase of £14,597, or 10.27 per cent. The net receipts from the year's working aggregated £216,779, an increase of £48,100, or 28.52 per cent. over those for the previous year. After deducting debenture interest, depreciation, &c., there remains £114,373, and £9,602 was brought in, making £123,976. The directors now recommend a dividend for the year on ordinary shares at the rate of 10 per cent. per annum. They propose writing down securities to the extent of £6,666, and to pay a bonus of one month's pay to the company's officers and employés, leaving £5,214 to be carried forward. The gross receipts from the traction branch amounted to £198,765, against £172,051, an increase of 15.53 per cent. The working expenses amounted to £87,826, against £79,665, an increase of 10.24 per cent. The balance of receipts over expenses in respect of the year's working amounted to £110,939, against £92,387 for the previous year, an increase of 20.08 per cent. The gross receipts of the supply department, including the amount represented by sale of current to the tramways, amounted to £171,167, against £138,021. The working expenses amounted to £62,293, against £58,132. The net receipts aggregated £108,874, an advance of 36.28 per cent.—*Financial Times.*

Cork Electric Tramways and Lighting Co., Ltd.

The revenue for 1916 was £67,011, and the expenses were £47,770, leaving £19,241, plus £4,041 brought forward, less £4,600 interest on debentures. After paying the preference dividend, putting £6,500 to reserve for depreciation and renewals, writing £1,534 off wiring consumers' premises, &c., and £569 off investments, £3,915 is to be carried forward. Lighting and power business continues to show progress, the year's additional connections totalling 557 kw., against 405 kw. for 1915. The revenue for the year increased by £3,106, lighting and power being up by £2,480, traction by £661, and other items down by £35. The expenses increased by £5,354, largely due to operating under war conditions (coal prices, war bonuses, &c.). The net revenue shows a still further reduction, and a dividend on the ordinary shares cannot be recommended because it is desirable to carry forward a larger sum than usual to provide against still further increase in the price of coal and other materials during the current year, and the carrying out of repairs to rolling stock, &c. which could not be executed owing to lack of skilled labour and difficulty in obtaining materials. The lighting and power tariff was again raised on July 1st, but the additions represent a very small percentage of the increased cost of operating. Capital expenditure during the year was £11,668, for the Curtis turbine and generating plant, house services, and cables. The 1,250-kw. Curtis turbine mentioned in the previous report was put into commission in September, and has already effected substantial economy in coal consumption.

Indian Electric Supply and Traction Co., Ltd.

At the annual meeting in London, on May 4th, the Chairman said that the year's results were very creditable to all concerned, and testified to the ability and energy of the staff in Cawnpore. The new capital expenditure of £8,919 on additions to generating station, car-shed and mains, was chiefly in connection with the municipal electric lighting and mills, which absorbed some 80 per cent. of the figure, and the balance represented extensions to power house and machinery, including £2,000, cost of new boiler now working. There had been difficulties in getting deliveries of coal, although they were among those who came in Class "A" for supply as an essential undertaking. One of the ways in which they felt the inability to get the coal delivered under their contract was that they had to make up with coal of an inferior quality, but in spite of this the (generating) cost per unit sold had fallen from .41d. to .36d. The net revenue account showed marked improvement, the total for 1916 being £20,220, as against £15,932, the expenses, including debenture interest, £6,311 for 1916, as against £5,588. The number of units sold had increased by 478,418, and the revenue had risen Rs. 67,598, or about 21 per cent., and the average price realised had risen from 1.82d. to 1.87d. per unit. The total connections were 82,701 8-c.p. lamps, against 72,607 in 1915. The cost previously stated was slightly lower at .71d. against .73d. The position of the tramways remained practically unaltered; that was to say, the improved earnings were offset by higher costs. The increase in the passengers carried of some 300,000 was no doubt due to the improved earnings of the labour classes. In addition to prohibitive cost of all plant and material, they had great difficulty in arranging shipments to India, but in spite of this they had been able to dispatch a 500-kw. turbine, which they hoped very shortly to learn had arrived safely. They were forced to adopt the policy of waiting until after the war for any serious attempt to extend or widen the business. They looked forward with confidence to the future. In proposing the re-election of Mr. K. A. Scott-Moncrieff as director of the company, the chairman said that a committee had been formed to represent companies such as theirs, registered in London, and operating in India, and Mr. Scott-Moncrieff had been appointed the first chairman.

River Plate Electricity Co., Ltd.

At the annual meeting, held on April 30th, Mr. Mattinson, K.C., who presided, said that the progress made by the company was gratifying, the balance before deducting depreciation being £5,878 better than for 1915. The increase in profit was due partly to the growth of business, but mainly to the economy with which the up-to-date plant enabled them to handle it. Last year he remarked that the dominant factor in the running of an electric power company anywhere, especially in South America, was the price of fuel. In South America the local supply of fuel, whether coal or oil, was almost negligible, and in these times of enormous shipping freights they could readily imagine that the cost of imported fuel was very great. Last year he spoke of coal being £5 to £6 in Buenos Aires, but to-day he had to speak of even higher prices. Coal was £7 in Buenos Aires, and oil bore its relation to this price. Profit in the running of an electric station would not be possible at these prices. The results of the company were to be largely attributed to the fact that during the past year they had had the benefit of a favourable oil contract entered into before the prices mentioned prevailed. That contract would also run throughout 1917, but, although so far this was reassuring, circumstances had now arisen which would make their fuel position in the current year much less favourable than in the past year. In the first place, the Argentine Government—pressed like every other Government for money—had imposed an import duty upon oil which fell upon them; in the second place, the source of their oil supply was the United States, and with the United States an actual participator in the war new complications had arisen which would further materially enhance their contract price. They must therefore be prepared for a substantial addition to their fuel cost during the present year. But what about fuel in 1918? It was necessary in such a business—where they had large bulk contracts, which must be carried out whatever the cost, like the supply for the public lighting of La Plata, and the tramway system of La Plata, and Armours' great packing establishment at Ensenada—to look ahead and, if possible, contract a year ahead. The war might or might not be still in progress in 1918, but no man of common prudence was justified in committing himself to any serious business proposition on the basis of peace being established before 1918. Moreover, he could not help thinking that so serious was the shortage of tonnage, and so great was likely to be the demand upon it in the period immediately after the close of hostilities, that the year 1918, at any rate the first part of it, was not likely to bring any amelioration of prices. That was the view which prevailed in business circles, and they were only able some months ago to renew their fuel contract for 1918 upon terms substantially in advance of the existing contract. Since then there had been a further great advance, and at the present time they could not contract for 1918 at anything like the prices obtained. As they would see this year, and still more in the following year, they would have to meet enhanced costs of working which would be reflected in the net profits. Their interest in the Tucuman Tramway, Light & Power Co. was limited to debentures. That company had fallen upon evil days. They were making a special allocation of £8,000 towards possible depreciation of investments, and when he reminded them that the war had caused for three years a suspension of all interest payments and amortisation upon their large holding in the German Trans-Oceanic Electric Co., and that no human being could be certain how the war would leave anything, he did not suppose anyone would question the wisdom of this precautionary measure.

Oriental Telephone & Electric Co., Ltd.

The gross earnings for 1916, including dividends and interest from subsidiary companies, amounted to £133,991, plus £2,344 fees received from subsidiary companies and £15,467 brought forward. The working expenses, maintenance, &c., were £44,493, depreciation of securities £250, interim dividends, debenture interest, and redemption charges £18,306. After paying the final preference dividend, and a final dividend of 6 per cent. tax free, on the ordinary shares, making 10 per cent. for the year, £55,000 is to be transferred to general reserve account, £2,000 to the staff pension fund, and £19,494 is to be carried forward. All the company's exchanges and those of the subsidiary companies continue to show improved revenues. The underground cabling extensions at Madras and Singapore have been completed. The Singapore exchange was destroyed by fire on December 9th, 1916. As a result of prompt measures to establish temporary communication, the number of exchange lines working on February 3rd was 700 out of a total of 1,850, and it was expected that the whole of the subscribers' service would be resumed by April 30th. The exchange is to be reconstructed in accordance with the most modern practice, but owing to the prevailing trade conditions there will be delay in manufacturing and installing the necessary equipment. The Indian companies again report a substantial increase in the number of subscribers to their exchanges, with correspondingly improved revenues. The Bombay Co. has paid 12 per cent. on shares of Rs. 50 each, as against 20 per cent. on shares of Rs. 25 each. The Bengal Co. has paid 7 per cent., as in 1915. The Telephone Co. of Egypt, Ltd., and the China and Japan Telephone & Electric Co., Ltd., have both paid 10 per cent., as before. Sir H. Babington Smith has joined the board as chairman in place of the late Sir George Franklin. Annual meeting: May 16th.

Brush Electrical Engineering Co., Ltd.

The annual meeting was held on Monday at 1, Kingsway, Mr. E. Garcke presiding. He said that the gross profits were £68,840, compared with £61,356 in 1915. The general charges showed a small increase. They had put £8,000 to depreciation, the same as in 1915, they placed £7,054 to reserve, compared with £5,000, and they had a net balance of undivided profits of £13,856, compared with £9,321 brought in. At a former meeting of the company the shareholders agreed with the suggested policy of not commencing the payment of dividends on the share capital during war-time, and they were, therefore, allowing the undivided balance to accumulate. As a matter of fact, the money could not be spared for distribution as dividend, for they had during the past three years expended £41,141 on additional plant and buildings without any increase of capital in the form of either debentures or shares. It was suggested two years ago that they should make a further issue, and the consent of the Treasury was obtained to such issue being made, but they had thought it better policy to utilise their undistributed profits and other resources instead of increasing the capital. The stock account in respect of goods in hand and in process of manufacture stood at £182,000, an increase of about £72,000, due to the greater volume of work on hand. The debentures were gradually being reduced by the operation of sinking funds. General reserve stood at £20,000, compared with £9,358, and the amount owing to creditors and on loan account showed a reduction of about £15,000. Altogether, therefore, the profit and loss account and the balance sheet for the past year showed improvement in most of the items. The effect of the Munitions Act and Excess Profits taxation in respect of the year 1916 was still uncertain, and for this reason also the amount carried forward must be ample. It was a matter for regret, he ventured to think, not only from a particular point of view, but on national grounds, that the Chancellor of the Exchequer had found it necessary to increase the excess profits tax from 60 per cent. to 80 per cent. No one was in favour of large and exceptional profits being earned by individuals or by companies by reason of war activities, and all excess profits of this character rightly accrued to the community. Moreover, it was recognised by everyone that the great cost of conducting this unparalleled war to a successful issue must involve heavy taxation all round; but it was also evident that after the war the nation would be badly in need of reproductive capital, not only to replace the accumulated capital which was unavoidably destroyed by the war, but also to provide for expansion of industry. The President of the Board of Trade had told them that an employer should not be satisfied with carrying his business to a certain point of expansion—that there could be no standing still in business; that they must go forward. Every man, he said, who was interested in a great business had to make that business as big as conditions would permit. This could not be done without the constant renewal and increase of capital. Practically the only source of new capital was the surplus provided by production in excess of consumption, and to take that surplus at the source by way of taxation to the extent of destroying the fund out of which future capital was obtained was like eating the seed and foregoing the fruit. It might appear presumptuous to give expression to these opinions in view of the statement of the Chancellor of the Exchequer that it was better to take the money in the form of excess profits duty than to add to the income tax, but he was not alone in being sceptical as to the correctness of this economic policy. The President of the Association of Chambers of Commerce had expressed the view that our Government was at present squeezing the reserves out of the producers that they ought to have available for business after the war. If this policy was continued, he said, the responsibility for unemployment must rest upon the Government, and not upon the manufacturers. American manufacturers had been able to accumulate enormous reserves in their businesses; the German Government had deliberately abstained from an excess profits tax in order to leave their industries in the strongest possible position after the war He (Mr. Garcke) feared that at the present time, when the indispensability of labour was being so strongly impressed upon them, they were apt to forget that capital was equally necessary, and, what was more, that labour could not be employed without it. That there would be a large demand after the war for new work and more commodities was undoubted, and that there would be abundant labour and willingness to work was also evidenced, but were they quite sure that they would have the other resources necessary for production? That was a big economic question which could not be too fully discussed Every man who was, or had been, in business knew that he could not convert a little business into a big business without capital, and he knew, too, the difficulties of raising that capital, and yet when they discussed that question in its large national aspects they frequently spoke and acted as if capital were unlimited The orders secured during 1916 were satisfactory in volume, and the same could be said of the order list as it stood to-day During the past year the whole resources of their establishment had been engaged. In the engineering shops their production had been very much on the usual lines, owing to the great demand for generating plant, motors, transformers, and other apparatus. In their rolling stock department, the character of the work had entirely changed from pre-war standards. The urgent demand for other work, coupled with the difficulties of shipping, had brought their ordinary industrial and export business to a standstill, but, wherever possible, they were arranging with their customers to allow their orders of this class to go on a waiting list, to be dealt with as soon as circumstances permitted. At previous meetings he had spoken of the success of the Ljungström turbine, and confirmatory evidence was available to-day Notwithstanding the present very unusual conditions, they had a larger number of orders for turbines of this type on hand than ever before, and there were many others in prospect as soon as the position became more normal. The female labour at the Loughborough works now represented a very considerable proportion of the total. There was one aspect of the labour question to which he would like to refer. They were familiar with the demands for higher wages made by all classes of employés in order to accommodate themselves to the increased cost of living, and he would be the last to suggest that such increases, by way of war bonuses, were not necessary, or had not in every way been deserved. Latterly, however, the Government, in order to expedite a settlement of such demands, had made direct awards bringing the advances granted into practically immediate operation. Now, in cases, like their own, where firms were engaged on contracts at fixed prices, which ran into large sums of money, and often took many months to complete, it might, he thought, not be unreasonable to expect that such Government awards should be accompanied by regulations for the purpose of automatically reimbursing manufacturers for the increased cost they were put to in respect of contracts which were unfinished at the time the increased wages became payable. That, unfortunately, was not the case; and although manufacturers might be able in some instances to obtain an advance on their contract prices, that was always a matter of difficulty, and there must be many cases where, so far as unfinished work was concerned, the bonus paid to employés came out of the manufacturers' small margin, and not out of increased prices. That was a matter which, he submitted, should be well considered by the Government departments concerned in dealing with similar applications in future.

Mr. B. S. Broadhurst seconded the motion.

Replying to Mr. Marchmont, the Chairman said they were all big shareholders in the company, and would like a dividend, but it would be a very uneconomical thing at the present juncture to make any distribution. They must have a little more patience, and wait until after the war, when conditions might enable them to pay and maintain a moderate dividend.

General Electric Co. (U.S.A.). The report of this company for 1916 shows that the extraordinary demand for its various products made it necessary to operate its manufacturing and other facilities to the limit of their capacity. The value of orders for electrical machinery and supplies was $167,169,000, or 70 per cent. more than in 1915, and 50 per cent. more than the corresponding orders for the largest previous year, 1913. The orders for special war munitions received during the year, amounting to $2,116,000, were merely supplementary to previous contracts. The sales billed amounted to $134,242,290, and the net result was a profit of $15,294,091, plus $3,866,882 income from other sources. Interest on debenture bonds absorbed $571,445, and dividends (8 per cent.) on stock $8,121,646, leaving $10,467,882 carried to surplus. The number of employés in factories and offices of the company and its subsidiaries was 79,000 at the end of 1916. The company followed its customary practice in writing off against income its total expenditures during 1916 for patents, applications for and licences under patents, and other outlays relating thereto, amounting to $891,880. The patent account is carried at $1.00, as in previous years. The increase in merchandise inventories was due not only to the greater volume of business, but to the necessity for carrying, at the existing high prices, larger than normal stocks of all kinds of material as a safeguard against uncertainties of delivery. Urgent pressure upon the management for immediate and extensive additions to the manufacturing facilities involved the expenditure of $8,828,255 for plant account during 1916. "This outlay, as compared with ordinary costs, was abnormal and excessive, in view of which it has seemed wise to write off against income an amount substantially equal to the year's disbursement. The cost of all the special tools, jigs, dies, drawings, and patterns was thus disposed of, and also the greater part of the cost of the large machine tools and apparatus. Advantage was taken of the opportunity to reduce the book value of building accessories, such as piping, wiring, &c., covering additions for a period of years, which will explain the fact that the amount written off for 'real estate and buildings' was larger than the expenditure thereon for the year." The total capital stock issued is $101,512,500.

Babcock and Wilcox, Ltd. The net profit for 1916 was £438,323, plus £42,125 brought forward. After paying the dividend on the 6 per cent. and 5 per cent. preference shares, from which income tax is to be deducted, and 15 per cent. (free of tax) on the ordinary shares, there is placed to reserve £150,000, and to staff pension fund £10,000, leaving £56,495 to be carried forward. The increase in reserves for estimated further expenditure on orders invoiced is required because of the greater cost of materials and labour, &c., which affect the completion of contracts taken into the accounts. A larger reserve for fall in value of investments is also necessary, owing to the diminution in value to which trustee investments have been subject. The company's investments in War Loan have been, by conversion and additional subscription, increased to £520,000 nominal of the new 5 per cent. War Stock. In view of the prevailing increased rate of income-tax and the directors' desire to pay the ordinary dividend free of income-tax, as has hitherto been the custom, the shareholders are in reality receiving the equivalent of an increased rate of dividend.

Austrian Companies. *The Kabel Fabrik A.G., of Pressburg*, reports net profits of £38,000 for 1916, as compared with £29,000 in the previous year. The directors recommend the payment of a dividend of 15 per cent., as contrasted with 11 per cent. in 1915.

The Felten & Guilleaume Kabel, Draht und Drahtseil Fabrik, of Budapest, reports net profits of £30,000 for 1916, as compared with £20,000 in the previous year. It is intended to pay a dividend at the rate of 15 per cent., as compared with 12½ per cent. in 1915, on share capital of £83,000.

The A.E.G.-Union Elektrizitats Gesellschaft, of Vienna, after apportioning £19,000 to depreciation in 1916, as against £17,000 in the previous year, reports net profits amounting to £75,000, as compared with £46,000. It is proposed to distribute 8 per cent., as contrasted with 6 per cent. in 1915.

The Elektrizitats A.G. vorm. Kolben & Co., of Prague, reports gross profits amounting to £169,000 for 1916, as compared with £136,000 in the previous year. After meeting general expenses and making provision for depreciation, the accounts indicate net profits and balance forward of £72,000, as contrasted with £69,000 in 1915, the rate of dividend being 9½ per cent., as against 9 per cent. in the preceding year.

The report of the *Felten & Guilleaume Co., of Vienna*, states that the value and volume of the turnover in 1916 were almost twice those in the preceding year, the strenuous activity rendering necessary substantially greater provision for depreciation than in 1915. After allocating £36,000 to this purpose in 1916, as against £18,000, the accounts show net profits amounting to £153,000, as compared with £105,000. It is proposed to pay a dividend of 20 per cent., this contrasting with a rate of 12½ per cent. in 1915, on ordinary share capital of £354,000.

The Neuhausen Aluminium Co.—The report for 1916 of the Aluminium Industries A.G., of Neuhausen, whose financial results were recently published, states that it was possible to keep the works very active and in uninterrupted operation, as in the previous year. As a result of great exertions, the works were supplied with raw materials for a certain time, and sale conditions were favourable. The installations at Neuhausen and Rheinfelden remained without change, whilst those at Lend Lauris experienced an unimportant expansion. In the case of the Vallais works, a fresh expenditure of £177,000 was incurred, chiefly for the extension of the Chippis Aluminium Works, and for the completion of the hydro-electric works on the Borgne. The installations in France were unchanged; the sequestration was sustained, and the company was only permitted to provide money for the maintenance of the mining concessions. Of the auxiliary companies which served for the production of alumina only, the Goldschmieden-Trotha Co. showed an increase in expenditure. The Martinswerk was largely extended, and the Hungarian Bauxite Co. worked satisfactorily.

British Ever-Ready Co., Ltd.—For the year ended March 31st, 1917, the amount available for appropriation, after writing off depreciation, payment of Excess Profits Tax for 1914-15 and 1915-16, and after making reserve for Excess Profits Tax for 1916-17, is £28,656. After paying 10 per cent. on the preference shares, and 10 per cent. and a bonus of 5 per cent. on the ordinary, £2,906 is to be carried forward. The amount of Excess Profits Tax payable for 1914-15 and 1915-16 was higher than was anticipated at the last meeting, owing to the tax having been raised by the Finance Act, 1916, from 50 per cent. to 60 per cent. for the latter year. This increase represents approximately £4,000. The full amount of the tax for these two years has been paid. Provision has been made for Excess Profits taxation for the past year, which, but for the high rate of taxation, would have been a most successful one. The directors consider the above distribution satisfactory having regard to the increased taxation. Annual meeting: June 1st.

Midland Electric Corpn. for Power Distribution, Ltd.—The report for 1916 states that the balance to the credit of the net revenue account, after payment of debenture interest, is £33,182, plus £8,932 brought forward, making £42,115. Out of this the directors recommend a dividend of 5 per cent. on 30,000 ordinary shares, leaving £11,802 to be carried forward, subject to excess profits tax. The net capital expenditure in respect of plant, mains, transformers, &c., was £36,916. To provide for this outlay debenture stock to a total nominal value of £45,600 was sold. The increasing demand for power continued to such an extent that it became necessary to again order additional plant. Accordingly a contract was placed for a new generating set of 3,000-KW. capacity, and the erection completed at the end of December last. Since that date still further applications for supply have been received, amounting to several thousands of horse-power, which the company is, unfortunately, unable to accept at present.

Bath Electric Tramways, Ltd.—Mr. J. B. Hamilton presided at the annual meeting recently. He said it was refreshing to find that at Bath the cost of tramway travelling had not been disturbed, notwithstanding that the cost of practically everything that one had to buy had been increased by 50 to 100 per cent. At the present time, however, many tramway undertakings were seriously considering their position, and it might become necessary to ask the Board of Trade, in consideration of the extraordinary state of affairs, to authorise rates of fares in excess of those which their statutory powers allowed to be charged. Notwithstanding many adverse conditions, the traffic and other receipts were up £1,157. Mr. A. A. C. Swinton seconded the adoption of the report.

Craigpark Electric Cable Co., Ltd.—The net profit for the year ended March 31st, 1917, was £7,966, after making provision for excess profits tax, plus £900 brought forward. It is proposed to put £2,000 to depreciation of buildings and machinery; £500 to reserve; to pay the 6 per cent. preference dividend, and 6 per cent. on the ordinary shares, carrying forward (subject to directors' fees) £1,266. The volume of business done was satisfactory, although production had been handicapped by shortage of labour and scarcity of raw materials. Annual meeting: Glasgow, May 10th.

West India & Panama Telegraph Co., Ltd.—The report for last half of 1916 states that the amount to credit of revenue is £49,118, as compared with £33,553 in the corresponding half-year of 1915, and the expenses have been £32,189, against £22,987. The directors have placed £4,000 to reserve, and it is proposed to pay on the ordinary shares 6d. per share (free of income-tax), leaving a balance of £2,888. The traffic receipts show an increase, due to prices of produce being favourable to the planters.

Brisbane City Electric Light Co., Ltd.—The credit balance for the year ended January 31st, 1917, was £25,711. The interim dividend and dividend duty paid in September, 1916, absorbed £10,884, and a further 3 per cent. on the preference, and 5 per cent. on the ordinary shares, together with dividend duty and an allowance for Federal income-tax, will absorb £14,279, leaving £2,117 to be carried forward.

Clevedon, Portishead & District Electric Supply Co., Ltd.—The annual meeting was held recently. In spite of very difficult conditions, the gross revenue was more than double that of the previous year. The receipts were £3,955, against £1,737 last year. Notwithstanding the increased cost of fuel, &c., the gross profit was £884, compared with £696

Oriental Telephone & Electric Co., Ltd.—It is proposed to pay 6 per cent per annum on the preference shares for the half-year ended December 31st last, less income-tax, also a final dividend of 6 per cent. on the ordinary shares, free of income-tax, making a total of 10 per cent. for the year. The annual meeting is called for May 16th.

Melbourne Electric Supply Co., Ltd.—Interim dividend on the consolidated ordinary stock at the rate of 10 per cent per annum, free of income-tax, for the half-year ended February 28th.

Calcutta Tramways Co., Ltd.—Final dividend on the ordinary shares of 6s. 6d. per share, less tax, or 5s. 6d. per share net, making 9½ per cent. for 1916.

Shanghai Electric Construction Co., Ltd. A dividend of 5 per cent. is announced, making 10 per cent. for 1916

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets and business are on the quiet side. Prices hold their own with a good deal of steadiness, but two factors combine to restrain the investor from opening his purse-strings. One of these is the situation in Russia, the other is the submarine activity. Neither is regarded as an obstacle that will not be overcome sooner or later; but, for the time being, they plant restraint in Stock Exchange allotments, and there are comparatively few changes of moment on the week.

The principal movements are again in the Mexican group. While there has been nothing fresh up to the present to add to expectations that Mexico will come into the war on the side of the Allies this week, inquirers are bidding for bonds which holders do not care to part with. Therefore, we have the anomaly of Mexico Tramways 5 per cent. first mortgage bonds standing at 37½, although the last bargain marked in the Stock Exchange Official List was at 21¼; and the 6 per cent. mortgage bonds, quoted at 27½, were last dealt in at 23¼. Mexican Light & Power Firsts, now standing at 37½, marked 29¼ a few days ago. The company's common and preferred shares stand at 13½ and 22½ respectively. Monterey debenture stock and Pachuca 5 per cent. first mortgage bonds have both been advanced without any stock changing hands of late.

Other foreign bonds are mostly firm. Brazilian Tractions have been erratic, rising to 46½ before they eased off a little, the reaction coming about in consequence of a slight weakening in the exchange. Melbourne Electric consolidated ordinary stock, which has been standing at 156 since the middle of February, gave way to 147½ on a slight pressure to sell; stock changed hands at 145, which is 47 points lower than the middle price at the outbreak of war.

The Argentine group of tramway stocks keeps fairly steady; and attention is being drawn to the 5 per cent. debenture, with interest payable on June 1st and December 1st, the yield being a trifle over 7¼ per cent. on the money, without making allowance for the five months' accrued dividend. Of its kind, the stock looks a very fair investment.

The British Columbia Electric Railway sextet is depressed, in consequence of the impression that competition is going to be set up in Vancouver. Whether this materialises or not remains to be seen, but a scheme is on foot to this end, though we understand that it is meeting with considerable opposition from holders of the British Columbia Electric Railway stocks.

Para Electric Railways ordinary are rather firmer at 3¼, and the preference at 4¼, these having sympathised with the decidedly better tone for Brazilian issues generally, which has been a feature in the Stock Exchange during the past fortnight.

The telegraph list is unusually devoid of change. Indo-Europeans are just below 50 again, and New York Telephone bonds, now ex dividend, stand at 99. Chili Telephones eased off to 6 15/16; while amongst cable shares, apart from Indo-Europeans, no alterations at all have occurred. Direct United States Cable shares are a shade better at 6. Eastern Telegraph preference changed hands last Friday at 62. West India and Panama ordinary have been done as low as 18s. 6d., but business in the list as a whole has been far to seek. Marconis show 1/16 fall; Americans, after drooping to 14s. 6d., recovered to 15s. bid.

The catalogue of home electricity shares is also colourless as regards changes. Apart from Cities and Counties, there is little going on amongst the London shares. Urban 5 per cent. preference were dealt in two or three days ago at 37s. 6d., and the ordinary shares are quoted at 3s. 6d. Victoria Falls preference are a little better at 21s. 9d. Edmundson's remain at 3s. 9d. for the ordinary, 50s. for the preference, and 10s. for the non-cumulative preference. The four Brush Electric stocks are quoted at 25 for the ordinary, and 79, 60, and 52 for the three debenture stocks in their order of priority. Manufacturing shares as a whole are as quiet as those of the supply companies. British Aluminium 5 per cent. debenture stock has risen 2 points to 58.

Babcock & Wilcox hardened 1/16 to 2 15/16 on the fine report, and manufacturing shares hold their prices firmly. In regard to controlled companies the Chancellor of the Exchequer's announcement that excess profits duty is to be substituted for the munitions levy has aroused lively attention, and the general opinion in the Stock Exchange seems that the alteration will be all to the good of the companies. Several of the iron and steel shares are therefore better.

The rubber market gave way at first on discussion of the Budget's intention to raise the excess profits duty from 60 per cent. to 80 per cent., though recovery followed in most cases. Business, however, runs on quiet lines; and the same remark will cover Stock Exchange markets with scarcely an exception.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price May 8, 1917.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	9	6½	—	£6 18 6
Charing Cross Ordinary ..	5	5	8½	—	7 2 10
do. do. do. 4½ Pref..	4½	4½	8¼	—	6 18 6
Chelsea	4	3	2⅞	—	5 4 4
City of London	8	8	11⅝	—	6 17 8
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10¼	—	6 16 6
do. 6 per cent. Pref.	6	6	10		6 0 0
Kensington Ordinary	7	10	5¼	—	5 11 7
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	3¾	—	5 6 8
Metropolitan	8	8	2½	—	6 0 0
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 4 0
St. James' and Pall Mall ..	8	8	6¼	—	6 8 0
South London	5	5	2¾	—	7 5 6
South Metropolitan Pref. ..	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	5⅝	—	6 5 9
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	95	—	6 6 2
do. Def.	83/6	1½	22½		6 13 4
Chile Telephone	8	8	$6\frac{5}{16}$	— $\frac{1}{16}$	5 15 4
Cuba Sub. Ord.	5	5	8½	—	5 17 8
Eastern Extension	8	8	14	—	*5 14 4
Eastern Tel. Ord.	8	8	141½	—	*5 13 1
Globe Tel. and T. Ord.	7	7	12¼	—	*5 14 8
do. Pref. ..	6	6	10	—	6 0 0
Great Northern Tel.	22	22	88	—	5 15 9
Indo-European	13	13	49½	—$1\frac{1}{16}$	6 11 4
Marconi	10	10	$2\frac{13}{16}$	—	3 11 2
New York Tel. 4½	4½	4½	99 xd	—	4 11 0
Oriental Telephone Ord. ..	10	10	2⅛	—	4 14 1
United R. Plate Tel.	8	8	6⅝	—	*6 0 9
West India and Pan.	6d.	6d.	1	—	2 10 0
Western Telegraph	8	8	14	—	*5 14 4
Home Rails.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	23¾	— ½	4 3 10
do. District	Nil	Nil	16	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A" ..	Nil	Nil	5/-	—	Nil
do. do. Income	6	5	80½	— ½	*6 4 3
Foreign Trams, &c.	Dividend 1914.	Dividend 1915.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	3½	—	8 16 0
do. 2nd Pref. ..	5½	5½	2¾	—	—
do. 5 Deb. ..	5	5	68½	-	7 6 0
Brazil Tractions	4	4	45½	+ ½	Nil
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	60	— 1	8 6 8
do. do. Preferred	—	Nil	44	— 2	Nil
do. do. Deferred	—	Nil	37½	— 2	Nil
do. do. Deb.	4½	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	37½	+ 4	Nil
do. 6 per cent. Bonds	—	Nil	27½	+ ½	Nil
Mexican Light Common ..	Nil	Nil	13½	+ 1	Nil
do. Pref.	Nil	Nil	24½	+ 5	Nil
do. 1st Bonds ..	Nil	Nil	37½	+ 4	—
Manufacturing Companies					
Babcock & Wilcox	14	15	$2\frac{15}{16}$	+ $\frac{1}{16}$	5 2 0
British Aluminium Ord. ..	5	7	27/6	—	7 6 10
British Insulated Ord.	15	17½	12¾	—	6 17 3
British Westinghouse Pref. ..	7½	7½	$2\frac{5}{16}$ xd	—	6 9 10
Callenders	15	20	13½	—	7 11 0
do. 5 Pref.	5	5	[illegible]	—	6 5 0
Castner-Kellner	20	22	$3\frac{5}{16}$	—	6 13 0
Edison & Swan, £3 paid ..	Nil	—	⅞	—	Nil
do. do. fully paid ..	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	69½	—	5 15 2
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9¾	—	6 3 1
do. Ord.	10	10	14½	—	6 18 0
Henley	20	25	15½	—	8 1 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11⅞	—	*8 8 4
Telegraph.Con	20	20	37	—	*6 9 10

* Dividends paid free of income-tax.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month.		No. of weeks.	Total to date.		Route miles open.	
		£	£		£	£		Inc.
Bristol (Trams) ..	April 27	20,480	+ 90	..	78,243	+ 960	30·5	..
Cork	,, 26	1,985	+ 73	17	7,655	+ 12	9·89	..
Dublin	,, 27	24,598	+5,096	17	99,740	+ 4,221	54·25	..
Hastings	,, 29	4,162	+ 81	..	15,587	+ 2,216	19·3	..
Lancashire United	,, 25	8,593	+1,026	17	30,6[illegible]2	+ 2,961	42	..
Llandudno-Col. Bay	,, 27	1,107	− 324	21½	4,167	— 416	6·5	..
Anglo-Argentine ..	,, 29	107,503	+1,163	17	868,155	+ 1,806	..	..
Auckland	,, 6	21,178	+ 411	40	214,586	+ 8,882	26·59	..
Calcutta	,, 28	17,499	− 198	..	..	− 1,060		..
Kalgoorlie, W.A. ..	January	2,431	..	..	2,431	..	20.5	..
Madras	..	..	..	..	..	..	..	..
Montevideo ..	April	29,230	+ 233	26	186,622	− 797	..	..
Dublin-Lucan Rly.	April 26	580	+ 17	17	2,083	+ 64	7	..

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, May 9th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Oxalic	per lb.	1/6	..
a	Ammoniac Sal	per ton	£75	..
a	Ammonia, Muriate (large crystal)	,,	£54	..
a	Bisulphide of Carbon	,,	£23	..
a	Borax	,,	£38	..
a	Copper Sulphate	,,	£61 10	..
a	Potash, Chlorate	per lb.	2/6	..
a	,, Perchlorate	,,	2/-	..
a	Shellac	per cwt.	215/-	10/- inc.
a	Sulphate of Magnesia	per ton	£16	..
a	Sulphur, Sublimed Flowers ..	,,	£35	£3 inc.
a	,, Lump	,,	£25	£2 inc.
a	Soda, Chlorate	per lb.	1/-	..
a	,, Crystals	per ton	120/-	..
a	Sodium Bichromate, casks ..	per lb.	..	..
	METALS, &c.			
c	Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c	,, Tubes (solid drawn) ..	,,	..	..
c	,, Wire, basis	,,	..	..
c	Copper Tubes (solid drawn) ..	,,	1/8½ to 1/9	¼d. dec.
g	,, Bars (best selected) ..	per ton	£165	£3 dec.
g	,, Sheet	,,	£165	£3 dec.
g	,, Rod	,,	£165	£3 dec.
d	,, (Electrolytic) Bars ..	,,	£142	£3 dec.
d	,, ,, Sheets ..	,,	£167	£3 dec.
d	,, ,, Wire Rods	,,	£150	£3 dec.
d	,, ,, H.C. Wire	per lb.	1/5⅞	$\frac{5}{16}$d. dec.
f	Ebonite Rod	,,	3/-	..
f	,, Sheet	,,	2/6	..
n	German Silver Wire	,,	2/3	..
h	Gutta-percha, fine	,,	6/10	..
h	India-rubber, Para fine	,,	8/0½	½d. dec.
i	Iron Pig (Cleveland warrants) ..	per ton	Nom.	..
l	,, Wire, galv. No. 8, P.O. qual.	,,	£40	..
g	Lead, English Pig	,,	..	..
g	Mercury	per bot.	Nom.	..
e	Mica (in original cases) small ..	per lb.	6d. to 3/-	..
e	,, ,, ,, medium	,,	3/6 to 6/-	..
e	,, ,, ,, large ..	,,	7/6 to 14/- & up.	..
d	Silicium Bronze Wire	per lb.	1/9½	½d. dec.
r	Steel, Magnet, in bars	per ton	..	..
g	Tin, Block (English)	,,	..	..
n	,, Wire, Nos. 1 to 16	per lb.	3/6	3d. inc.

Quotations supplied by—

a	G. Boor & Co.	g	James & Shakespeare.
c	Thos. Bolton & Sons, Ltd.	h	Edward Till & Co.
d	Frederick Smith & Co.	i	Bolling & Lowe.
e	F. Wiggins & Sons.	l	Richard Johnson & Nephew, Ltd.
f	India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.	n	P. Ormiston & Sons.
		r	W. F. Dennis & Co.

London Chamber of Commerce.—At the annual meeting of the Chamber, on Wednesday, May 2nd, the following report of the Electrical Section was submitted:—

At the annual meeting, Mr. W. L. Madgen's resignation as chairman of the Section was received with much regret, as was also that of Mr. A. M. Sillar, deputy chairman, and a vote of thanks was passed to these gentlemen for their services. Mr. Stuart A. Russell was unanimously elected to the office of chairman, and it was decided that the position of deputy chairman should not be filled for the time being.

New Electricity Bill.—Consideration was given to a Bill introduced by the Incorporated Association of Municipal Engineers which would enable local authorities to open showrooms to sell fittings and wirings, and practically to carry on the business of ordinary electrical contractors, and the Section reaffirmed previous resolutions protesting against interference on the part of the municipal authorities with the business of making and selling fittings and wiring premises in competition with electrical contractors.

Trade After the War.—The Section considered the various reports of the Special Committee of the Chamber on Trade During and After the War, and a discussion took place as to the attitude of the Electrical Section on the question of proposed tariffs in connection with goods of enemy, allied and neutral nations. It was left to the discretion of the chairman to express the views of the electrical trade on this matter to the Special Committee on which he represented the Section.

Government Committees on British Trade.—In view of the appointment by the President of the Board of Trade of a Committee to consider the position of the electrical trade after the war, especially in regard to international competition, a communication was addressed to the Committee asking for some indication of the points upon which they would desire evidence, and the lines on which they proposed to conduct the inquiry. The Section being of opinion that it was desirable to offer evidence, a Special Committee was appointed to consider the evidence to be given, and two members were asked to prepare drafts of evidence, one on the legislative side of the question, and the other on the commercial, industrial, and international side. After further consideration, the member of the Committee appointed to give evidence on the legislative side of the question decided that such a course would be undesirable, and Mr. Stuart A. Russell, chairman, prepared a draft of evidence on the commercial, industrial, and international aspect, which was duly forwarded to the Government Committee, and acknowleged by the secretary, but up to the end of the year no appointment had been given for the evidence to be heard orally.

Electrical Exportations Committee.—The Section offered to assist the War Trade Department in furthering its efforts to prevent the export to enemy countries of those essential insulating materials which entered into the manufacture of electrical apparatus now so largely used in the manufacture of munitions of war. After a conference had taken place with representatives of the War Trade Department, the Admiralty, and the War Office, a Committee of members of the Electrical Section was appointed as an official Advisory Committee attached to the War Trade Department. Various kinds of material captured by the military and naval authorities have been submitted for examination, and reports have been forwarded to the War Trade Department.

HIGH-PRESSURE ELECTRIC RAILWAY SYSTEMS.

One of the most interesting electric traction developments within recent years has been the employment of high-tension direct current as utilised on the Bury to Manchester line of the Lancashire and Yorkshire Railway, and on the Shildon to Newport line of the North-Eastern Railway. The most remarkable high-pressure direct-current scheme is the Chicago, Milwaukee and St. Paul installation, which works at a pressure of 3,000 volts.

It is not so much the high pressure that makes the undertaking notable as the fact that the locomotives are larger than any other locomotives, steam or electric, hitherto built; and, furthermore, they are designed for regeneration. As a result of the high track pressure, the spacing of the sub-stations is wide, but the efficiency of the machines which these sub-stations contain must be appreciably lower than that of the converters usually adopted. Motor-generators composed of a synchronous motor coupled to two direct-current dynamos, permanently connected in series, are not, of course, so efficient as rotary converters. If rotaries could have been installed in the sub-stations, the overall efficiency of the system would have been improved, although the smaller number of sub-stations required, as the result of the high track pressure leads, of course, to economy in other directions. A 3,000-volt rotary has not, so far as the writer is aware, been built even for a 25-cycle circuit, and as the current for the Milwaukee and St. Paul system is taken from power stations built originally for general lighting and power supplies, the need for motor-generators in the sub-stations is scarcely to be wondered at.

Even on the Shildon to Newport lines of the North-Eastern Railway, where the track pressure is only 1,200 volts, each converter unit in the sub-stations consists of two 600-volt rotaries connected in series. On the Bury to Manchester lines of the Lancashire and Yorkshire Railway, however, where the pressure is 1,500 volts, each rotary is designed for the full working pressure. High-voltage rotaries are also running in America, apparently with success, but a 3,000-volt, 60-cycle rotary has still to be developed.

Another new system, equally attractive from a technical standpoint, is the "split-phase" system, as adopted on a section of the Norfolk and Western Railroad. In this case, single-phase current at a pressure of 11,000 volts is collected from a single overhead wire, but it is converted on the locomotives, by means of a phase converter, into three-phase current, which is supplied to the driving motors.

Like the direct-current motors on the Chicago, Milwaukee, and St. Paul Railway, those on the Norfolk and Western system are regenerative. The advantages of the "split-phase" system are that it posseses all the good points of the three-phase system and it only involves the use of one overhead wire. When regeneration is desired, the ordinary three-phase system is distinctly advantageous, because the motors will, when the rotor revolves slightly above the speed of the revolving field, return current to the line without the use of special arrangements on the locomotives. But in yards and at crossovers, the two conductors make the overhead equipment complicated, and pressures as high as those used on single-phase lines are not, as a rule, adopted.

On the Italian State Railways, the three-phase system has been adopted as standard, but the working pressure is only 3,000 volts. With a "split-phase" system, a pressure of 15,000 volts or more can be employed with the same ease and safety as with a single-phase system, and when the engines are descending gradients, the motors return current to the line through the phase converter. The latter, which resembles an induction motor so far as its general construction is concerned, does not introduce much additional complication or expense, and its use is amply justified by the fact that it enables three-phase current to be supplied to the driving motors whilst single-phase current is drawn from only one overhead conductor. For conditions such as those which are met with on the electrified lines of the Norfolk and Western system, where the gradients are severe and the trains hauled are heavy, the "split-phase" system is undoubtedly advantageous.

When regeneration is required, the single-phase system has little to recommend it. True regenerative single-phase locomotives have been designed and constructed, but they are distinctly inferior to locomotives equipped with three-phase motors. The most interesting tests which have been carried out with single-phase locomotives within recent years are probably those made on an experimental line of the Midi Railway in France. All kinds of single-phase motors were tried, and it was specified that the engines submitted for trial should be capable of regenerating when descending gradients. Some of the engines fulfilled these conditions, but, owing to the special exciting arrangements which had to be provided for making the motors act as generators, the engines were more complicated than others that have been built for service where regeneration is unnecessary. One firm that built a locomotive for this experimental line came to the conclusion, after many trials, that regeneration with single-phase current was too troublesome to warrant its adoption, and, instead of designing the locomotives to return current to the overhead conductor, the company's engineers fitted the engine with resistances to absorb the regenerated current.

It would be wrong to assert that single-phase motors cannot be made to regenerate, but it is certainly true that they do not lend themselves to it nearly so well as three-phase motors. Although single-phase motors have been considerably improved within recent years in some respects, they still remain, and will always remain, inferior to machines which work with direct and polyphase alternating current. An American engineer who is an ardent advocate of single-phase traction mentioned some time back, whilst describing some experiments with mercury vapour rectifiers, that on fitting one of these rectifiers to a single-phase locomotive the power of the engine was materially increased, which proves pretty clearly, if proof is needed, that a motor of given dimensions and weight will develop more power when supplied with direct current than when supplied with single-phase alternating current.

The difficulty of obtaining high-tension direct current for traction purposes from generators and converters is one of the obstacles in the way of the development of really high-pressure direct-current systems. If the revolving machinery at present utilised in sub-stations could be replaced by some form of static apparatus, such as mercury vapour rectifiers, commutation troubles would vanish and direct-current pressures considerably in excess of 3,000 volts might be applied to the track, provided, of course, that the motor and control equipments could be built to work at these pressures. The highest pressure that has been used on a direct-current railway is 5,000 volts. An experimental 5,000-volt line associated with the Michigan United Traction Co.'s system has now been working for some time without a breakdown in the insulation or any trouble due to the high voltage. The track, in this case, is not fed through rotary converters, but through mercury vapour rectifiers.

Hitherto, it has been customary in experiments of this kind, to place the rectifiers on locomotives, and to collect alternating current from the overhead wire; but in this case the rectifiers are placed in a sub-station, and high-pressure direct current is fed into the system. Whether this scheme will ever be practicable on a large scale, remains to be shown; but in any case, the scheme is, to say the least, extremely interesting. In some ways, a high-pressure direct current on an overhead wire is preferable to a high-pressure alternating current, especially when there are telegraph and telephone wires in close proximity; but whereas alternating-current pressures can be reduced with static transformers placed on locomotives and motor coaches, direct-current pressures can only be changed with revolving machines. But as motor equipments have been made to work satisfactorily on this short experimental 5,000-volt line, there is no very obvious reason why the system should not be developed on a larger and more elaborate scale.

AN APPROXIMATE FORMULA FOR MAGNET COILS.

[COMMUNICATED.]

Electricians and engineers who only occasionally want to make approximate calculations, may find that the employment of the formula usually given in text-books is not infrequently a little inconvenient and unhandy. The writer finds a formula reduced to simple expressions for approximating readily the length of wire in, or the ohmic resistance, current, or ampere-turns of, shunt field coils can easily be obtained as follows :—

In a magnet coil, the approximate number of turns per layer per inch of length of winding is 1 ÷ dia. (inches) of wire, and the number of layers per inch of depth of winding is also 1 ÷ dia. of wire ; the number of turns per square inch of winding space is $(1 \div \text{dia. of wire})^2$, and the number of turns for a given winding space is approximately equal to the area of winding space in square inches multiplied by $(1 \div \text{dia. of wire})^2$.

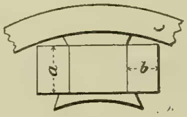

Fig. 1.

The total length in feet of wire in a coil will, therefore, be :—Area of winding space × length of mean turn (feet) $\times (1 \div \text{dia. of wire})^2$.

The resistance of the coil will be :—Area of winding space × length of mean turn (feet) × resistance per foot $\times (1 \div \text{dia. of wire})^2$.

The current (amperes) in the coil will be :—Volts across coil ÷ (area of winding space × length mean turn (ft.) × resistance per ft. $\times (1 \div \text{dia. of wire})^2$).

The ampere-turns will be :—Volts across coil ÷ (length of mean turn in ft. × resistance per ft.)

Formulæ derived from the above reasoning may be simply stated :—

Length (ft.) of wire in coil $= A \times T \times L_k$

Resistance (ohms, cold) $= A \times T \times R_k$

Current (amps.) $= V \times C_k / A\,T.$

Ampere-turns $= V \times C\,T_k / T.$

when— A = Area ($a \times b$) of winding space around magnet pole in square inches, as indicated in fig. 1.

T = Length of mean turn in inches.

V = Volts across coil, and

L_k, R_k, C_k, and $C\,T_k$ are constants.

Constants may easily be worked out for any size of wire : values for Nos. 10 to 26 gauge D.C.C. wires are shown in the table below :—

Wire gauge No.	Dia. D.C.C.	L_k.	R_k.	C_k.	CT_k.
10	·14	4·25	·00266	378	19,100
11	·128	5·10	·0039	260	15,650
12	·116	6·2	·0059	170	12,600
13	·104	7·7	·0093	108	9,850
14	·090	10·3	·0166	60·5	7,450
15	·082	12·4	·0247	40 7	6,040
16	·074	15·2	·0380	26·3	4,775
17	·066	19·2	·0630	15·9	3,650
18	·058	24·70	·110	9·1	2,680
19	·050	33·30	·212	4·72	1,860
20	·042	47·2	·375	2·675	1,510
21	·038	57·5	·58	1·72	1,190
22	·034	72·0	·945	1·06	913
23	·030	92·5	1·65	·605	670
24	·028	106	2·26	·442	563
25	·026	123	3·175	·315	465
26	·024	144	4·6	·217	376

The constants shown were calculated on the slide rule, and are not given as absolute values ; they are, however, sufficiently near for obtaining fairly accurate results.

THE DETERIORATION OF CURTIS RATEAU TURBINE BLADING.*

(*Concluded from page* 503).

Two final cases are interesting on account of the rapidity with which deterioration takes place, and also because the machines are of later design than those previously described. The first of these is one of the 12,000-kw. generator turbines installed at Brakpan, containing 11 guide blade diaphragms. The first five stages on this set have been subjected to heavy pressure, so much so that displacement of the diaphragms has occurred. It would appear that steel, containing no nickel, 3 mm. thick, will give better results than the 2 mm. 30 per cent. nickel steel, although it is strange that in diaphragms 2, 3, and 4 the latter material shows no cracks.

The other case is on the three large compressor turbines of 10,000 h.p. installed at Rosherville.

The following table shows the arrangement of blades and condition when examined after the number of running hours specified. "H" signifies steel containing no nickel, and "J" 30 per cent. nickel steel :—

10,000-h.p. Compressor Turbines.

Diaphragm.	No. 7. 10,362 hours.	No. 8. 11,543 hours.	No. 9. 5,994 hours.
No. 1 ...	"H." steel good.	"H." steel good.	"H." steel good.
No. 2 ...	..	..	..
No. 3 ...	"J." cracked.	"J." badly cracked.	"H." good.
No. 4 ...	"H." good.	"J." badly cracked.	"J." slightly cracked.
No. 5 ...	"J." good.	"J." cracked	"J." good.

The above results point to "H" steel being a much more suitable metal for guide blading than "J" steel.

Conclusions.—In summarising the behaviour of the materials used in blading these turbines, it will be seen that there is no difficulty in choosing a material for moving blades which can be depended on to give fairly satisfactory results in particular stages. Five per cent. nickel steel, brass and aluminium bronze in suitable stages will have a life of 40,000 hours, and, perhaps, 50,000 or more, which, if the turbines are run continuously, means five or six years.

Nozzles with thin cast-iron vanes should be abolished, but if cast-iron is used the design should be such that there is no possibility of pieces becoming detached.

The guide blading in use on these turbines is clearly unsatisfactory; three years or more must often elapse before this is discovered, and an equivalent time is taken to prove the success or otherwise of any alteration.

While the author feels that mild steel is preferable to the high percentage nickel steel in use, it must be admitted that the latter has given good results in many cases.

High percentage nickel steel has been more extensively used and for a much longer period than non-nickel steel. The evidence is, however, very much in favour of mild steel.

Blades made from brass sheet and carefully fitted to retaining rings have been used for small turbines. The cast-in method of attaching blades is very simple, and requires a minimum amount of machining and fitting, so that it would be preferable to retain this design if satisfactory results can be obtained.

The author believes that the position can be much improved by the use of thicker blades of mild or low percentage nickel steel, say, 3/16 in. or ¼ in., tapered, perhaps, on the outlet side to ⅛ in. Unfortunately, an alteration of this kind on a ring designed for 2 mm. blades reduces the area for steam passage somewhat.

In the case of the guide blade diaphragms for the 10,000-h.p. compressor turbines, the blades have been increased in thickness from 2.25 mm. to 3 mm. in three diaphragms on one turbine without affecting the efficiency or output.

On the 12,000-kw. generator turbines at Simmer Pan and Brakpan, six stiffening blades of mild steel, 3/16 in. thick, have been cast in each half.

On the same class of turbine cast-iron stiffening blocks are being cast between adjacent guide blades on the horizontal and vertical diameters of the diaphragm. This blocks up four ports in the complete ring, and should stiffen up the diaphragm very considerably.

The President (Mr. Bernard Price) said, whilst the statistics given were conflicting in some respects, he thought the following facts stood out as definitely proved :—

1. In the case of some blading materials high temperature contributes to deterioration.

The behaviour of aluminium bronze and high percentage nickel steel running blades in various stages pointed clearly to the fact that these materials were unsuitable for use at the higher temperatures.

2. The guide blading for the first three or four Rateau

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* Abstract, from the *Proceedings* of the South African Institution of Engineers.

stages is relatively immune from the deterioration so noticeable in subsequent stages.

This was, to his mind, a most striking fact; it appeared fair to argue that this cannot be attributed in any appreciable degree to the influence of temperature.

3. The first indication of the cracking of guide blades is always at the inlet side of the blade, and these cracks then extend cobweb fashion over the surface of the blade.

He ventured to suggest that the above-mentioned facts all pointed to axial movement of the diaphragms as being the primary cause of the loss of nature of the blading material. It would seem that the designer had relied upon the blades alone to withstand the forces acting on the diaphragms, and as these forces varied with the load on the machine a variable stress was set up in the high percentage nickel steel of which the blades were made. At the high pressure end of the Rateau stages the blades were relatively short in length, and it seemed reasonable to assume that up to about the fourth stage these blades were sufficiently strong and stiff to prevent any appreciable axial movement of the diaphragm, but beyond that stage this no longer held good.

There was a considerable amount of evidence to show that deterioration was more rapid on those machines which took a fluctuating load. Movements due to fluctuations in the load occurred continuously and rapidly, and their effect upon the molecular structure of the blading material would be many hundreds of times that caused by starting up and shutting down.

The Vereeniging machines ran steadily night and day, and the load they carried was a very steady one. The longer life of the guide blading at Vereeniging as compared with Rosherville was quite consistent with the argument he had put forward.

The large machines at Simmer Pan and Brakpan had been fitted with nozzle governors of a type which was much more sensitive than that in use on the other turbines. These machines, therefore, took up the major portion of the fluctuations of load, and this might very well have accentuated the trouble experienced on these sets.

The fact that the blades started to crack at the inlet side seemed also to support the theory that axial movement was responsible for the trouble. The shape of the blades was such as to place the inlet side in tension.

The cure for these guide blade troubles would, therefore, appear to lie in designing the diaphragms and guide blade rings so that axial movement was impossible.

It seemed to him that with suitable design deterioration should be confined to the effects of wear alone, and the problem appeared to be to find the hardest material which will withstand the temperatures existing in the Curtis and Rateau stages. Some of the metals at present in use appeared to withstand these temperatures quite satisfactorily, but they were relatively soft, and when iron alloys were used were subject to slight rusting at stages where the steam became wet. He had no knowledge of the molecular theory of alloys, but it seemed to him it should be possible to decide from theoretical considerations those combinations which were likely to be subject to molecular change under the influence of temperature, and, having eliminated these, selection could be made according to hardness and ability to withstand moisture. There seemed to be very little evidence of chemical action of gases in the steam; if it could be shown that, when using a given class of feed water, this danger was present, it might be necessary to eliminate also those alloys which would be expected to suffer from such chemical action.

In his opinion, the most important conclusion to be drawn from the paper was that the particular troubles dealt with were primarily due to axial movement.

ELECTRICAL INDUSTRIES IN CHINA.[*]

According to the Japanese journal, the *Zaisei Keizai Jiho* (Financial and Economic Review) for December, quoted in the February issue of the Shanghai *British Chamber of Commerce Journal*, the electrical industry of China is as yet in its infancy, and, as is natural, existing enterprises are confined almost entirely to large towns and open ports, seldom extending beyong urban districts. An idea may be gained of the state of her electrical industries from the fact that the aggregate capacity of electric motors in China is stated to be only 70,000 KW.

The number of electrical undertakings throughout China is 87, of which 62 are located in China proper, and 25 in Manchuria. Eighty of those enterprises are light or power services, or the two combined; four are such services carried on in conjunction with electric railways, while three are devoted to the manufacture of electrical apparatus and supplies. As for electric tramways, China proper (including Hong-Kong) has only three cities (Shanghai, Hong-Kong, and Tientsin) where these are maintained. The South Manchuria Railway Co. operates street railways at Dairen and Fushun, which are the only towns having such services in Manchuria. According to the latest data, the electric energy supplied for power and light throughout China totals 33,000 H.P. and 1,375,000 C.P. respectively. For purposes of comparison, it may be mentioned that the Hokkaido alone uses 35,000 H.P., while the city of Tokio and suburbs are served with 1,900,000 C.P. As a prime mover, steam power is almost exclusively employed in China, water power being utilised only in the Province of Yünnan.

Out of the 87 Chinese electrical undertakings, six are Chinese Government enterprises, 53 are managed by Chinese private individuals, while the remaining 28 are foreign undertakings. Some of the Chinese private businesses, however, are run with foreign capital, so that the enterprises really under Chinese private management are reduced to 41. Out of the 28 foreign undertakings Japanese interests number 10, seven of which are located in Manchuria. The number of kilowatts represented by the Chinese (both Government and private), foreign (Japanese excluded), and Japanese enterprises are 22,000, 31,000, and 17,000 respectively. As a rough estimate, for accurate figures are difficult to obtain, the capitalisation of the industry amounts to 36,000,000 yen (yen = 2s. 0½d.). Of this, foreign investments amount to 14,000,000 yen, and Japanese investments to 5,000,000 yen. Electrical enterprise in China has not yet attained such a stage of development as to yield satisfactory returns on the capital, only 13 businesses declaring an annual dividend of 5 per cent. There must, however, be room for economy in the cost of operation and maintenance, and with the general development of industrial and economic resources in that country this branch of enterprise is bound to expand.

The entire telegraphic service is controlled by the Ministry of Communications. At the end of 1913, telegraph lines extended over 37,403 miles, with 51,129 miles of wire. Submarine cables, with the exception of the Woosung-Canton line opened in the early part of 1915, are all under foreign control. The telephone service, inaugurated in 1903, consists of Government (both central and provincial) and private undertakings. The control of both telegraph and telephone systems is practically in the hands of foreigners, from the circumstance that these systems were constructed by the aid of foreign capital.

The electrical apparatus and supplies branch of the industry is almost non-existent, with the result that there is severe competition in the Chinese market for the sale of apparatus and supplies. Before the war Germany occupied the first position, the United Kingdom the second, and Japan came third in the value of goods of this class imported into China. Since then a considerable change has taken place, with a consequent increase of imports from Japan and the United States. The following figures show the early effect of the war on imports in this line from different countries:—

IMPORTS OF ELECTRICAL APPARATUS, &C., INTO CHINA.

From	1913. Hk. taels.[*]	1914. Hk. taels.[*]	1915. Hk. taels.[*]
United Kingdom ...	596,472	735,870	403,851
Germany	845,422	735,884	1,412
Japan	392,749	688,140	845,053
Hong-Kong	173,980	243,976	259,602
United States	179,079	134,733	285,010
Belgium	70,515	70,633	8,428
Other countries ...	148,873	185,181	281,683
Total	2,407,070	2,794,417	2,085,039

The growth of electrical industries, no less than other enterprises requiring the introduction of foreign capital, is hampered by the scarcity of funds occasioned by the war. On the return of peace, however, severe competition is expected to ensue in regard to electrical development in China. The activity of United States capitalists in China is remarkable, and they have formed, it is said, a combination for exploiting the light, power, and tramway services in the principal towns.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Kingsway" Miners' Electric Hand Lamp.

The General Electric Co., Ltd., of London, have introduced an electric hand lamp for use in mines, which has been approved by the Home Office. The chief points considered in developing this lamp have been efficiency of illumination over the full run of 9 or 10 hours, together with strong construction, durability of parts, and freedom from corrosion.

The accumulator is of the absolutely non-spillable type, and the lamp can be put in any position for any length of time without the least chance of acid escaping.

The terminals and switch arrangements have been specially designed to minimise corrosion, particularly during charging, and there are no springs of any kind attached to the accumulator, the terminals of the accumulator being made of solid pieces of non-corrodible material.

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[*] *Board of Trade Journal.*

[*] The average value of the Haikwan tael was 3s. 0¼d. in 1913, 2s. 8¾d. in 1914, and 2s. 7¼d. in 1915. 100 Haikwan taels = 111.40 Shanghai taels, for which exchange quotations are made.

The spring-controlled switch contacts are also of robust construction, consisting of strong flat springs with the upper ends screwed to the lampholder, the lower ends having the switch knobs riveted into them. No celluloid is used in the switchgear.

The lampholder is provided with an adjustable conical reflector to come below the lamp, and another conical reflector is supported on top of the lamp bulb. These reflectors are of polished nickel, and are so shaped that they considerably increase the illumination in the horizontal direction.

In addition, a patented external reflector can be fitted, consisting of a curved nickelled reflector, which, when not in use, snaps on to the lamp case, and when in use partly surrounds the globe, concentrating the light over an angle of about 90°. The use of this external reflector has also the advantage, when lamps are being carried to the working face, of shielding anybody walking behind from the glare of the lamp.

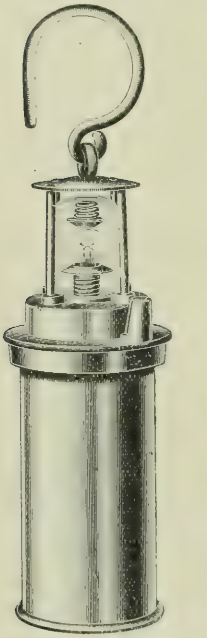

Fig. 1. The Kingsway Miners' Lamp.

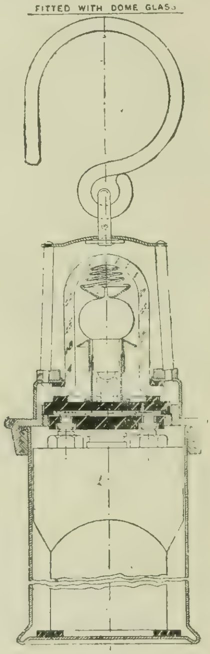

Fig. 2. —Sectional Elevation of Lamp.

The leaded steel case is fitted with a strong threaded sleeve, which screws into the head of the lamp. The head is built on a strong brass casting, and is provided with a magnetic lock of simple construction. No parts of this lock are accessible when the head of the lamp is screwed on, but when it is off, the removal of one screw allows the bolt and controlling spring to be removed and examined, the total number of parts for the lock being the bolt, the spring, and the aforementioned screw. The general arrangement of the lamp is shown in figs. 1 and 2 herewith.

Copper-Plating Propeller Blades.

Wooden propeller blades for aeroplanes, &c., are now being coated with a thin layer of copper. This process of electroplating copper on wood (or other materials if desired) is by no means new, but has never before been used for the above purpose, and the work is only in the experimental stage.

The advantages of copper-plated propellers are numerous. They are stronger and give a better cutting surface, they will not become ragged-edged, they are protected from brush, &c., upon landing, and they possess many other advantages of less importance.

Excellent results in copper-plating wood are attained as follows:—Render the wood impervious to fluids by saturating it in a solution of wax or stearine varnish, then give it a coat of thick linseed oil varnish. Repeat this process until the mould is considered sufficiently impervious. Now coat the wood with a thickly fluid solution of shellac in alcohol and allow it to become thoroughly dry; then place it in a silver nitrate solution of four parts water and six parts alcohol. Drain off all excess nitrate solution. Place the article for a few minutes in a closed vessel containing hydrogen sulphide fumes. This coats the article with a thin coat of silver sulphide. Repeat this process twice.

After having performed the above preliminary work, proceed to copper-plate in the usual manner. The following solution mixed with water to make 100 quarts gives best results:—

44 lb. copper sulphate.
13·2 lb. sulphuric acid at 66° Be'.

Use about 20 amperes at start, working gradually up to about 75 amperes at 4 or 4·5 volts.—*Scientific American.*

The Cambridge Thermo-Couple Potentiometer.

The accompanying illustration, fig. 3, shows the latest form of the thermo-couple potentiometer made by the **Cambridge Scientific Instrument Co., Ltd.**, of Cambridge, for the accurate measurement of small differences of potential not exceeding 90 millivolts. It is intended specially for use in temperature measurement by means of thermo-electric couples; the value of the unknown potential difference is determined by comparison with the E.M.F. of a Weston standard cell, readings being obtained directly in millivolts and fractions of a millivolt. Each division on the slide wire corresponds to 0·005 millivolt and is approximately 1 mm. long, so that by estimation readings can be obtained to one microvolt.

An accumulator cell supplies the current to the main circuit, which includes the adjustable resistances R_1 and R_2, two resistance coils, the graduated wire S S, the resistance coils marked M V C, and the graduated slide wire V V. The plugs D_1 and D_2 in this circuit enable ranges of 0—30, 30—60, or 60—90 millivolts to be obtained.

The wire S S is graduated so that the reading shown at any point N on its length is equal to the potential difference between that point and a point M in the circuit, provided the fall of potential in the main circuit is exactly 1 volt per 100 ohms circuit resistance: by moving the slider N along the wire S S the potential difference between M and N can be adjusted to correspond to the E.M.F.'s of different Weston normal cells. With the aid of a standard cell the resistance of the main potential circuit can be varied by means of R_1 and R_2 until the fall of potential in the main circuit is exactly 1 volt per 100 ohms circuit resistance.

The coil M V C is a continuous coil in 29 sections, each of which has a resistance of exactly ·1 ohm. On the basis of 1 volt per 100 ohms the fall of potential in each section is thus 1 millivolt. Similarly, the resistance of the slide wire V V being ·12 ohm, the fall of potential along its length is 1·2 millivolts. Thus in the portion of the circuit including the millivolt coils and the slide-wire there is an available fall of potential of 30·2 millivolts. Therefore the E.M.F. of a thermo-couple, or other source of E.M.F. less than 30 millivolts in value, can be measured in millivolts given by the reading on the millivolt coils M V C, and the fraction of a millivolt determined by the graduation on the slide wire.

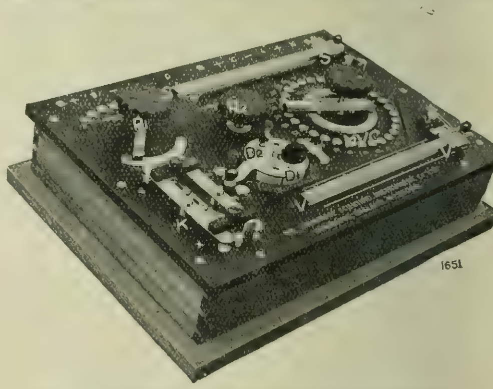

Fig. 3. Cambridge Thermo-Couple Potentiometer.

If it is desired to measure a potential difference between 30 and 60 or 60 and 90 millivolts, the plugs D_1 D_2 must be moved into the positions corresponding to this range.

The double key K is designed so that the galvanometer can be put in circuit either with the standard cell or the unknown potential difference; by pressing the contacts at *c* the circuit of the cell is completed through the galvanometer, and by pressing the contacts at *x* the circuit of the source under test is similarly completed. It is thus possible when measuring the unknown P.D. to test the accuracy of the fundamental adjustment for the standard cell without disturbing any of the connections; it is also possible by locking the contacts at *x* to follow the variation of a variable P.D.

Improved Finger-Contacts for Electrical Apparatus.

The usual way of making finger-contacts is to fix a carbon contact block rigidly in the free end of a spring finger, whose other end is securely held in a fastener. The requisite yielding pressure of the carbon block on a co-operating contact-piece is thus obtained by the resilience of the finger carrying the block. In practice these fingers may break, or else the block-end of the finger may bend up, causing bad connection, heating, and arcing. **Mr. G. S. Haslam**, of Balmoral, Cranleigh Drive, Leigh-on-Sea, has sent us particulars of a contact-finger which, he claims, is unbreakable; the carbon block is carried on the free end of the finger, and is hinged to its support. The requisite pressure is obtained by a separate steel spring bearing on the finger. A flexible copper connector bridges the hinge to ensure conductivity.

These fingers, of which one is illustrated in fig. 4, are easily taken apart from the front of the rheostat and a new spring can be fitted in a few moments. They have been thoroughly tested, and have proved very satisfactory. The inventor has applied for letters patent.

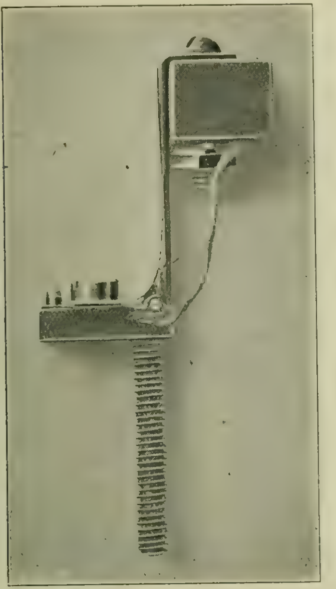

Fig. 4. Improved Contact Finger.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Wiring with Tough Rubber Compound Cables.

Your readers, after perusing the article contributed by Mr. W. Ellerd-Styles, A.M.I.E.E., and also the letter by "Another Member of the E.A.C.," on the above subject, may now be interested in the views of one with a wider perspective. Any suggestion for improvements that will tend to increase the business of the supply undertakings, without impairing the efficiency of the installation, will be heartily welcomed by central-station engineers responsible for its development. It is very generous of your contributor to offer to instruct the supply authorities' representatives, and no doubt there are many who will avail themselves of his generosity—when there is some indication that he can do so.

In advocating any system, one would think that the first essential is a varied experience to enable the advocate to discriminate where and how it could best be adopted to meet certain conditions, where other methods have failed. There may be several classes of work where it would be advantageous to use it; cannot these be specified? To suggest seriously that by its use a permanent waterproof system may be effected is trifling with the intelligence of your readers, especially when it is stated that this can be accomplished by the insertion of rubber washers in the nipples of switches, &c.

"Another Member, &c.," suggests "that the best plan is to *enclose* it in short lengths of light steel conduit of ample size," and also that a junction box of more substantial and better design, "preferably fireproof," be provided, for fixing under floors, &c. He has also heard that "where exposed to the sun's influence . . . . the sheathing has been found to crack open in a very short time." If this be true it is sufficient justification for the attitude adopted by "most of the insurance companies," and more especially the engineers responsible to the supply undertakings, who may be excused if they conclude that the suggestion, to use this cable for all purposes, is a sort of "curate's egg" counsel, prompted by the limitations of the ostrich's vision.

Without detracting from the many advantages of this cable for the uses for which it was originally intended, it cannot be accepted as good practice to increase the bulk of the dielectric to replace the mechanical protection so often necessary throughout the widening field of electrical application. The best preservative for all cables is discrimination applied only by those who have acquired it in the field of experience.

Consumers' Engineer.

This article, in your issue of 27th ultimo, is very interesting, both from the "wiring system" and from the switching points of view.

The only fault we can find is the use of turn switches on some of the circuits. The superiority of the tumbler as compared with the turn method of actuation is so obvious that it is needless to explain it. And in the cases under notice tumbler switches are available which will do all that the turn switches accomplish.

Passing by the fact that the American names "2-point switch," "3-point switch," are more or less meaningless.

A. P. Lundberg & Sons.

London, N., *May 2nd*, 1917.

Electric Vehicles.

The letter published last week from Mr. Rowley would seem to indicate that the electric vehicle is in an experimental stage, and that no thought has been given to any question of standardisation of its parts.

The fact that this is not so cannot be too often stated, even if it is only to ensure that such men as Mr. Rowley shall not write to the Press on matters which they are evidently not familiar with, and thereby damage the free development of the electric vehicle.

The battery for use in electric vehicles has been standardised now for over three years, both with regard to number of cells (*i.e.*, charging voltage) and external dimensions. So far as capacity goes, this cannot be standardised, nor is it wanted, for the capacity is fixed by the load to be carried, and the class of work done, as well as by the mileage to be covered.

The list given, in the publication of the Electric Vehicle Committee, of electric charging stations indicates that at least batteries can be charged at quite a number of central stations throughout the country, and, as the charging plug has been standardised for years, any "electric" can get attention for the asking at fixed and published rates.

Mr. Rowley talks of his big car, and a tour from Avonmouth to Newcastle; does he realise that "electrics" are not made for touring, and the conditions which he specifies ought not to occur at all, but that he should either travel by train, or, if he wishes to see the country, take a petrol touring car?

His idea of the "electric" wants bringing up to date, and he could not do better than take a tour to Birmingham, Bradford, London, or any other big town, and learn what an "electric" is, and what it will do; he would probably be surprised to find that hundreds of "electrics" are in use, and that they can show operating costs which give neither the horse nor the petrol truck a "look-in" for short hauls up to about 100 miles per day; above this figure, except under special conditions, the petrol van, or the railway, is the better means of transport.

Semper Ipsi Este.

Manchester, *May 7th*, 1917.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Annual Report.

The report of the Council, to be presented at the annual general meeting of the Institution on May 17th, is printed in the *Journal* for April. It shows that the membership at April 1st numbered 6,613, a net reduction of 63 on last year's total; in addition, 26 candidates for Associate Membership have been approved by the Council during the year, subject to their satisfying the examination regulations. Under the new Articles of Association 41 alien enemies have been removed from the list of members. Numerous military distinctions have been awarded to members during the year, including 58 decorations and 108 mentions, and 39 members have lost their lives in the service of their country.

The following premiums for papers have been awarded by the Council (value £10 each):—

Ayrton Premium: G. V. Twiss, "High-tension Overhead Transmission Lines."

Fahie Premium: F. R. McBerty, "Machine-switching Telephone Gear."

Paris Premium: C. Vernier, "Wayleaves."

Extra Premium: F. Gill and W. W. Cook, "Principles Involved in Computing the Depreciation of Plant."

Extra Premium: S. P. Smith, "The Theory of Polyphase Armature Windings."

A number of suggested alterations in the Wiring Rules have been submitted for the consideration of the Committee, but it is not proposed to undertake a further general revision until after the war. In the meantime, a sub-committee has been appointed to collect evidence with regard to the use of lead-covered conductors for house wiring. A committee was appointed last May, under the chairmanship of Mr. C. H. Wordingham, to draw up regulations for electrical installations on ships other than warships, and the regulations will be published in the course of a few months. The Standard Specification for Street Lighting will also be published shortly, as a majority report of the special committee appointed for this purpose.

The research on the heating of buried cables has continued, the expenditure during 1916 being £960, of which £840 was provided by the Government Department for Scientific and Industrial Research. Tests on insulating oils are also in progress, the outlay having been £356, of which £250 was provided by the Research Department. Schemes of research have been prepared in respect of various insulating materials, with a view to drawing up standard specifications; the B.E.A.M.A. will collaborate in this research, dealing mainly with its industrial aspect, while the Institution will carry out the scientific part of the work. The Committee on Electricity Supply has held six meetings, and has kept in close touch with the Joint Committee appointed by the I.M.E.A. and the I.A.E.P.C. The Institution Committee has arrived at a decision with regard to the adoption of standard frequencies for certain large areas, and is considering the voltages that should be recommended for transmission and distribution, and the question of obtaining reasonable facilities for wayleaves. The Committee has been awaiting the publication of the report of the Electrical Trades Committee of the Board of Trade, with a view to working along the lines which the report is expected to indicate, but when the report will appear is uncertain, especially in view of the recent appointment of an Electric Power Supply Committee by the Board of Trade, and it is considered likely that some time will elapse before definite recommendations can be made by the I.E.E. Committee.

The number of members serving, or having served, in the Forces since the outbreak of war is 1,671. During last year the President, at the request of the Authorities, nominated a number of electrical engineers for commissions as Lieutenants, R.N.V.R., for electrical duties on battleships and as equipment officers in the Royal Flying Corps. The classes which have been in progress at the Northampton Polytechnic Institute since June last year have been attended by 111 disabled sailors and soldiers, of whom 91 have been placed in situations and 96 approved for employment. Over 230 applications for men were received from employers. The Committees of Local Sections are co-operating, and men are under instruction in Manchester, while progress has been made at Birmingham, Leeds, and Newcastle. On the invitation of the Ministry of Labour, the Council has appointed a special committee to assist in carrying out an investigation with regard to openings in the electrical engineering industry for disabled fighting men.

The issue of a memorandum by the Reserved Occupations Committee with regard to substitution in electrical generating stations led the Council to point out the risk to the nation that would be involved by failure to maintain the supply of electricity through the skilled operating staff being reduced below a safe limit, and the Committee invited the Council to organise a deputation of representatives of supply undertakings to discuss the position with it. The deputation, consisting of 14 members, on March 28th was introduced by Mr. C. P. Sparks, and drew attention to the small amount of labour employed by supply undertakings compared with the number of employés working in factories depending upon electric power supplied by them, as well as the economy of fuel effected by the use of electric power. The Chairman of the Committee stated that although some of the undertakings might have done all that was possible, the Committee wished to bring all into line, and requested the deputation to consider what additional classes could be replaced by women, to ascertain to what extent substitution had been made, and to be prepared to attend another conference in three months.

The accounts show an excess of income over expenditure of £3,777, compared with £1,847 in 1915. Mortgages, reduced by £772, stood at £32,719. The Life Compositions Fund stood at £5,257. The assets were valued (less depreciation) at £120,799, and the liabilities at £42,610, leaving a balance to the good of £78,189, an improvement of £4,454.

Electric Zinc.—Mr. Hughes, the Commonwealth Prime Minister, states that the electrolytic spelter works at Hobart will cost £1,000,000, Great Britain lending half. There will be sufficient zinc concentrates retained in Australia to keep the works employed at full pressure.—*The Times.*

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

5,644. "Lanterns or casings for incandescent electric lamps." Wardle Engineering Co. & H. T. Wilkinson. April 23rd.

5,663. "Dynamo-electric machines." C. L. Breeden & H. Lucas. April 23rd.

5,693. "Magnetometer for measuring weak magnetic fields." Valente da Cruz, J. L. April 23rd.

5,706. "Sparking plugs." F. F. Burley & H. Coxon. April 24th.

5,738. "Wireless signalling systems." British Thomson-Houston Co. and General Electric Co. April 24th.

5,778. "Heating elements for electric radiators, &c." O. Bathke. April 24th.

5,788. "Reflectors for electric flashlamps, hand lanterns, pocket lamps, &c." W. D. Fox. April 25th.

5,801. "Electric light fittings." B. Thomas & E. Thomas. April 25th.

5,804. "Apparatus for detecting and magnifying minute electric impulses." T. Harvey. April 25th.

5,811. "Dynamos." W. Kingsland. April 25th.

5,815. "Switches for miners' electric lamps." W. H. Davis and J. Davis and Son. April 25th.

5,825. "Centrifugally-actuated short-circuiting devices." British Westinghouse Electric & Manufacturing Co. April 25th. (U.S.A., May 3rd, 1916.)

5,843. "Magneto-electric machines." T. H. Cleathero & F. Spurr. April 25th.

5,973. "Arrangement and construction of aerial propellers for driving dynamos, &c., on aircraft." A. H. Stark. April 26th.

5,898. "Means for cleaning sparking plugs of internal-combustion engines, &c." J. H. Andrew. April 26th.

5,941. "Electric switches." H. B. Butler. April 27th.

5,984. "Electric lamps for projection apparatus." British Thomson-Houston Co. (General Electric Co., U.S.A.). April 27th.

5,993. "Electromagnetic detecting or indicating apparatus." F. W. Dodd. April 27th.

6,019. "Section insulator for overhead electrical equipment." H. Burton and J. Whelan. April 28th.

6,023. "Electrophones." S. M. Hyman & Stolz Electrophone Co. April 28th.

6,036. "Electric multiple switches." E. A. Laidlaw. April 28th.

6,046. "Plates, slabs, &c., for electric insulation." P. J. Pybus. April 28th.

6,050. "Electrical arrangements for facilitating starting of internal-combustion engines." J. W. T. Cadett & C. Percy. April 28th.

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

4,780. Process for the Electrolytic Deposition of Zinc on Metallic Surfaces. P. Marino. March 31st, 1916. (105,255.)

4,827. Electromagnetically-operated Switch. A. P. Turnbull. April 1st, 1916. (105,257.)

5,325. Semi-automatic Telephone Exchange Systems. Western Electric Co., G. Deakin & L. Polinkowsky. April 11th, 1916. (105,266.)

5,875. Intercommunication Telephone Systems. J. W. Dungey. April 25th, 1916. (105,272.)

8,334. Detonators or Fuses for use with Grenades, Shells, Mines, or the like, and Explosives generally. F. S. Denison. June 13th, 1916. (105,283.)

8,453. Glass-working Machines. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 15th, 1916. (105,285.)

8,551. Means for Securing Globes, Shades, Reflectors, and the like on Electric and other Lamps. J. Cook & J. Clegg. June 17th, 1916. (105,288.)

8,736. Electric Switches. T. P. Casotti. June 21st, 1916. (105,291.)

9,608. Method of and Apparatus for Evacuating the Bulbs of Electric Incandescent Lamps and other Glass Vessels. Deutsche Gasglühlicht Akt. Ges. (Auerges.). September 27th, 1915. (101,621.)

16,144. Construction of Magneto-electric Machines. G. F. Cooke. November 10th, 1916. (105,310.)

77,206. Electric Circuit Interrupting Systems. British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.). November 30th, 1916. (105,314.)

18,553. Electrolytic Production of Oxygen and Hydrogen. G. F. Jaubert. December 29th, 1915. (102,974.)

Technical Study.—According to the *Birmingham Daily Post*, an interesting experiment is being made by the Austin Motor Co. by the formation of a technical society at the works, having as its object the promotion of the study of engineering and other branches of applied science, and to provide a means for the interchange of ideas and information between its members. It is proposed to hold frequent meetings, at which papers of special interest will be read and discussed, and lectures illustrated by the works lantern and kinematograph will also be arranged for.

Engineering Organisation.—*Empire Trade Notes* says that a further stage in the formation of plans for the furtherance of British engineering interests after the war is marked by the decision of the British Engineers' Association to affiliate to the British Empire Producers' Organisation, which has strong connections amongst associated industries of the Dominions and Colonies. The alliance between the great Over-sea producers and the British engineering manufacturers is stated to possess reciprocal advantages.

THE

ELECTRICAL REVIEW.

VOL. LXXX. MAY 18, 1917. No. 2,060.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: May 18, 1917. [No. 2,060.

	Page
Wayleaves	533
The Complete Union ..., ...	534
Electric Winding at Victoria Colliery, Ebbw Vale (*illus.*) ...	535
"Making Do," by "P. B."	537
Bo'ness Electricity Works (*illus.*)	538
The Simplification of Line Testing, by G. F. Tanner	539
Improvements in Magnetic Iron Alloys (*illus.*)	539
New Electrical Devices, Fittings and Plant (*illus.*)	541
Legal	541
War Items	542
Correspondence—	
Wiring with Tough Rubber Compound Cables	543
The I.E.E. Wiring Rules	544
Electric Vehicles	544
The Deterioration of Turbine Blading	544
Business Notes	545
Notes	548
City Notes	552
Stocks and Shares	554
Wayleaves	555
High-Tension Overhead Transmission Lines, by G. V. Twiss (*continued*) (*illus.*)	556
Electrical Supply in Shanghai	559
Reserved Occupations.—Electrical Works Employés	559
Foreign and Colonial Tariffs on Electrical Goods	559
New Patents Applied for, 1917	560
Abstracts of Published Specifications	560
Contractors' Column	Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

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Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

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WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

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1917 EDITION

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WAYLEAVES.

THE statement which we publish elsewhere in this issue, emanating from Mr. W. A. Chamen in his official capacity as Chairman of the Joint Committee of the I.M.E.A. and the I.A.E.P.C., is of exceptional interest and importance. It will be observed that the Committee proposes to introduce a Bill at the first opportunity, which, amongst other provisions, is intended to secure compulsory powers for the erection of overhead or underground cables across private property with or without the consent of the owners, subject to the issue of a certificate by the Board of Trade declaring the construction of such lines to be desirable on the ground of public utility. Owners desiring to oppose the grant of the certificate will be given one month in which to lodge their objections, after which the Board may issue or withhold the certificate with or without a local inquiry. The right of the owner to compensation, agreed upon or determined by arbitration, is conserved, and the appointment by the Board of Trade of an arbitrator "sitting continuously" to settle such questions is provided for; the possible establishment by Parliament of a new authority to take over from the Board the handling of wayleaves and other matters is foreseen, but would be dealt with in the Act appointing such new body.

The right of veto at present possessed by the local authority is also to be modified, in a separate clause, which limits the veto to electric lines along or across a street, and, further, enables the Board of Trade to override it if consent is unreasonably withheld, a not uncommon occurrence.

It was suggested in the course of the discussion on Mr. Vernier's paper that a short Bill should be introduced conferring upon electricity supply authorities powers similar to or identical with those secured by the Post Office last year; not only the author, but also other speakers, doubted the possibility of inducing Parliament to deal with the matter effectively during the war. However, the Joint Committee shows a commendable optimism in bringing forward proposals which appear to cover the whole question, and intends, in the fighting spirit that is required if progress is to be made, to press on with them as quickly as possible. There is the "will to victory"! We congratulate the Committee on this evidence of well-directed energy; the draft clauses appear to cover all requirements, so far as can be foreseen, and we trust that success will attend the efforts of the promoters to place them on the Statute Book as soon as possible.

Our only regret is that Mr. Chamen's communication was not presented during the discussion on Mr. C. Vernier's paper, in which he so admirably set forth the case for compulsory wayleaves before the Institution of Electrical Engineers. The unanimous endorsement which was accorded to his views in the discussion which followed, and the timely action of the Joint Committee, give good grounds for hoping that at last something will be done towards the removal of the chief obstacle, the offspring of greed and ignorance, which has so long hindered the development of electricity supply in the rural districts of this country. Many of the more enlightened of our landowners have learnt to realise that their land is held in trust for the public weal, and that to treat it as a chattel over which they exercise sovereign rights is to betray the trust reposed in them. Unfortunately, however, the laws by which we are governed were cast in the feudal mould, and it is still within the power of any selfish landowner absolutely to forbid the erection of electric lines across his land, or to compel the payment of extortionate fees for the concession, with the result that some other member of the community must either pay more for a supply of electrical energy or go without, in either case suffering material injury at the hands of the despotic owner. What is demanded is not in any way oppressive to the landowner: it is only the right of access to other property across his fields, subject to the payment of a fair rate of compensation for the privilege, a principle which has been recognised by Parliament in connection with some other public services, and which is implicitly included in the principle underlying many Acts of Parliament, that all lands and goods, and even the person of the citizen, are ultimately owned by and at the disposal of the State.

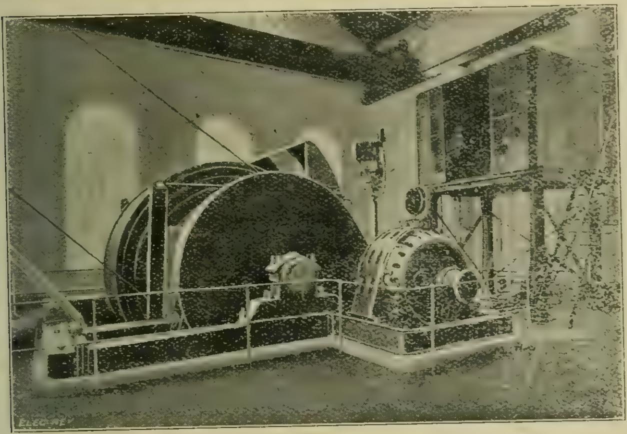
In the period of commercial stress which will inevitably follow the war, our industries cannot endure the handicap to which they will be subjected if a cheap supply of electricity is not at their disposal; and if that cheap supply is to be made available, one of the most important factors in bringing it to pass will be the coupling up of neighbouring generating stations, in order to economise fuel, plant, and labour. Further, our farmers must be supplied with cheap power, which can only be accomplished by carrying the lines overhead and across country. The securing of facilities to run overhead lines wherever they may be necessary is therefore one of the most urgent conditions that must be fulfilled to assist in the maintenance of our industrial supremacy and the provision of remunerative employment for our millions of workpeople. Public opinion in these times is pliable, and can be moulded as never before; our Government is more nearly wide awake than any of its predecessors within the past half-century, and the grant to the Post Office of powers similar to those sought by the electricity supply industry constitutes a useful precedent. It remains only for words to be followed, as Mr. Williams put it, by *action*. It is up to the Institution of Electrical Engineers, the Incorporated Municipal Electrical Association, the Associated Power Companies, and other bodies concerned, such as the British Electrical and Allied Manufacturers' Association, &c., to come together and agree to bring their united weight to bear, in order to induce Parliament to grant the necessary powers with the least possible delay. Already the Board of Trade has taken definite and positive steps towards the development of cheap electricity supply, and without doubt this department could be depended upon as an invaluable ally. We hope that the leaders of the industry will lose no time in devising means to exert the utmost possible pressure upon Parliament to secure this long-needed reform.

The Complete Union.

When the Minister of Munitions and the Director of National Service received the important deputation of manufacturing industries in March (see Elec. Rev., May 4th, p. 486), it was stated that some of the difficulties of manufacturers had been greater than perhaps they would have been had the employers been sufficiently organised. It seemed that in its dealings with organised Labour negotiations had sometimes been more easily conducted because of representative Union committees being able to advise Government departments concerning various questions affecting Labour. The difficulties of conducting negotiations with Labour have, however, been great, and at times not followed by success, as, unfortunately, we have had evidence during the past fortnight. For a long time past when such problems have been under discussion it had been widely recognised that in order to ensure satisfactory conduct of negotiations both sides must be equally well organised, but it has again been proved to demonstration, with the sad consequence that the production of munitions has been interfered with, that even unions and organisations fail us unless there is cohesion in their ranks. Mr. Hodge, the Minister of Labour, in moving the second reading of the Trade Union (Amalgamation) Bill, on Monday last, expressed the belief that if there had been such a measure as this on the Statute Book earlier, a great deal of trouble would have been saved during the war. Lord Henry Bentinck, M.P., deals in a letter to the *Times* (May 16th) with what he describes as the causes of the present engineering labour trouble. He considers that it is born of two causes: first, tactless and clumsy handling of Labour by the Government; secondly, a deep-seated discontent continually aggravated by measures of coercion and by overwork. Mr. Hodge showed that Government Departments knew how difficult it was to deal with trades which had many separate unions to represent their interests. As matters stood, it was almost impossible for crafts to join together because the law required the support of a two-thirds majority of members before amalgamation could be effected. He instanced a particular industry in which there were no fewer than nine unions all catering for the same class of worker, with the result that nine arbitration cases had had to be listened to where, with complete organisation, one would have sufficed, for the ultimate award was practically the same in all cases. Delays naturally followed, and delays cause friction, and a little friction in a number of places may easily spread until comparatively small demands or grievances may involve armies of workers. The Bill was read a third time on Tuesday, Mr. Hodge accepting slight amendments as to the strength of vote and ballot required in order to effect amalgamation. In the iron and steel trades, he mentioned, there was a general agreement in favour of amalgamation, and the masters also favoured it. After the war there would be a great revival of those trades, and any points in dispute between Capital and Labour could be more easily handled if there were only a few unions instead of the present 15. It may be thought by some that strong Labour organisations may have great power for evil, when they are quite united in spirit and in demands, but it is to obviate some of the possibilities of evil that follow from their disorganised state that the new Bill is introduced. We have long supported the view that our manufacturing organisation must be as efficient and representative as we can make it, so that it may deal authoritatively with the changing aspects of industrial situations, and may assist the Government of the day. But we also fully agree with Mr. Hodge that when the great problems of demobilisation and reconstruction have to be dealt with it will be undoubtedly in the interests of workmen, as well as of employers, that they should meet in large units. The sentiment of the manufacturer has undergone a change in recent years, and to-day, speaking generally, he would far rather deal with the men's organisations than with scattered groups of workers. The day has passed, we believe for ever, when recognition of Unions can be refused without discussion. The experiences of the coming years will show how far the Trade Union (Amalgamation) Bill, which to-day seems in theory to be a most desirable and even necessary measure, will justify itself by securing complete unity in Labour's ranks and a loyalty to leaders among the members of individual Unions.

ELECTRIC WINDING AT VICTORIA COLLIERY, EBBW VALE.

Owing to the very large area of the coal workings, the Ebbw Vale Steel, Iron and Coal Co., Ltd., proprietors of this and other mines in Monmouthshire, recently decided to enlarge an old shaft at their Victoria Colliery, taking for this purpose the old "No. 5," and widening it to 18 ft. diameter clear and 20 ft. towards the bank opening. An entirely new electrical winder and operating plant was arranged for, not only with a view to dealing more efficiently with the valuable Black Vein and Gwarycae seams, but also on account of the fine source of power available at the company's Victoria Works, with its near-by power house. Since the completion of this shaft, with its substantially designed 45-ft. headframe with 15-ft. sheaves, the old "No. 1" steam-driven shaft equipment has become a secondary outlet.

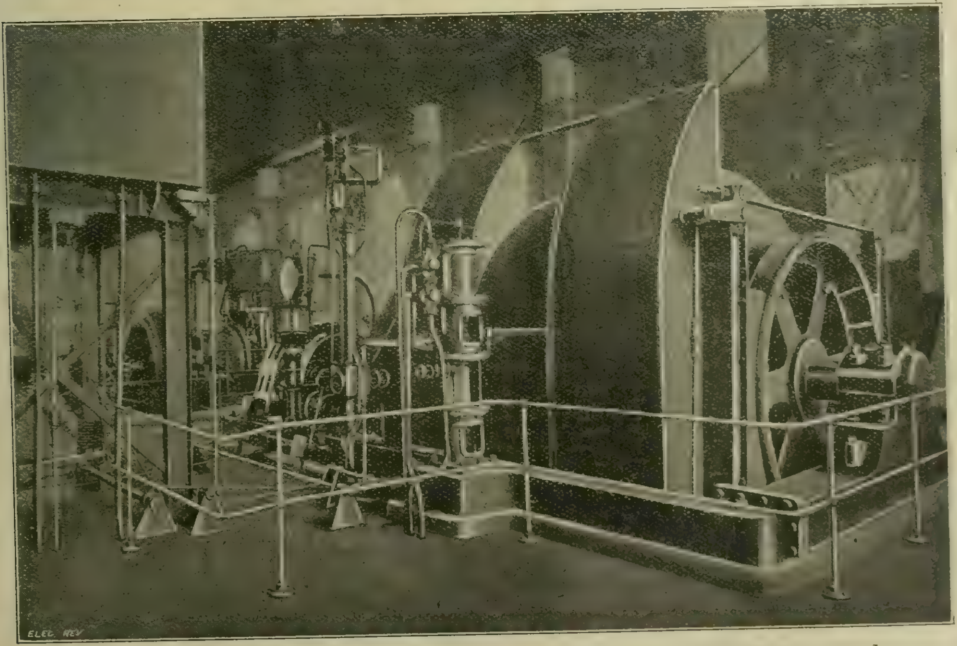


Three-phase Winder and Driver's Platform, Victoria Colliery, Ebbw Vale.

The wind at the new (or enlarged) opening is by single-deck cage, with two trams to the deck, the winder being rated to deal with a net unbalanced load of three tons of coal, with an output of 240 tons per hour, from a depth of 564 ft. A rope drum of cylindro-conical type has been adopted as most economical in practice, the diameters being 8 ft. on the small end and 13 ft. on the large part.

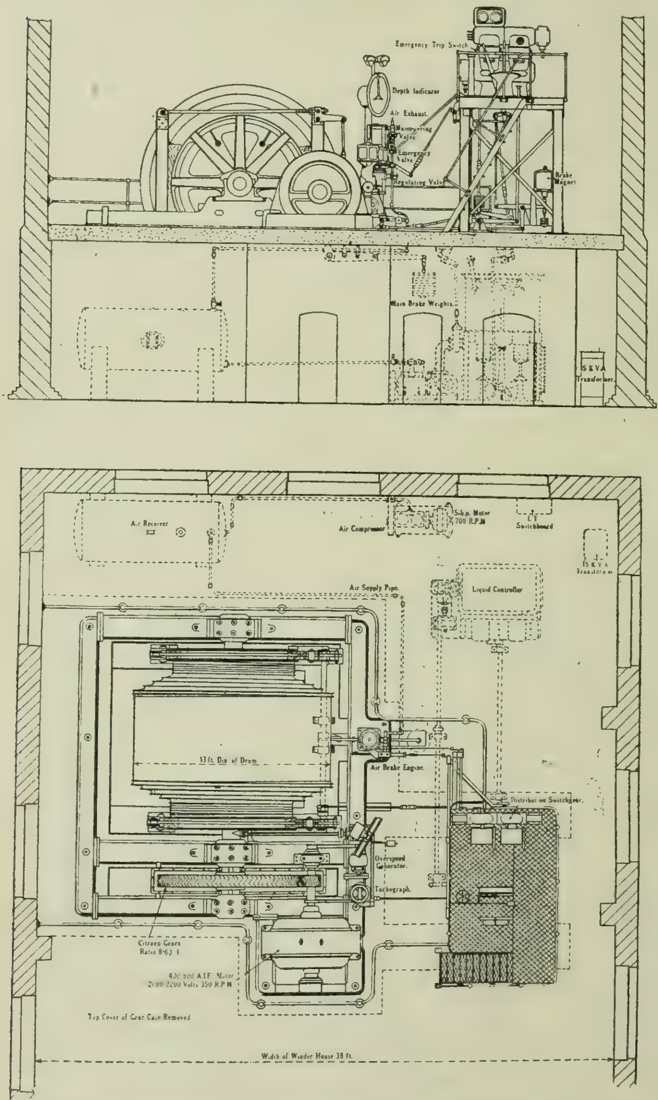
The winding motor is of A.I.F. Westinghouse A.C. type, 400 B.H.P. continuous rating, designed for a maximum full load speed of 360 R.P.M., and drives the drum through a Citroen speed reduction gear with a ratio of 8·6 to 1, an oil-tight gear case being fitted. Specially built for winding service, the motor is so designed as to be capable of with-standing heavy overload peaks. Here the electric winder possesses very marked advantages over the steam winder, for the latter, when faced with serious overloading, simply would not start, or, even if sufficient boiler pressure were available, would be very materially reduced in rate of acceleration. The motor is fitted with two bracket bearings, and, in addition, a third pedestal-bearing accommodating the journal for the driving-pinion shaft.

Renewable treads are fitted to the brake paths, while the drum is carried upon a powerful shaft, this, in accordance with the requirements of the Mines Act, being bored throughout its length. The post-type brakes are weight-operated and regulated by means of an $8\frac{1}{2} \times 12$ in. air-brake engine, fed by a motor-driven compressor. An auxiliary transformer is installed, in order to supply the power for the compressor and controller-pump motors, also the emergency brake solenoid. It should here be noted that, in this case, the compressor is started and stopped automatically by means of an air governor switch, so that the receiver pressure is maintained within the proper working limits. The control apparatus for the rotor is of the Westinghouse liquid-resistance type, regulation being effected by the following means :—The apparatus consists of two tanks.



Three-phase Winding Plant, Air Compressors, &c., Victoria Colliery, Ebbw Vale.

mounted one above the other, a small motor circulating pump, an oil-immersed main reversing switch, also a main emergency switch for use if required. In the upper tank are three fixed electrodes and a movable sluice gate, the electrodes being connected with the main rotor slip rings. The supply of resistance liquid is contained within the lower tank, in which are fitted coiled pipes through which cooling water is circulated. A small motor-driven pump near the tanks lifts the resistance liquid to the upper tank, whence it returns to the lower one over the sluice gate, which reaches its lowest position when the driver's operating lever is at "off." Movement of this lever throws the main reversing switch on the motor circuit in one or other direction (according to drum rotation), and raises the sluice gate. The latter in turn causes the level of liquid in the upper tank to rise, consequently decreasing the resistance between slip-rings. The gate may be left in any position, or immediately thrown to the highest point, this depending upon manipulation of the operating lever. As, however, the liquid obviously cannot follow the gate-raising operation quicker than the pump can raise the liquid to the higher level, a certain maximum motor acceleration (due to rate of decrease of rotor circuit resistance) cannot be exceeded, although lower accelerations may be obtainable. The amount of maximum acceleration is easily adjustable by means of a stop-valve in the pump delivery pipe.



Views showing general arrangement of Electric Winding Plant, Victoria Colliery.

In addition to the auxiliary action of the controller pump, and as a further precaution against possible mishandling of the winding gear, the well-known Westinghouse overspeed device is fitted, which not only limits the maximum winding speed, but also prevents excessively quick acceleration.

A small D.C. generator, driven from the motor shaft, maintains a constant current through a tripping relay so long as its voltage rises only in proportion to the amount of resistance switched into the circuit during acceleration, and also provided that after acceleration its speed does not exceed the designed speed. Should at any time the current limit be exceeded, the no-volt coil circuit of the main oil switch is broken, thus causing the brakes to operate and bring the winder to rest. The main control switch pillar is mounted on the driver's platform, and fitted with an automatic oil switch having overload and no-volt trips. There is also fitted a mechanical trip, this being connected by means of rods to the overwind tappets on the depth indicator, so that in the event of an overwind the plant is shut down, and automatic braking also effected. By the foregoing, it will be seen that both control and safety devices are amply provided for. The current available is supplied at 2,000 to 2,200 volts, three-phase, 50 cycles, and iron-clad switchgear is fitted throughout the installation.

This interesting winding plant was installed by the British Westinghouse Electric and Manufacturing Co., Ltd., the sub-contractors for the mechanical parts being Messrs. Douglas & Grant, Ltd., Kirkcaldy, and the installation being supervised by Mr. Walter Dixon, of Glasgow, consulting engineer to the colliery company. We also learn that arrangements are being made for the installation of two Sulzer-Westinghouse pumps, each capable of delivering 100,000 gallons per hour, which will replace the Cornish pumps now used for the three working levels, the intention being to equip a general pumping station which will deal with the whole area (some 1,700 acres) of this portion of the Ebbw Vale Co.'s property.

For the drawing showing the arrangement of the winding plant we are indebted to the *Iron and Coal Trades Review*, which journal mentions that three-phase 50-cycle energy is supplied to the plant from the Victoria Works power station at 2,200 volts by overhead mains, and that all the large surface motors are operated at this pressure, while underground and small surface motors are supplied with 500-volt current and the lighting circuits with 110-volt direct current.

The two main haulages below ground are driven, one by a 150-H.P. motor and the other by a compressed-air engine, two electrically-driven Belliss compressors being installed alongside the electric winding engine to give the necessary air supply to the pit. A new electrically-driven Sirocco ventilating plant capable of exhausting 175,000 cb. ft. of air per minute is also a feature of the installation.

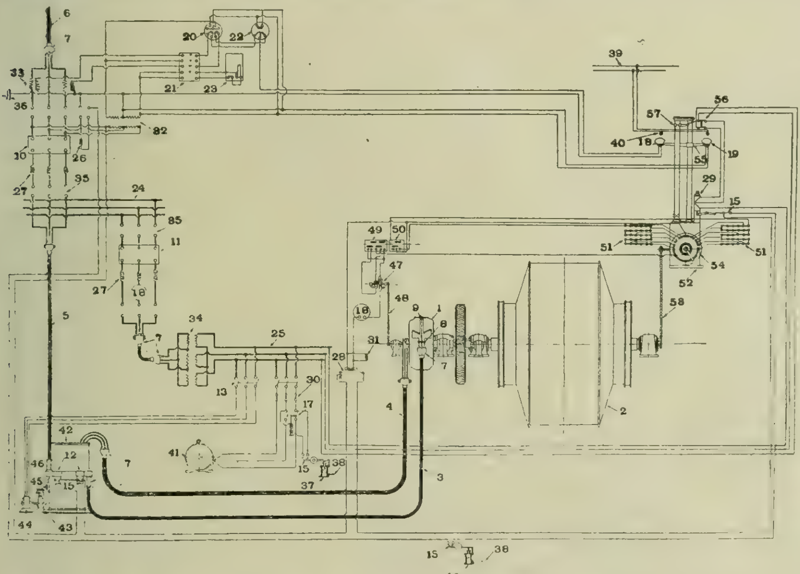
"MAKING DO."

By "P. B."

There is so much that a poor contractor cannot get nowadays, in these hard times of war-affected industries, that he is often hard put to it to make do with the unaccustomed materials upon which he is able to lay his hand as substitutes. He is forbidden to use some things, and others are unobtainable, or only obtainable in small quantities at exorbitant prices and after month-long delays.

On the other hand, his activities are restricted too, and such work as he gets is for munition or "essential" factories (which bring priority certificates in their train to ease the troubles they cannot remove), or for maintenance work and small alterations.

Now, most means of "making do" are atavistic—reversions to early practices of half-forgotten electrical pioneering. The appeal from the Cable Makers' Association to use single wires in place of three and seven-stranded cable is a case in point. In other cases, too, he may find help by looking backwards; but let none forget that, however necessary such makeshift ways and means are to-day, they are not the best, and therefore can and must be only temporary expedients for the period of the war.



1, Winder motor; 2, Winder drum; 3, Stator cable; 4, Rotor cable; 5, Controller cable; 6, Incoming cable; 7, Trifurcating box; 8, Disconnecting plugs; 9, Neutral point box; 10, Main oil switch; 11, Auxiliary switch; 12, Reversing switches; 13, Three-pole knife switch; 14, Two-pole knife switch; 15, Single-pole trip switch; 16, Air pressure trip switch; 17, Solenoid operated switch; 18, Ammeter; 19, Voltmeter; 20, Indicating wattmeter; 21, Integrating watt-meter; 22, Power factor indicator; 23, Time switch; 24, H.T. bus-bars; 25, L.T. bus-bars; 26, No-volt coil; 27, Overload coil; 28, Relay; 29, Solenoid three-phase; 30, Fuses; 31, Shunt; 32, Shunt transformer; 33, Series transformer; 34, Current transformer; 35, Isolating plugs; 36, Earth; 37, Air governor switch; 38, Compressed-air pipe; 39, Lighting circuit; 40, Illuminating lamps; 41, Compressor motor; 42, Liquid controller; 43, Liquid controller pump; 44, Liquid controller pump motor; 45, Pump regulating valve; 46, Cooling coil water valve; 47, Overspeed generator; 48, Overspeed generator drive; 49, Overspeed field reversing switch; 50, Variable speed switch; 51, Resistances; 52, Depth indicator; 53, Depth indicator drive; 54, Rheostat faceplate; 55, Instrument arm; 56, Limit switch; 57, Depth indicator pointer.

Key Diagram of Electric Winder Connections (see facing page).

After using steel conduits for two and a half decades, he is told that steel has more important uses than conduit construction, and he must ration his consumption; he falls back with happy memories on the wood casing and capping that he found so adaptable and infinite-testable (in the dry) in his apprentice days, only to be told that timber is scarce and cargo space more needed for other things; he must curb his appetite for wood. But if he cannot enclose he can cleat; if dry wood helped his tests, dry air will help more. Wires strained between insulators, cleats or other types, are unsightly but effective; the danger of damage is all patent to the passer-by, and so the risk is discounted; the work is cheap and quickly fixed, and low-insulation wire is quite good. Many an early installation worked for years, at high voltage too, with cotton-covered (and even bare) wires not only cleated, but in some cases clipped tight to the roof purlins and rafters; and bare wires in teak casing were not unknown. We are not likely to return to that stage, but porcelain-cleated work is common enough, and if glazed porcelain is difficult to procure we can turn to wood, slate, or marble.

For larger cables, which would ordinarily be drawn into steam or gas barrel, say from 2 in. to 5 in. diameter, there is cast-iron pipe to fall back on—flanged, spigot and socket, or Richardson's "P.R.J.," such as heating engineers use. For suspended work the flanged type has undoubted advantages, but the spigot and faucet holds its own underground, with joints lead-caulked for watertight work, or run in with cement if the cables themselves be lead-covered. Steel-tape armouring can be avoided in this manner, besides the large sizes of screwed tubing, which are, of course, themselves mild steel. A further very useful container for big cables, when it is not necessary to keep them absolutely watertight, is the cast-iron troughing with removable cast cover, of which one sees so many miles along the lines of London's electrified railways.

The use of copper and brass being restricted by request, these will naturally be replaced by iron in the case of wood screws, even in situations where the latter would be objected to normally, either from their discolouring the paintwork or eventually rusting. We can think about beauty again later on.

Another return to almost pre-historic methods is the substitution of iron for copper in lightning-conductor work. We are not so short of the softer metal that there is any move in the direction of pulling down old-established conductors or digging up earth-plates to melt for other purposes: but iron strip, iron collecting-points, and iron earth-plates or rods are all installed to-day as they were in the time of Faraday. It is a more cumbersome material to work with, stiffer for equal size, and bulkier for equal conductivity, but it will safeguard effectually for a time, and its principal danger is that the condition of points and plates and joints may not be examined and attended to in some future year of peace, and so lightning danger be increased instead of decreased. We must look to the needs of the moment, however, and if posterity should neglect to guard itself by due attention to maintenance details, it will be over its own head that the sword will hang.

For the sake of economising in accessories, it is now advisable to light buildings, as far as possible, by a small number of large candle-power lamps in preference to a large number of smaller lamps, even in cases where such a course departs from the best illuminating engineering standards. By so doing, economy in fittings, in lamps, and in labour will be effected, and the last will be considered far from the least of the three items. In a similar way, the grouping of a number of lamps on one switch, where this can be done without much increasing the length of wiring, is desirable; should it lead to increased current consumption (which it quite possibly will not, for most people entering a large room with several switches grouped at the door will switch on the whole lot), the cost of this, between now and the declaration of peace, is not likely to equal the saving on first cost.

At the same time a reduction in current consumption is to be striven for whilst the difficulties in obtaining fuel are so great, and therefore the most efficient of lamps and apparatus should be installed when obtainable. Consumption has, fortunately, been much curtailed in the lighting department, owing to the police restrictions after the air raids, and the adoption of "daylight saving" in the summer time; otherwise, increasing demands for power purposes, synchronising with shortage of colliers and difficulties of transport, would have produced an even more serious situation. Not only coal, but other forms of fuel also are hard to obtain, and the contractor will think sorrowfully of certain country customers of his who paid in good, rich gold for sundry small generating sets driven, on his recommendation, by that now-forbidden luxury, petrol. In the case of fuel shortage, however, instead of looking backward to wood in place of coal, or water and wind to supply a more direct energy, we must look forward: not to large schemes of tide-driven or sun-driven dynamos which would take years to develop (we have no years to spare for that now), nor even to the utilisation of our moorland peat-beds, but to the linking-up of power stations and the elimination of the inefficient small and isolated plant. This is no "making do" with something worse for the time; it is the times making us do something better for the time to come.

To return to smaller things: some reversion to the "tree" system of wiring seems permissible at a time like this, for there is not the slightest doubt that it is very economical in the length of wire required. In steel-conduit work it is, of course, very difficult of application; but in the case of wood-casing or cleated wiring, many yards run of wire can usually be saved by tapping extra lights on to adjacent mains instead of carrying the leads back to distant distribution boards or looping-in points. By this means many short ends of wire, otherwise mere scrap, may be brought into useful service, especially for the small additions and alterations needed in ordinary maintenance work. The shorter pieces may be useful for tee-ing off mains, the larger ones for splicing into more useable lengths. If solder is scarce for this work (but it is hardly as bad as all that), it will be necessary to fall back on clamp connections: even in *absolutely* temporary jobs (so many temporary jobs become semi-permanent that they are danger-breeders) the dry joint is possible. The fire-insurance inspector, the supply authority engineer—these cannot be ignored; but if consulted beforehand, and with the case placed before them reasonably, there will be but few who will not stretch a point in the emergency. But—no return to early methods without early safeguards: if the tree system, then the local fuse; the one without the other is unthinkable.

The obsolescence of the arc lamp before the war prevented the upset that would have occurred a few years earlier owing to carbons being almost unobtainable in the first few months, but this trouble is now almost forgotten.

Another wire-saving device, now but little used, is that of the earth-return. There is no suggestion of a return to early practice in lighting work here, such as existed in utilising the stem of an electrolier or the ironwork of a ship in the primitive ages, but for bell work and telephone work there are many places where its adoption would be economical.

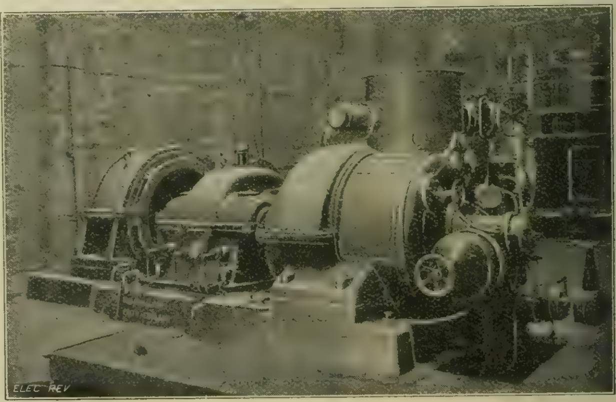
Simplicity in lamp fittings is imperative for the time, and the batten-holder presents this feature *in excelsis.* Failing that hermaphroditic combination of ceiling-rose and lampholder, some type of plain conduit, straight or bent on the job, is desirable; and in this connection the need for a stock lampholder, suitable for screwing direct on to $\frac{3}{4}$-in. conduit without the use of a reducing connector, is much felt.

There are many instances of "making do" which will occur to all—the use of metal shades in place of opal, of painted metal in place of enamelled ones, the painting instead of galvanising of other metal, the substitution of women for men (the *electricienne* has arrived, not only in the office, the showroom, and the battery-charging station, but in the realms of the wireman too). In some cases we are delighted with the new order of things, in others we just make them do for the time, and hope for the end of the time to come quickly. This way or that, by one means or another, we have gone on, we do go on, and we have every intention of going on till we can pick and choose once more and strive in the old strenuous way after perfection.

BO'NESS ELECTRICITY WORKS.

The Bo'ness electricity undertaking was started during 1904, when the generating plant consisted of two 100-KW. Davey, Paxman engines, coupled to Lancashire Dynamo Co.'s D.C. machines. Three years afterwards it was found necessary to provide additional plant; a Davey, Paxman-Lancashire Dynamo Co.'s 300-KW. set was then installed. During subsequent years the load has increased, so that at the start of the war the station was often loaded to the full capacity of 500 KW. Various temporary measures were suggested to deal with the increasing load, but eventually it was decided to put in a high-pressure turbine with an additional boiler and a separately fired superheater, and to fit mechanical stokers to the existing Heenan & Froude water-tube boilers. When the Secretary for Scotland was asked to grant the loan, he decided that the estimated expenditure would have to be reduced by £3,000 until after the war, and it was decided to delete the boiler and superheater, also the spare armature, and to put in Ferguson superheaters for the existing boilers.

The new plant, which consists of a 500-KW. Fraser and Chalmers high-pressure turbine, coupled to a Brush generator, was started up and put on test on April 25th, in the presence of Mr. J. M. M. Munro, the Council's consulting engineer, and Mr. F. E. Stanley, the chief engineer to the contractors, the National Electric Construction Co., who lease the station from the Council. This test was satisfactory in every way. The turbine runs at 4,000 R.P.M., and is guaranteed not to take more than 16·1 lb. of steam per KW.-hour at full load. The gear reduces this speed from 4,000 to 600 R.P.M., at which speed the generator is run. The latter is a compound-wound machine with interpoles, and is fitted with the Brush Co.'s latest commutator, which is designed to prevent the mica between the copper segments from rising. On test, the full-load efficiency of this machine was 94·8 per cent. The condensing plant was supplied by Messrs. Cole, Marchent and Morley, and consists of a contra-flow condenser, to which is



500-KW., D.C., GEARED TURBO-GENERATOR.

coupled a Rees Roturbo rotary set, the rotary air pump taking its water from a connection on the salt-water circulating pump. The complete set is driven by one 49-H.P. motor at 2,000 R.P.M. The superheaters are of Messrs. Ferguson's standard type, and the chain-grate stokers were supplied by Messrs. Babcock & Wilcox. A part of the scheme was the laying of two ·60 L.S. and S.T. cables to a distant part of the town. The work was chiefly done by women, and, we believe, was the first instance of the employment of females on this class of work.

The installation has been carried out under the supervision of Mr. H. C. Babb, the engineer and manager.

THE SIMPLIFICATION OF LINE TESTING.

By GEO. F. TANNER, A.M.I.E.E.

[The following useful note appears in the current issue of the *Post Office Engineers' Journal.* The author informs us that the method is universally applicable; it is independent of assumed constants and corrections; it is equally of value to the mains engineer in dealing with an earth fault on a twin conductor, and D may be in as low a unit as yards with equal accuracy.]

In every case where a Varley loop test is made, the question which at once arises to the orthodox is, "what is the weight per mile of the conductor under test?" In the generality of cases, as, for instance, in testing over a paper cable where the conductors are of the same gauge, or where it is possible to obtain similar conductors, this knowledge is not only unnecessary, but frequently contributes to a less accurate result.

There is no originality about the following method, yet, as it appears to be seldom used, it is perhaps excusable to bring it under notice.

Provided the conductors comprising the loop under test are of the same gauge, the only known factor required is the distance between the two testing points.

Assuming the conditions of the ordinary Wheatstone bridge test for an earth fault, then calling the result of the resistance of loop test, London to Birmingham, L, and result of distance test l, and distance to Birmingham D miles, the distance of fault in miles—

$$= D \times l/\tfrac{1}{2}L \text{ or } 2D \times l/L.$$

That is, the result of the first test divided by the result of the second test, multiplied by twice the distance over which the test is made, gives the distance of the fault in miles.

It will be seen that the result of expressing the distance of the fault as a fraction of the loop itself is to fractionise all inaccuracies due to slight variations in weight per individual mile. It is independent of temperature correction also. The method produces a truer result than by slavishly working out the problem on a resistance-per-mile basis.

It came under the writer's notice that the weight-per-mile principle was not quite good enough, as manufacturers not infrequently supply slightly more copper than the specification calls for. In short, without going into details, variations do occur from various causes in actual practice. A method was, therefore, sought to combat this source of error, and the foregoing suggested itself. I may add that its application has yielded more successful results in practice than the older and more general method; it also has the advantage of being much simpler.

Thawing Water Pipes by Electricity.—During the past winter a petrol motor wagon was put to a somewhat novel use at Spokane, U.S.A., by the Water Department of that city—that of thawing the public water mains, which had become frozen up owing to the excessive cold. Mounted on the platform of the wagon is a 40-H.P. petrol engine coupled up to a 300-ampere, 60-volt generator, the current from which is conveyed to the water pipes by a ½-in. flexible conductor. It is stated that the machine has given most satisfactory results, and has done away with the steam thawing arrangement previously employed, at the same time rendering the water authorities independent of the electricity supply companies' mains, which were not always available for water pipe thawing purposes.

IMPROVEMENTS IN MAGNETIC IRON ALLOYS.

(From *Gen. Civ.* Abstract.)

It is not generally realised how great is the potential saving or waste in annual expense associated with the quality of the materials used in electrical machinery, and, in particular, with the magnetic quality of the iron. Formerly it was thought that the magnetic properties of iron depended simply on its degree of purity, and Swedish charcoal-iron was the standard of excellence. A new era began with Sir Robert Hadfield's discovery that a small proportion of silicon or aluminium improved the magnetic properties of iron. Even ½ per cent. increase in the efficiency of a 5,000-KW. transformer, due to reduced iron losses, represents 25 KW. increase in output, and (with energy at ½d. a unit) an annual saving of £456. It is estimated that the saving due to improvements in the magnetic quality of iron since 1889 exceeds £2,000,000 per annum in the United States alone. The principal stages in recent progress are summarised in Table I, page 540.

Until 1910, 21 years after Hadfield's "key" discovery, the maximum permeability did not exceed 8,350. Then a notable advance was effected by Terry's experiments with electrolytic iron, and, yet more recently, Yensen (Illinois), has attained still more remarkable results by thermal treatment *in vacuo.** So far as Yensen's experiments concern electrolytic iron, they have no immediate application in practice, because it is not yet feasible to produce electrolytic iron in bulk. It appears, however, that commercial iron, treated *in vacuo*, acquires magnetic properties far superior to any hitherto at the disposal of the electrical designer. Directly the vacuum treatment can be accomplished on an industrial scale iron losses will be, roughly, divided by five, and the annual saving in the 5,000-KW. transformer mentioned above would be £4,560 per annum. The significance of such possibilities in connection with the better utilisation of materials, and the cheapening and more extensive use of electricity supply, needs no emphasis.

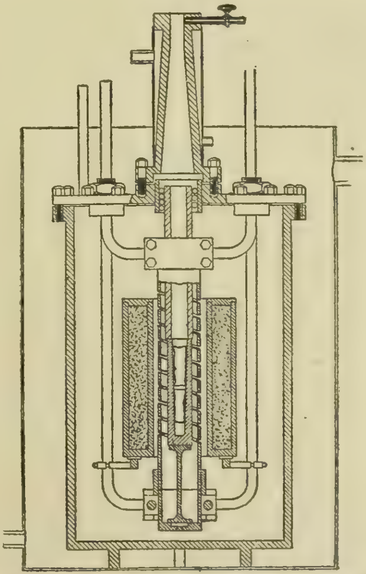


Fig. 1.—Section of Arsem Furnace for Heating Iron in Vacuo.

Increased permeability permits the use of a lighter and cheaper magnetic circuit for a given flux *i.e.*, for a given machine output. Eddy-current losses are small in comparison with hysteresis losses, but it is worth while to reduce them by using high-resistance material in thin sheets. The mechanical and thermal treatment of iron has little influence on its electrical resistance, and in practice it is only necessary to consider its chemical composition. Hysteresis losses diminish with temperature for constant H, but in practice $B_{max.}$ must be kept as nearly as possible constant, hence the hysteresis losses increase with temperature.

Experience shows that maximum permeability in iron corresponds to minimum hysteresis losses. Also, many of the conditions for high mechanical strength are also conditions for high permeability. For instance, any material of lower permeability than pure iron, and especially air or gas inclusions, reduces the permeability of the sample, and also reduces its mechanical strength. The crystalline structure is also a matter of importance, the magnetisation of iron crystals not being the same in all directions. Large crystals and low reluctance are desirable.

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* See Electrical Review, April 14th, 1916.

The purest iron is that obtained electrolytically. On an industrial scale, iron containing C. 0·004 ; S. 0·006 ; Si. 0·007 ; and P, 0·008 per cent. has been obtained from a cast containing C. 2·35 ; S. 0·07 ; Si, 1·31 ; P. 1·07 per cent. By using electrolytic iron, the utilisation of material in transformers is increased by 33 to 40 per cent. ; in A.C. motors, the output is increased 50 per cent. for equal size and temperature ; in D.C. motors, 16 per cent. reduction may be effected in the weight of active iron. Yensen's specimens of electrolytic iron, which were yet further improved by treatment *in vacuo*, were prepared as follows : The electrolytic deposit was crushed, chemically purified, dried *in vacuo*, and then placed in a magnesia crucible in an Arsem vacuum furnace (fig. 1), where the metal was melted under a pressure of 0·5 mm. mercury. Thus prepared, the iron contained no trace of oxide, and less than 0·01 per cent. of carbon and of silicon. The treatment *in vacuo* more than doubled the permeability of the iron, and reduced the hysteresis losses in the same ratio.

Carbon has an unfavourable effect on the magnetisation curve and on the hysteresis losses ; it is very difficult to eliminate completely, but is less injurious in the form of graphite than in combination. Pearlite (Fe_3C) and cementite (Fe_2C) are magnetically inferior to ferrite (pure iron). *Boron* exerts a somewhat similar effect to that of carbon on the magnetic and mechanical properties of iron. If a small percentage of boron be added to iron melted *in vacuo*, part of the boron reduces iron oxide and improves the magnetic properties, but the rest combines with the iron and produces an opposite effect. The presence of boron is tolerable up to 0·05 per cent. ; it increases the electrical resistance by about 0·62 microhm-cm. per 0·01 per cent. of combined boron. There is still a difference of opinion as to the exact effect of *sulphur* and *phosphorus* on magnetic properties, but it is certain that more than 0·03 per cent. of these elements produces bad results ; and, in view of their detrimental influence on mechanical properties, it is desirable to eliminate them as completely as possible.

Quite unexpected results have been obtained with the *iron-cobalt alloy* Fe_2Co. Its magnetic properties are distinctly superior to those of pure iron, the gain in saturation density being 10 to 13 per cent. With fields between 50 and 200 gilberts per cm. the magnetisation of the alloy is about 25 per cent. greater than that of iron ; it is lower than that of iron only for fields below 7·5 gilberts per cm. The hysteresis losses of Fe_2Co are considerably below those of the best transformer irons for inductions below 10,000 gauss, and nearly equal to them for inductions above 15,000 gauss. The alloy is brittle, but has the same tensile strength as pure iron when both are annealed, and twice as great tensile strength in other cases ; in order that it may be used advantageously in field cores or the like, it is necessary to cheapen its production, and to reduce its fragility by further alloying. The magnetic properties of iron-cobalt alloy and of pure iron are compared in Table II.

TABLE I.—Recent Progress in Electrical Irons.

Year and investigator.	Material tested.	Maximum permeability.	Coercive force in gilberts per cm. for B_{max} = 10,000 gauss.	Coercive force in gilberts per cm. for B_{max} = 15,000 gauss	Hysteresis loss, ergs per cb. cm. per cycle for B_{max} = 10,000 gauss.	Hysteresis loss, ergs per cb. cm. per cycle for B_{max} = 15,000 gauss.
1900—Hadfield	Swedish iron	4,000	0·92	1·0	2,700	5,500
1900 Hadfield	2·5 per cent. Si alloy	5,100	0·72	0·79	2,200	4,700
1901 Gumlich and Schmidt	Forged iron	8,350		0·6	—	—
1903—Baker	4·9 per cent. Si alloy	—	—	1·2	—	6,200
1910—Terry	Electrolytic iron	11,000	—	—	—	—
1912—Gumlich and Goerens	4 per cent. Si plate	11,600	—	0·54	—	—
1912— „	„ „	9,400	—	—	—	—
1912 Paglianti	1·75 per cent. Si alloy	—	0·6	0·75	1,650	3,500
1913—Yensen	Pure iron treated *in vacuo*	19,000	—	0·29	813	1,640
1915 - —	Pure iron + 0·15 per cent. Si	66,500	0·09	0·16	286	916
1915— —	Pure iron + 3·4 per cent. Si	63,300	0·08	0·15	282	1,025
1916	Pure iron + 3 per cent. Si	72,000	0·09	0·16	254	926
1916— —	Commercial iron treated *in vacuo*	20,900	0·30	0·34	865	1,760

TABLE II.—Magnetic Properties of Iron-cobalt Alloy and Pure Iron.

A = Pure iron melted *in vacuo**
B = Fe_2Co*
C = Standard transformer steel†
D = 4 per cent. Si-steel†
E = Wood charcoal Swedish iron* } Commercial irons.
F = Pure iron melted *in vacuo*‡
G = Fe_2Co‡

	A	B	C	D	E	F	G
Maximum permeability	22,800	13,200	3,850	3,400	4,850	24,300	8,800
Induction corresponding to ditto (gauss)	10,000	8,000	7,000	4,000	6,500	8,500	8,000
Hysteresis loss, in 1,000 ergs per cm. cube per cycle for B_{max} = 10—15,000 gauss	0·8—1·7	1·5—3·2	3·3—5·9	2·3—3·0	2·5—4·5	0·7—1·7	2·2—4·4
Coercive force, in gilberts per cm. for B_{max} = 10—15,000 gauss	·27—·33	·48—·65	1·2—1·33	·88	·88—·95	·22—·26	·75—1·0
Remanent magnetism, in 1,000 gauss for B_{max} = 10—15,000 gauss	9·3—14	9·1—12	7·7—9·9	5·4	6·9—8·0	9·3—13	9·3—12·3

* Annealed at 900° C. † Subjected to standard industrial treatment. ‡ Annealed at 1,100° C.

Aluminium, being non-magnetic, may only be used in small quantities, not exceeding 0·1 per cent. ; its effect is then useful.

Influence of Chemical Composition on Magnetic Properties.—The properties of ferro-silicon alloys have been investigated extensively by chemists, metallurgists, and physicists since Sir Robert Hadfield first discovered the superiority of some of these alloys for electrotechnical applications. The addition of silicon reduces hysteresis losses and increases permeability, the effect commencing at about 2 per cent. silicon, and continuing to the limit at which forging becomes impracticable (about 7 per cent. Si). The action is due not to the direct influence of the silicon (which reduces the intensity of magnetisation at saturation), but to neutralisation of the effect of carbon. The carbon in a ferro-silicon alloy, though present to the extent of 3 or 4 per cent. or more, is neither combined nor in solution, but is entirely in the form of graphite, which is the least injurious form, so far as concerns magnetic properties.

From Yensen's investigations on 33 alloys containing from 0·068 per cent. to 4·39 per cent. Si, and about 0·01 per cent. carbon, with oxygen as the only impurity, it appears that silicon first reduces the oxide of iron, before combining with the iron. In this respect it differs from carbon but resembles boron, although the oxidising effect of the latter is more energetic. On plotting the magnetic properties of this series of alloys against the percentage of silicon, there are seen to be two maxima in the curve of maximum permeability, corresponding to two minima in the curves of hysteresis loss and coercive force. The first of these corresponds to 0·15 per cent. Si, and the second to 3·5 per cent. Si as regards maximum permeability, or to 4 per cent. Si as regards minimum hysteresis loss. The discrepancy between the Si contents corresponding to the second permeability maximum and hysteresis minimum is due to the hysteresis loss depending much more on the coercive force than the permeability. The existence of a marked permeability maximum and hysteresis minimum with a very small silicon content is, doubtless, due to the silicon eliminating the traces of iron oxide previously present. In other words, the result is due to purifying the iron, and not to the formation of an alloy. The quantity of silicon necessary for this purpose varies with the amount of oxide in the iron, and regular variation of magnetic properties with percentage of silicon can only be expected after the iron oxide has been eliminated. Formerly the good magnetic qualities of 2·5 to 4 per cent. Si alloys were attributed solely to conversion of the combined carbon to graphite, but Yensen's iron, containing only 0·01 per cent. of carbon, could not require anything like 3 or 4 per cent. of silicon to neutralise it, hence we are driven to the conclusion that the second permeability-maximum and hysteresis-minimum mentioned above is due to no direct action of silicon, but to its combination with iron.

The purity of the iron used in preparing a ferro-silicon alloy is most important. For instance, the permeability of a 3·4 per cent. Si alloy using electrolytic iron melted *in vacuo*, is about 20 times as great (at 6,000-7,000 gauss) as that of a similar alloy using commercial steel. For a maximum induction of 10,000 gauss, the hysteresis loss is eight times as great; and for 15,000 gauss, three times as great in the commercial alloy as in the pure iron-alloy. The electrical resistance is practically the same in both cases, and is about five times greater than that of pure iron.

Of two pure iron-alloys, one containing 0·05 per cent. and the other 4·44 per cent. Si, giving equal hysteresis losses with a maximum induction of 10,000 gauss, the high-silicon alloy is characterised by low remanent magnetisation and maximum permeability to low flux densities, whereas the low-silicon alloy has very high remanent magnetism and great permeability at high and medium flux densities. Silicon, itself indifferent from the magnetic standpoint, diminishes permeability in the first case, but in the second case it plays the part of a molecular lubricant diminishing the friction which opposes orientation of the molecules in the magnetic field. The fusion *in vacuo* method has furnished two alloys, one with a low-silicon content, hard, ductile, of high permeability, low hysteresis loss and low resistance, suitable for dynamo plates; the other with high-silicon content, hard, moderately strong, of high permeability, low hysteresis loss and high resistance, suitable for transformer plates. The properties of these alloys are summarised in Table III.:—

TABLE III.—The Two Best Vacuum-Melted Ferro-Silicons.

Silicon content (per cent.)	0·15	3·4
Tensile yield point (lb. per sq. in.)	19,800	57,800
Breaking strength (lb. per sq. in.)	36,700	76,000
Extension (per cent.)	56	21
Reduction in area (per cent.)	90	28·5
Maximum permeability...	66,500	63,300
Induction corresponding thereto (gauss) ...	6,500	6,500
Hysteresis loss (ergs per cm. cube per cycle):		
B_{max} = 10,000 gauss...	286	280
B_{max} = 15,000 gauss...	916	1,025
Resistivity (microhms-cm.)	11·8	48·5

Diverse opinions are held as to the effect of Si in the presence of other elements in iron alloys, probably owing to the different methods employed by various investigators and the different conditions under which tests have been made. Marenine published, last summer, the results of tests made in the Technological Institute of Petrograd, from which it appears that the action of Si in the more complex alloys is analogous to its effect in ferro-silicon. According to this investigator, the chemical composition of plates used for electrotechnical purposes should be:—C. not more than 0·08 to 0·1 per cent.; Mn. 0·1 to 0·3 per cent.; Al. not over 0·1 per cent.; S and P. traces; Ni and Cu. less than 0·05 per cent.; Co. probably desirable in large quantities; Si. 0·5 to 0·7 per cent. for dynamos, 3·5 to 4·5 per cent. for transformers.

Mechanical Treatment.—Ingot iron has normally a coarse crystalline structure, but, during subsequent mechanical treatment, these crystals are crushed and intermingled. The longer the mechanical treatment, and the lower the temperature at which it is given, the more profound the changes in the crystalline structure. The iron is rendered more or less amorphous, and the magnetic properties are affected adversely. Similarly, iron subjected to repeated blows (even if only light), suffers in magnetic quality.

Heat Treatment.—The ill-effects of mechanical treatment may be corrected by annealing at about 1,000° C., followed by gradual cooling. The result of such treatment is to eliminate internal strain set up by mechanical treatment, and to induce the formation of large crystals. For best results the annealing must be continued long enough, and the cooling must be gradual enough, for all the desired changes in structure to be effected. There are great possibilities in combined thermal and magnetic treatment, such, for instance, as cooling the annealed iron in an alternating field. When the iron passes from the β to the α state, its particles are momentarily polarised, and as much as 50 per cent. increase may be obtained in the maximum permeability. This treatment, however, is not yet beyond the laboratory stage.

The well-known *ageing* of transformer plates, by which their losses are materially increased, is more rapid the higher the working temperature. The phenomenon is due to changes in crystalline structure, the stability of which varies with chemical composition. The structure of ferro-silicon and electrolytic iron is so stable that deterioration by ageing is very gradual.

Melting in vacuo.—The possibilities of this process are certainly immense, but it is not possible to foresee their exact scope. Electrolytic iron is not yet available on a commercial scale, but, as shown by Table I, commercial iron treated *in vacuo* has magnetic properties superior to those of electrolytic iron, so that the more urgent desideratum is to develop electric vacuum furnaces on an industrial scale.

Yensen finds that samples of purest commercial steel, re-melted *in vacuo*, annealed at 1,100° C. and cooled at the rate of 30° C. per hour, are given two or three times their former maximum permeability by this treatment; at the same time, the hysteresis losses are reduced. Chemical analysis shows no change in the composition of the metal, but micrographic examination shows the crystalline structure to be much larger in the iron which has been treated *in vacuo*. Also, this metal is free from the tiny cavities caused by gases in the commercial iron. Further investigations are needed urgently, since there are possibilities of immense annual saving by reducing the iron losses of electrical machinery and apparatus of all kinds.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Ironclad Switch.

We have received from Messrs. S. Bill & Co. Ltd., of Queen's Road, Aston, Birmingham, a sample of their new pattern ironclad 60-ampere double-pole switch, with side handle and interlocked lid, to comply with the Home Office rules.

The switch, which we illustrate in fig. 1, is of substantial design, with a separate porcelain interior for each pole, the terminals being shielded by porcelain partitions. A special feature is the cranked spindle of the lever handle which is attached by a loose coupling to the coupling bar of the switch blades, this arrangement getting over the trouble arising from the different thicknesses of china bases which it is impossible to avoid in manufacturing, and which would otherwise disturb the alignment of the lever spindle. The arrangement is, we understand, provisionally patented. This type of switch is supplied with either solid or laminated blades; the brass and copper work is substantial and the connecting leads are led in through bushed holes direct into the terminals which have double screws. Fixing lugs are provided to the case, and a bolt and wing-nut secures the lid.

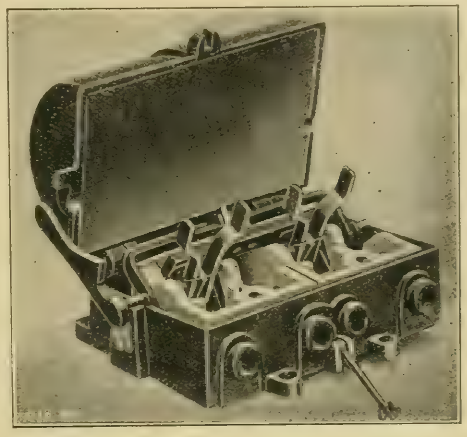

Fig. 1.—D.P. Ironclad Switch with Side Handle.

Magnetic Chuck Switch.

Messrs. Donovan & Co., of 47, Cornwall Street, Birmingham, inform us that they have recently introduced a new type of switch for rapidly and conveniently energising and de-energising magnetic chucks. The necessity for such a switch has long been realised by manufacturers who use magnetic chucks on their machines, and the switch in question has been introduced with a view to making the operation as simple and rapid as possible. When operating the switch an arm is pushed on to the "on" position, which energises the chuck, and it remains in that position until it is desired to de-energise, when the handle is pushed in the opposite direction to the reverse position, and as soon as it is released by the operator it automatically returns to the "off" position. These switches have been throughly tested by manufacturers in practical use, and have been found to be perfectly satisfactory, and a great improvement upon the former practice. The makers will send illustrations and a full description of these switches upon application.

LEGAL.

Munitions Court Cases.

At the Bradford Munitions Tribunal 10 employés of a dynamo manufacturing company were charged with failing to work regularly. Two of them had been released from the fighting line to take part in urgent aeroplane work, and, at their special request, had been allowed a day-and-a-half extra holiday at Easter. The main reason for the prosecution was that similar liberties were taken after the Christmas holiday. The offence of all the men was the same. The Admiralty were pressing urgently for completion of orders, and this was impossible if men absented themselves for days and half-days without very good reason. This was the first time the firm had prosecuted for time-breaking, and they did it now with regret. One man's defence was that his wife was ill. Other men said that they had been away to Weymouth, Mid-Cornwall and Devon, and had been unable to get back in time. Two apprentices admitted that they had left work because others had done so. It was mentioned that the other apprentices in this business had submitted themselves to the works tribunal and been fined 1s. each. The Chairman of the Tribunal said the importance of this prosecution was obvious to anybody. The work of these men was of the greatest possible urgency in the national interest. He warned the offenders that further offences would be very severely dealt with. One man was fined 40s., four were fined 20s. each, two 10s. each, and the two apprentices 1s. each. One case was withdrawn.

At the Nottingham Munitions Tribunal Court, an emergency driver in the service of the Nottingham Corporation Tramways, applied for a leaving certificate, on the ground that he was dissatisfied with his wages and could obtain work of a character more useful to the country. He already had a situation offered him. Mr. J. Aldworth, the manager of the tramway undertaking, explained that it was certified as being necessary for munition workers. Applicant entered the service last year, and was trained to drive. The man's earnings, with the bonus, during the past 13 weeks, had averaged £2·6s. 9d., including one week of four days. He drove one of the cars for munition workers, and it was impossible to replace him. The Tribunal granted the certificate, believing that the work he proposed to undertake was of greater national value than that in which he was engaged at present.

British Thomson-Houston Co., Ltd., *v.* Corona Lamp Works, Ltd.

Mr. Walter, K.C., on May 10th, laid before Mr. Justice Younger in the Chancery Division a motion for an injunction in this patent action.

He stated, however, that the matter was not one that could be satisfactorily dealt with on motion, and, following a precedent of a case before the Court of Appeal, he had arranged with Mr. Kerley, K.C., who appeared on the other side, that there should be no order upon the motion, except that the costs should be costs in the cause, the defendants undertaking until the trial to keep an account.

Mr. Kerby stated that this was the great Half-watt lamp case, and that there would be a full-dress debate later.

His Lordship assented to that course being adopted.

Gruban *v.* Booth.

On Monday last the hearing of this case, which had occupied the attention of Mr. Justice Coleridge and a special jury in the King's Bench Division for some days, was concluded, the jury awarding plaintiff £4,750 damages. The plaintiff was Mr. J. G. W. Gruban, of East Molesey, who came to this country in 1893 from Saxony, and was naturalised after the outbreak of war. He was managing director of Messrs. Haigh, Gruban & Co., Ltd., tool makers, of Oldham, into which business he put £10,000. The defendant was Mr. F. Handel Booth, M.P., whom Mr. Gruban introduced to the business as a co-director in 1915. Plaintiff claimed damages for alleged fraud, stating that defendant represented that he held the authority of the Ministry of Munitions and other officials for stating that the plaintiff would be interned unless he handed over his position and property to defendant, who agreed to be trustee for the plaintiff. Though plaintiff agreed to defendant's proposal, he was interned a week later. Subsequently the Advisory Committee inquired into the matter, and plaintiff was liberated. Mr. Booth denied that any such agreement as referred to, was made, and repudiated liability.

The questions put to the jury after Mr. Justice Coleridge had summed up, and their replies to same, were as follows :—

1. Did the defendant falsely and fraudulently represent to plaintiff that he (the defendant) was in a position to protect plaintiff from attacks if plaintiff obtained for him the appointment of chairman of the company?—Yes.

2. Did the defendant falsely and fraudulently represent that he had been informed by the Minister of Munitions (Dr. Addison) that plaintiff would be interned unless he resigned?—Yes.

3. Did defendant maliciously, and without reasonable and probable cause, cause the plaintiff to be interned?—No.

The damages awarded on question 1 were £2,250, and on question 2, £2,500—total, £4,750.

WAR ITEMS.

Trading with the Enemy.—The "London Gazette" for May 11th contains further lists of persons and bodies in the following countries with whom trading is prohibited :—Argentina, Paraguay and Uruguay, Bolivia, Brazil, Chile, Columbia, Netherlands, Netherland East Indies, Norway, Spain, Sweden, &c.

For Our Blinded Heroes.—We have received a copy of the report of St. Dunstan's Hostel for Blinded Soldiers and Sailors for the past year. Few of the beneficent efforts following upon the horrors of war make so pathetic an appeal as does that on behalf of the man for whom everything is so greatly changed because he had laid upon the altar of the Allied cause that priceless treasure, the sight of his eyes. At St. Dunstan's, Regent's Park, there are 354 blind inmates, and accommodation is now extended so as to double that number. The men learn to live new lives, are taught new ways of doing old things, learn useful occupations, and so on, amid surroundings which are designed to make life as happy and bright as possible. The familiar fate of blind leaders of the blind does not find fulfilment here, for in the workshops the instruction is mainly given by men who are themselves blind. The whole story is a very fascinating and very touching one, and we are sure that the generous-hearted who have it in their power to support so splendid an object will not turn a deaf ear to the appeal for subscriptions and donations. These may be sent addressed to the Secretary at the Hostel, as above.

Female Labour at Bristol.—The military necessities have made big demands on the staff of the electricity undertaking at Bristol, so that, as in the case of similar undertakings, the substitution of female labour for those members of the staff and employés who could be released for military service has been resorted to. The training of women for rotary sub-station work has been looked upon with some trepidation owing to Bristol's multiplicity of systems, but it is hoped that they may be found suitable for this work also. Female labour has been introduced into the laboratory, generating station, meter department, and sales department. In addition, the depletion of the general office staff has been filled by members of the female sex. The following tabulation shows Bristol's record in this direction prior to and since the war :—

	At present.	Prior to war.
Switchboard operators in training	8	—
Cleaners at generating station	9	—
Meter readers	7	—
Sales department (showrooms)	2	—
Clerks and stenographers	26	1
Laboratory assistant	1	—

Exemption Applications.—Before the Somerset Appeal Court, exemption was claimed by the Taunton Electric Traction, Co., Ltd., for Mr. V. L. Marshall (33, in Class A), acting tramway manager and traffic inspector, taking the place of the regular manager whilst in the Army. Mr. Marshall was appointed because he was medically rejected, and on April 20th his conditional exemption was cancelled by the Taunton Tribunal. It was claimed that he was not fit for general service, and that he was doing practically three men's work, and had liberated five men for service. The Court dismissed the appeal, but allowed an appeal to the Central Tribunal.

At Colchester, the borough electrical engineer appealed for the retention of F. E. Rodwell (32), stoker at the electricity works, and stated that the demand for power was now greater than ever, and that it had been found impossible to secure a substitute. The Tribunal decided that the time had arrived when a substitute should be found, and they respited the appeal for a month with this in view.

Barnstaple Tribunal, on May 9th, considered a Military appeal against exemption held by M. Y. Andrew (18, in Class B 1), premium pupil at the Corporation electricity works. The manager said that the conditions imposed when exemption was granted were being observed. The Military Representative (Mr. H. P. Woodcock) said that he believed that some instructions had been issued to electric light stations that women could be employed on the switchboards, and asked if any attempt had been made to train anyone else so that Andrew could be released. Mr. Hadfield (the manager) replied that he had been training this man for 18 months, and the Chairman of the Electric Light Committee (Ald. H. Barrett) said that if the Military could supply them with a competent substitute the man could go, but Mr. Hadfield could not devote the necessary time to training anyone else. Mr. Woodcock said it was not for the Military to supply a substitute, and added that he knew of one switchboard attendant who had applied to the Labour Exchange for a post, and they had none for him. Mr. Hadfield observed that he believed the man referred to picked up his knowledge of electricity, and he would require capable supervision, which he had not the time to devote. The application was refused, and the exemption confirmed, and the Military gave notice of appeal.

At Worcester, Messrs. J. Ward, Ltd., appealed for the retention of A. E. Shrimpton (39), electrical engineer, who has the oversight of work at a number of controlled and munition factories. The Tribunal conceded conditional exemption.

At Carlisle, on May 9th, the city electrical engineer (Mr. Purse) appealed for R. Boyle, a handyman at the works, discharged as medically unfit from the R.F.A. in 1914. Conditional exemption was conceded.

Twenty employés were appealed for at Houghton-le-Spring by the Sunderland District Tramway Co. Mr. G. Stratton stated that several of the men were on the repair staff, and they found it very difficult to keep a sufficiency of cars running owing to the lack of qualified men: 129 employés had joined the Forces. The Tribunal granted six months' exemption, on the understanding that if opportunity offered substitutes would be engaged.

Sheffield Tribunal has granted exemption until the end of July to S. Gray, electrical engineer, appealed for by Messrs. J. Booth & Co., who is in Class C 3.

Before the Surrey Appeal Court, the Military Representative appealed against conditional exemption held by Mr. T

Hill (37, in Class B 1), electrical engineer, of Farnham. The appeal was upheld, and three months' exemption substituted.

The Surrey Appeal Court has granted three months' exemption to Mr. W. E. Baker (34, in Class C 1), electrical engineer, of Ashtead.

An appeal was made to the Sussex Tribunal by an electrical engineer at Burgess Hill for himself and a motor attendant. He stated that he contracted for the supply of electricity for lighting at Burgess Hill, and ran the plant at several munition factories. He had lost 35 men, and his present staff consisted of 19 women, men, and lads. The employer was given three months' conditional exemption, and the other appeal was rejected.

At Bexhill-on-Sea, Mr. R. W. Waine appealed for J. Bloor (36, in Class B 1), electrician, the only man left in two shops. Three months were given on the man joining Section B of the Volunteers.

Before the Hants Appeal Court, Mr. F. Bruce Holt (32, passed for general service), electrician, Ryde, appealed as owner of a one-man business. He stated that he had lighting installations to complete. His last man had been taken, and he now had only the assistance of a boy and girl. His business, the only one of its kind in the town, would have to close if he went. The appeal was disallowed.

At Woodbridge (Suffolk), further exemption for their electrical engineer was applied for by the Electric Light Co., who stated that the engineer had charge of the works at Woodbridge and Orford. Three months, with leave to appeal again, were granted, and an appeal was threatened by the Military Representative.

Bath Tribunal has, on the appeal of the Military, withdrawn conditional exemption held by G. N. Shipp (22, in Class B 1), stoker at the works of the Bath Electric Tramways, Ltd.

At Oxford, the Military appealed against conditional exemption granted on September 14th last to A. Greenaway (33, passed for general service), electrical fitter to Messrs. Barlow & Alden. Exemption cancelled, with a month's grace.

Salisbury Tribunal has given exemption until September 1st to an engine driver and electrician, in Class B 1, applied for by the Electric Light Co., whose manager stated that it was impossible to obtain another man.

Hitchin Rural Tribunal has granted three months' exemption to A. Edwards (30, in Class C 3), electrician at Lilley Manor, applied for by Mrs. Sowerby.

At the Shoreditch Tribunal, Mr. James Hind, of 6, Eldon Street, E.C., electrical and general merchant, made a second application on business grounds. He said he had a turnover of about £45,000 a year, and dealt chiefly in small electrical articles, such as torches, &c., which he got from Switzerland. His trade had been proved to be satisfactory to the Government, as they had granted him permission to import a number of prohibited articles. His profit was a little over £1,000 a year, but he explained that mostly he sent the orders abroad, and they sent direct to the customer. Despite this, however, he carried stock worth £4,000. A member said it was clearly a factoring business. Applicant was granted four months, V.T.C.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Wiring with Tough Rubber Compound Cables.

Seeing that several letters have appeared in your "Correspondence" columns since the publication of the article "Wiring with Tough Rubber Compound Cables," I venture to seek space in which to briefly reply to the points raised.

The letter in your issue of May 4th, page 493, signed by "Another Member of the E.C.A.," is much appreciated. In the first paragraph he deals with the attitude of "fire insurance companies" in respect of the adoption of C.T.S. cables. I attribute this to their usual sluggishness. They are always slow in recognising new methods.

The suggestion to use light conduit in plaster for runs to switches is, no doubt, a good one where alterations are likely to be required, but for many situations it is quite unnecessary.

There is certainly room for a good type of joint box, as your correspondent suggests, although I have not had any trouble with the existing designs. With a little scheming it is possible to dispense with joint boxes by employing multi-plate ceiling roses, which fulfil the requirements stipulated, being fireproof, and having ample terminal accommodation.

As regards the sun's influence, there is no doubt that the surface of any kind of rubber is affected to a certain extent, but so long as the makers know that a C.T.S. cable is to be used in strong sunlight, they can always treat it in such a way as to prevent even the superficial cracking mentioned in the letter under consideration.

I should be pleased to give information of the nature suggested, but could not do so in the space at my disposal, as the uses of C.T.S. in various situations would require to be dealt with at length.

Certainly the methods of switching and details of circuits could be applied to other "wiring systems." The object of including them was to conform with the wishes of many contractors, and also to demonstrate how the twin cable and triple cable simplified the wiring.

With regard to the letter written from the "Consumers' Engineer's" dugout, I am sure that "Another Member of the E.C.A.," in addition to myself, will not object to your correspondent's claim to possess a wider perspective than our humble selves, particularly when it becomes so blurred as to miss the vital points. I also admit that if all supply authorities' representatives were like "Consumers' Engineer" it would be a hopeless task to attempt to instruct them on new methods. As a matter of fact, although I quoted only three instances to demonstrate the little knowledge possessed by *some* supply representatives of C.T.S. cables, if space permitted I could instance a score more.

Continuing, he states that in advocating any system, the first essential is varied experience; just so, hence the article.

With regard to trifling with the intelligence of your readers *re* the watertight system (I always avoid the use of the term "permanent"), I have sufficient confidence in their experience and memory to venture to quote the well-known Mr. D. S. Munro, M.I.E.E., who recommended the use of C.T.S. cables with conduit boxes as far back as 1913.

I will pass over the misread suggestions of "Another Member, &c.," and the allusion to "poultry" in order to reach the concluding paragraph. My 18 years' experience in the electrical contracting industry brings me to heartily endorse the two concluding lines.

In conclusion, I venture to allude to the letter from Messrs. A. P. Lundberg & Sons. Seeing that they are specialists, I appreciate their interest. I do not agree that the tumbler switch has a marked superiority over the turn pattern for several reasons. In the "Diamond H switch" we have a very rapid and long break. It has "four positions," whereas I do not know of a tumbler switch that has more than "three," and for this reason there is one control, that of the "billiard room," which could not be controlled by one tumbler switch. The turn pattern can be used on "600 volts," and is used on many railway systems, especially where shops are supplied with current from the system at 600 volts. The turn pattern can be obtained up to 40 amperes capacity.

As to the American names being more or less meaningless, if we consider the definition of the term "point" in the I.E.E. Rules, and then deal with the two-point switch, the title seems appropriate. One turn of the switch closes the circuit to one pair of terminals (or point), a second turn closes the circuit, at another pair of terminals or point in addition, a third turn disconnects at the first point, leaving the second point still on, a fourth turn switches all off.

Apologising for the length of this reply, and thanking you for your assistance,

W. Ellerd Styles.

London, E.C., *May 14th*, 1917.

Both Mr. Ellerd Styles and "Another Member of the E.C.A." appear to have emphasised the critical point regarding C.T.S. cables, viz., the price. It is difficult to believe that the difference between the cost of the sheathing and the cost of taping and braiding is so great as to make the finished "cab tire" cable roughly twice as dear as C.M.A. taped and braided V.I.R. cable.

From a contractor's point of view C.T.S. is an interesting proposition, but it is hard to convince a customer that he should pay as much or more for a C.T.S. job than a screwed-tube one. It does not look reasonable. Of course, I refer to an ordinary installation, and not one where corrosion troubles have to be guarded against, for in the latter case the advantages of C.T.S. are obvious.

If, however, the makers insist that the price is justified, I would say why only make the cable in C.M.A. grade? Why not in N.A.? How many installations are carried out in C.M.A. compared with N.A.? An extremely small percentage.

In any case, it seems to me that the makers are likely to miss their opportunity if they maintain their present policy. It is a case of killing the goose that lays the golden eggs.

Practical.

As "Consumers' Engineer" suggests in his communication published by you last week, no doubt your readers welcome "the views of one with a wider perspective"; in fact as the writer of the letter which you kindly inserted in your previous issue, signed "Another Member of the E.C.A.," I may say that it was with this very object that I ventured comment upon Mr. W. Ellerd-Styles's article.

Without doubting for one moment "Consumers' Engineer's" "wider perspective," I cannot help wondering on what grounds he bases his comparison. I certainly have only been an installation engineer for about 20 years, but I understood that Mr. W. Ellerd-Styles wrote with an authority based upon some experience.

I do not see that it is "trifling with the intelligence of your readers" for Mr. Ellerd Styles to have seriously suggested that a "permanent waterproof system may be effected" with

C.T.S., provided a reasonable construction is put on the word "permanent" as used, that proper care is taken, and suitable types of fittings used for such an installation.

"Consumers' Engineer's" quotation from my previous letter tends to mislead, seeing that he ignores the reason that I gave in suggesting "short lengths of light steel conduit of ample size" for enclosing C.T.S. where run in plaster; it was surely clear that it was not primarily as a mechanical protection for the wires that I offered this hint.

Again, who claimed that it is "good practice to increase the bulk of the dielectric to replace the mechanical protection so often necessary throughout the widening field of electrical application"? Certainly not the makers. The cab-tire *sheathing* is claimed to be the *mechanical* protection of *low* insulation resistance.

In order that I may fully appreciate your correspondent's reference to "the use of this cable for all purposes," I will risk "buying" the "curate's egg" analogy if he will favour me with the "answer."

In case of a wrong conclusion being arrived at, I anticipate the possibility by assuring him that neither have I met nor do I know Mr. W. Ellerd-Styles, nor am I interested in any manufacturer of "C.T.S.," but as a live contractor, see some of the possibilities of this material, and hoped to gain by a healthy discussion if such appealed to your readers.

Another Member of the E.C.A.

[We have not been able to find any reference to a "permanent" waterproof system in Mr. Ellerd-Styles's article.—Eds. Elec. Rev.]

In reference to letters on this subject that have appeared in your recent numbers, may we suggest that it would be more satisfactory if the writers signed their names to their letters. This would help matters in two ways: First, by enabling us to give what information is required to the inquirer direct, possibly in a fuller way than can be dealt with in your columns; and, secondly, by preventing persons interested in other wiring methods, or those who rely upon hearsay evidence only, from expressing criticism of an unfair character; which is not always appreciated as such by your readers in anonymous communications.

St. Helens Cable & Rubber Co., Ltd.
J. H. C. Brooking, *General Manager.*
Warrington, *May 14th*, 1917.

The I.E.E. Wiring Rules.

The recent paper by Mr. Rawlings, abstracted in your number of April 27th, page 475, is of much importance. It may interest Mr. Rawlings to know that in a large town several leading members of the E.C.A. are using slip-joint tubing which the I.E.E. Rules specifically forbid. On protest being made by a supply authority, the contractors stated that they paid little attention to the I.E.E. Rules, and also declared that no one had power to enforce them.

This attitude is unfortunate, as it naturally opens the door wide to the jerry wireman.

One can only hope that the I.E.E. will take steps to obtain powers to have their rules enforced, which would be greatly to the advantage of both consumers, electricity undertakings, and contractors.

A further useful step would be to set up in large centres committees formed from all parties concerned, such as supply undertakings, contractors, insurance companies, &c., which committees could arbitrate all disputes between parties. There is little doubt that if such an arrangement were undertaken it would greatly improve the quality of the work, and eliminate that curse to everybody the inefficient contractor.

Wiring Rules.

Electric Vehicles.

I note the letter in your issue of the 4th inst. from Mr. E. F. Rowley. As to the matter mentioned in paragraph No. 1, *i.e.*, standardisation, my committee, acting in co-operation with the B.E.A.M.A. (Accumulator Makers' Section), have already secured standardisation of plate sizes, filler holes and plugs, and the maximum overall sizes of container jars for lead-plate batteries. They quite recognise the desirability of going further, and I can assure your correspondent, whose suggestions will be noted for consideration in the future, that these matters have been frequently discussed at our meetings. Owing, however, to all battery makers having to concentrate almost wholly on war work—in most cases with depleted staffs—it is impossible, while the war lasts, to do anything more in the direction of standardisation.

As to the proposals made under (2) in Mr. Rowley's letter, he is aiming at an ideal which I hope we shall some day achieve. As, however, capital will probably be scarce for some years after the war, I fear some time must elapse before such a scheme could be launched. Mr. Rowley speaks of the difficulty of charging seven or eight batteries of different voltages. Allow me to say, as one having had some two years' experience of running a public charging station and garage, that in the case where the number of cells is in line with the recommendations of my Committee, *i.e.*, not in excess of 44 lead-plate cells, no particular difficulty is experienced. Vehicles in our garage have batteries varying in the number of cells from 40 to 44. To be able to deal with such variations a properly designed charging switchboard is, of course, necessary.

Frank Ayton,
Hon. Secretary.
The Electric Vehicle Committee of Great Britain.
Ipswich, *May 10th*, 1917.

The Deterioration of Turbine Blading.

The interesting and instructive paper on the above subject recently read before the South African Institute of Engineers by Mr. A. Fenwick, has justly received a wide publicity in the technical Press of this country, and it is to be hoped that our manufacturers and users of turbines will take advantage of such a complete and thorough statement of working results. There is, however, a danger that, in the case of those who are not thoroughly familiar with all the circumstances, doubts and fears as to the reliability of impulse turbines may arise, which will tend to unjustly discredit this type of turbine as built in this country. In the hope that these fears may be removed, we trust that we, as the owners of the Curtis turbine patents for land purposes in this country, may be allowed to place before your readers a few words of explanation and information.

In the first place, it should be noted that elsewhere it has been stated that all the turbines referred to in Mr. Fenwick's paper are of one particular firm's make, and that the failures recorded are not due to the type of turbine described, but to the use of improper materials or design.

When we took up the manufacture of Curtis turbines, about 14 years ago, the blades were cut from solid rings—the material was mild steel, and was found to be serviceable, particularly in the high-pressure stages. Towards the exhaust end, owing to an increasing amount of moisture in the steam, erosion would commence after some 6,000 hours' working. This deterioration was augmented in some cases by ordinary rusting taking place while the turbine was out of service, and due to leaky stop valves, the blading standing in a warm, damp atmosphere. Many of these early turbines are still running, and have suffered less in efficiency than would be expected from the appearance of the blading, thus confirming Mr. Fenwick's observations.

It was early recognised that a more suitable material was wanted for the blades, and systematic investigations were started by us to find a material possessing the following characteristics:—

1. Non-corrosive in steam and water.
2. Resisting erosive action of high steam velocities.
3. High tensile strength.
4. Retention of initial physical properties.
5. Adaptability for manufacture.
6. Reasonable cost.

It will not be necessary here to relate the methods employed, or give all the results of our investigations. Those interested may be referred to a paper read by our chief chemist, Mr. W. B. Parker, F.I.C., before the Institute of Metals (*Journal* of the Institute of Metals, 1915, Vol. XIV), written for the purpose of soliciting the active assistance of metallurgists towards getting the most suitable material for turbine blading.

Among the non-ferrous alloys we have found that high-grade phosphor bronze best filled the above given requirements, and after several years' experience we have found none better. This alloy has initially a yield point of 12 tons, and tensile strength of 24 tons. After being exposed to high steam temperature the alloy ages, *i.e.*, the yield point is lowered, and somewhat in proportion to the temperature to which it is exposed. This reduction in strength is, fortunately, not important, as the shortest and least stressed blades are exposed to the greatest heat. We believe that the phosphor bronze has lately been adopted for impulse marine turbines, and with satisfactory results.

The output of steam turbines for a given R.P.M. is gradually growing, and the blading stresses have correspondingly increased, and to such values that the phosphor-bronze alloy is not strong enough for the requirements at the low-pressure end of the turbine. Where this greater strength is required, steel, or steel alloys, are used.

To avoid corrosion high-percentage nickel-steel looked most promising, and was experimentally tried by most turbine builders. Two machines which we built were provided with 25 per cent. nickel-steel blading, which came to grief after less than a year's service. The behaviour of this alloy is most mysterious, as pointed out by Mr. Fenwick, and we believe there is no satisfactory explanation to-day as to the real cause of failure, our own investigations being inconclusive. Even with so low a percentage of nickel as 3 to 5 per cent. trouble may be experienced owing to the tendency of nickel to segregate when pouring the ingot, and we have therefore for some time past been using a high-grade open-hearth carbon steel (having a higher percentage of manganese than usual), so as to obtain a material of great tensile strength, dependable and giving constant results. This steel is not affected by corrosion to any greater extent than steel containing a permissible amount of nickel, and we find that corrosion is not appreciable if the feed-water is pure and no deleterious compounds are introduced into the boiler, and, further, if the turbine is kept dry while standing.

It would be desirable, however, if a non-rusting blading material, having great tensile strength, could be obtained.

Experiments are in progress in this direction with what is known in the cutlery trade as "rustless steel," but it is too early yet to say if this alloy will stand the test of time.

With regard to nozzle and guide blade material, there is no doubt that the serious troubles described by Mr. Fenwick are mostly due to the employment of 30 per cent. nickel-steel alloy, and partly to too thin guide blades. First-stage nozzles exposed to high pressure and temperature with cast-iron division walls, as mentioned by Mr. Fenwick, could only be expected to give the trouble experienced. Bronze alloys have been found most satisfactory for this purpose, especially when used for extra high temperatures, and the extra cost involved is well justified. The most suitable material for guide blades, according to our own experience, is a good grade of mild steel. If a non-rusting steel can be obtained for the longest rotating blades, this material will be equally useful and welcome for the guide blades.

The drop in pressure across a diaphragm is considerable in the first stages of a turbine. Mr. Fenwick mentions a drop of 6 lb. across the diaphragms of turbines in classes 2 and 4. It should be pointed out that this is the average pressure difference, and in the case of the first diaphragm the drop is about four times this amount, increasing the stress per blade to four times that given in Mr. Fenwick's table. We believe that cast-steel diaphragms should be used where the pressure drop is great, the diaphragm being provided with suitable port holes, and having separate nozzle segments bolted to the diaphragm. With this construction, all serious bending stresses in the guide blades are avoided, and the extra expense, we think, is justified. Where cast-iron diaphragms are used, the metal should be carefully selected so as to avoid excessive growth, which is mostly due to the presence of too much silicon.

In conclusion, we would express the hope that the proposed national investigation of blading material will be taken in hand without delay.

For The British Thomson-Houston Co., Ltd.
Frederick Samuelson.

Rugby, *May 15th*, 1917.

I have read with interest the articles appearing in your issues of May 4th and 11th on the paper contributed by Mr. A. Fenwick to the South African Institute of Engineers *re* the above.

Although you draw attention to the source of manufacture in a footnote, the fact that the turbines described are wholly of German manufacture is not disclosed in the extract, and I write to draw attention to this point to prevent British manufacturers being prejudiced.

From experience of plant manufactured by the leading British makers extending over the last 12 years, deterioration only takes place where unsuitable boiler feed is used.

The greater success of the British turbine builders is no doubt due to design and careful selection of material used in construction of the turbine blading.

Charles P. Sparks, M.I.E.E.

London, E.C., *May 15th*, 1917.

BUSINESS NOTES.

The Australian Association of British Manufacturers and their Representatives.—The report for 1916 of this Association has been received from Melbourne, and it includes a statement of the activities of the Executive Council, which controls the Association in the Victorian capital, and of the Sydney Council, which operates in New South Wales. Both sections of the Association have been enaged on the question of the Federal income-tax, and they display a very natural pleasure at the success of their endeavours to bring about the repeal of Sec. 15 of the Income-Tax Assessment Act of 1915.

Urgent representations were made by the Association to the Prime Minister, as well as to all members of both the Australian House of Representatives and the Australian Senate, that the policy of Australia should be, first, to protect Australian industries; and, second, to promote trade between Australia and the United Kingdom, and that, as far as the latter trade was concerned, such policy would be materially assisted by encouraging direct representation of British manufacturers in Australia. The effect of the taxation falling under the Section in question was directly to discourage such direct representation, because the manufacturer who employed a local agent was made liable to pay tax on all his sales to Australia, while his competitor who carried on business by means of correspondence or catalogues, or through a London, New York, or other buying house, escaped taxation altogether. This in itself constituted a glaring iniquity in penalising one manufacturer and letting another go "scot free."

Cases had occurred in which overseas manufacturers had cancelled their Australian agencies in order to avoid payment of this taxation. The Association asked that the Government should bear in mind that agents paid both Federal and State income-taxes on their commission, or profit on their transactions, and also employed labour in their business, so that the closing down of such agencies not only robbed the agent of his livelihood, but deprived the Governments of tax payable on his earnings, and also reduced employment. Another point driven home by the Association provides incidentally an interesting commentary on the exhortations addressed to the home manufacturer to employ resident agents or open actual branches abroad, rather than rely upon catalogues, correspondence, and occasional visits. One of the reasons put forward by the Australian Association of British Manufacturers and their Representatives for the repeal of this Federal income-tax was that the British manufacturer did employ resident agents, whilst the foreign manufacturer contented himself with sending an occasional traveller, who, nine cases out of ten, would get away without paying tax on behalf of his principal. Through this difference of method, a direct preference accrued to the foreign in competition with the British manufacturer. Moreover, as many British manufacturers had taken up the position that such taxation must be borne by their Australian agents as part of the agency expenses, it was feared that such agencies would become unremunerative, and be relinquished.

As the result of this very clear and emphatic statement of the case, the Council of the Association take justifiable credit to themselves for having, as already described, obtained the repeal of the objectionable section. Its repeal means that British manufacturers will not now be liable to pay Australian income-tax on goods sold by them to buyers in Australia, merely because they have an agent or representative in Australia who receives a commission or remuneration in connection with such sales. Under the original section, which was law and remained in force from November, 1915, when it was passed by the Federal Parliament, until its repeal in December, 1916, British manufacturers were liable to pay income-tax in most cases at the rate of 1s. 6d. in the £ on 5 per cent. of the invoice value of all goods sold to persons in Australia if any person in Australia received a commission or remuneration in respect of the sale of the goods. The success of the Association in this respect will result in a considerable direct monetary benefit to all British manufacturers carrying on business with Australian customers by means of an agent in Australia.

It is satisfactory to learn from the report that the Association intends keeping a careful watch on behalf of the home trade on the new import duties legislation when it is introduced again. In the meantime, they have successfully approached the Prime Minister of the Commonwealth and the Prime Ministers of the various States, with a view to preference being granted to goods of British manufacture when purchases are made by departments of their respective Governments, such preference to be in addition to the ordinary preference obtained by goods of British origin under the Customs Tariff. In concluding their report, the Council allude to the great difficulties experienced by British firms trading with Australia, not merely on account of shortage of labour and raw material, but also due to lack of freight. It is admitted that American and Japanese competitors have been taking every advantage of these circumstances, and doing everything possible to increase the Australian business. The Council have therefore invited members to co-operate by doing everything possible to assist Great Britain to triumph in the trade war which must be fought after the termination of the present hostilities.

Competitive Imports.—The Association has forwarded with its report a tabular statement, compiled by H.M. Trade Commissioner in Australia,, showing statistically the share of the United Kingdom, British Dominions, and the United States respectively, in Australia's imports of competitive manufactured merchandise.

The totals for 1914-15 and 1915-16 are shown below:

Imports of competitive manufactured merchandise.	1914-15.		1915 16.	
From United Kingdom ..	£31,732,974	64·9 %	£34,562,821	62·18 %
,, Brit. Doms. & Possns.	1,899,075	3·8 %	2,473,470	4·45 %
,, United States ..	7,430,170	15·2 %	10,594,793	19·06 %
,, All other countries ..	7,804,792	16·1 %	7,948,185	14·31 %
Total	£48,867,011	100 %	£55,579,269	100 %

The following figures in respect of metals (manufactured) and machinery for 1915-16 will be of interest:—

		Preference.	Non-preference.
Imports of metals manufactured	. Total	£13,533,115	£26,808
From United Kingdom		8,683,440	26,771
,, British Dominions & Possessions..		607,215	2
,, United States		3,736,228	14
Machinery	.. Total	£3,209,297	
From United Kingdom		1,485,153	
,, British Dominions & Possessions		181,523	—
,, United States		1,389,158	-

Plant for Sale.—The Wolverhampton B.C. Electricity Works has for disposal one 700-KW. Belliss-Parker 500-volt D.C. generator set, and one 500-KW. Willans-E.C.C. 500-volt D.C. generator set, both complete, with surface condensing plant. Full particulars are given in our advertisement pages to-day.

Patents and Alien Enemies.—The Chesham Supply Co., Ltd., have applied to the Board of Trade to avoid, or suspend, the series of patents from No. 23,132/05 to No. 4,692/13, granted to the makers of the Bosch magneto, for details of the mechanism.

Messrs. Edward Bennis & Co., Ltd., have decided not to proceed with their application in respect of Patent No. 5,041/13, granted to L. & C. Steinmuller.

Meter Prices.—The Walsall Electrical Co., Ltd., announce increases in prices of meters, both large and small, as from May 15th.

Lamp Manufacture in Spain.—"Thales," Sociedad Espanola de Lamparas Electricas is the name of a new concern which has recently been organised in Barcelona, with a capital of £2,000, to carry on the manufacture of electric lamps.

Openings in Italian Markets.—In its latest list of trade openings, the British Chamber of Commerce for Italy (Inc.) (Genoa) includes the following inquiries :—

No. 1,276. Rome agent seeks connections in rubber, colours, sulphates, coal, iron, chemicals, electrical machinery, instruments and apparatus, woollen piece-goods. R. A. G. Q.

No. 1,279. Party at Genoa would represent on commission manufacturer of chemicals, machinery and engineering sundries. G. C. L.

No. 1,289. Agents at Florence would handle on commission, hardware, ironmongery, and metals. F. D. D. B. F.

No. 1,290. Engineer at Genoa would buy on commission or for own account, machinery and metals for shipbuilding. G. I. R. M. C.

No. 1,294. Party at Naples would buy for his own account, hardware, ironmongery, fire-bricks, machine tools. N. E. F.

No. 1,296. Rome firm would handle coals, pig iron, tin, copper, lead, fire-bricks, &c. R. D. L. C.

No. 1,299. Leghorn agent would represent shippers of chemicals, metals, coals, &c. L. G. F.

No. 1,300. Genoa agent would represent on commission, exporters of coal, fire-bricks, &c. G. L. B. C.

No. 1,312. Firm at Genoa would buy for own account, or represent on commission, chemicals, caustic soda, soda ash, silicate of soda (glass), colphony, paraffin wax, iron, pig-iron, steel, oils, engineering articles, electrical sundries, &c. G. D. B. B.

Patent Application.—Application has been made for leave to amend Patent No. 12,867, of 1914, granted to Mr. C. O. Bastian, for "Improvements in, or relating to, electrical resistances." Particulars appear in our advertisement pages to-day.

Italy.—Accidierie Ellettriche is the style of a joint stock company launched at Sesto S. Giovanni for the establishment and working of an iron foundry and steel works, and trading in the products. The capital is fixed at 300,000 lire.

Catalogues and Lists.—Consolidated Pneumatic Tool Co., Ltd., 9, Bridge Street, Westminster, S.W. 1.—46-page electric tool catalogue (No. 8E) ; new edition. Descriptive matter and tabulated sizes, weights and code-words appear relating to D.C. drills and A.C. drills, single, two and three-phase drills, rail drills, portable generating plant and air compressors, grinders, coal and ore borers, electric hammer drill, portable electric blower, drilling stands, couplings for connecting cables, &c. The pamphlet is fully illustrated, some of the pictures showing the works ; there is a code-word index and a thumb index to sections.

British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park.—New series of illustrated leaflets, showing a number of their recent switchgear installations. The switchgear at the L. & N.W. Railway Co.'s power station at Stonebridge Park, also the sub-station switchgear at that company's sub-stations at Willesden and Dalston, are clearly shown, also a 35,000-volt A.C. switchgear equipment at the works of Det Norske Nitridaktieselskap ; L.T. switchgear at the Clydebank Works of the Singer Manufacturing Co., Ltd. ; and sub-station switchgear for the Walsall Corporation.

Dissolutions and Liquidatious.—Braithwaite & Kirk, 117, Victoria Street, London, S.W.—Mr. A. E. G. Braithwaite is retiring from the partnership for health reasons, and the business has been taken over by Messrs. J. H. Humphryes & A. Anderson, and will be continued by them as Braithwaite & Co. They will attend to all debts due to and liabilities of the late firm.

Collins & Price, electricians and electrical engineers, 35, Moorfields, Liverpool, and Hoylake.—Messrs. F. Collins & C. E. Price have dissolved partnership. Debts of the Liverpool branch will be attended to by Mr. Collins and those of Hoylake by Mr. Price.

Harman Electric Co., Ltd.—Creditors must send particulars of their debts, &c., to the liquidator, Mr. P. F. Huddleston, 72, Finsbury Pavement, E.C., by June 30th.

Pump and Power Co., Ltd.—A meeting is called for June 18th at 38, Victoria Street, S.W., to hear an account of the winding up from the liquidator, Mr. L. R. Sankey.

Trade Announcements. On the 21st inst., Messrs. W. T. Henley's Telegraph Works Co., Ltd., will remove their Birmingham branch offices and stock rooms to Broad Street Chambers. The new premises will afford facilities for carrying much larger stocks of electric wires and cables, flexible cords, jointing materials, boxes, tapes, &c., to meet war demands for urgent delivery. New telephone number: Midland 790. Telegraphic address unaltered : "Henletel," Birmingham.

The new English carbon black and paint works of Fuller's Carbon and Electrical Co., Ltd., are now in operation, and the company are in a position to supply orders for the electrical and engineering trades and War Office and Admiralty specifications.

Mr. J. M. Dering announces that he is continuing the business of his father, the late Mr. J. M. Dering, sen., electrical engineer, of Anglesia Place, Gravesend.

Book Notices.—"Elementary Principles of Wireless Telegraphy" (Part II). By R. D. Bangay. London : The Wireless Press, Ltd. Price 2s.

"Science Abstracts" (A and B). Vol. 20, Part IV. April 30th, 1917. London : E. & F. N. Spon, Ltd. Price 1s. 6d. each net.

Actions Physiologiques et Dangers des Courants Electriques. By J. Rodet. Paris : Gauthier-Villars. Price 3 fr. 25 c.—In this work the author discusses the various physiological effects produced by electric currents upon the human organism, the nature of accidents due to electric currents, and the conditions under which death may result. One chapter is devoted to experiments on horses, and another to accounts of a number of accidents to persons. In the remaining chapters the precautions which should be taken to prevent such accidents, and the methods of treatment recommended for sufferers from electric shocks and burns, are detailed. The book is practical, and deals ably with a subject which is of great and increasing importance.

LIGHTING AND POWER NOTES.

Blackpool.—Mr. Charles Furness, the borough electrical engineer, estimates a surplus of £2,000 this year on the electricity undertaking, largely due to the increased charges just sanctioned, as against a loss of £887 last year. Some economies are expected in the working expenses, and there will be about £2,000 capital expenditure at the works on contracts accepted last year in connection with the condensing equipment.

Bradford.—Street Lighting.—At last week's meeting of the City Council the discontinuance of public street lighting during May, June, and July was agreed to.

Continental.—France.—The Government has approved the scheme, as a project of public utility, for the establishment of a hydro-electric power station at Fontpedrouse (Pyrenees Orientales) to utilise the water power of the River Têt and its tributary Riberolle to provide the electrical energy for the operation of the railway between Perpignan and Villefranche.

It is reported that the Société Electrometallurgie de Dives has acquired a large area of land, and also the right to utilise certain waterfalls in the district of Limoges, with the object of establishing a large new hydro-electric generating station.

Epsom.—Provisional Order.—The B. of T. has granted a provisional order for electric supply in the parishes of Cuddington and Ewell, in the area of the Epsom R.D.C., to the South Metropolitan Electric Tramways and Lighting Co.

Harrogate.—Year's Working.—The total income of the electricity undertaking for the year 1916-17 was £19,546, an increase over the estimates of £435. The expenditure was £19,540, leaving a debit balance of £75, which was better than the estimate by £379. In the previous year the Committee had a surplus profit of £1,730, but the extra cost of coal has been £900, and the loan charges and income-tax have increased, while the income has been less.

India.—The Government of India has had under consideration the question of the obligation laid on licencees under Clauses 6 and 7 of the schedule to the Indian Electricity Act of 1910 to supply energy on receiving requisitions in due form, in view of the ban placed on the supply of plant, &c., for the extension of industrial undertakings otherwise than for war purposes, as it is realised that it may be impossible during the war to fulfil this obligation where the existing plant is fully loaded, but in view of the protective phrases (occurrences beyond his control, Schedule, Clause 6 (1), and without reasonable excuse, the burden of proving which shall lie on him (Sec. 42B), it is not considered necessary at present to make any emergency provision in the matter.—*Indian Engineering.*

Leigh (Lancs.).—Price Increase.—Owing to the increased cost of materials, the Electricity Committee has decided to increase the price of electricity for lighting purposes by 15 per cent., as from July 1st.

London.—Southwark.—At a meeting of the B.C, Councillor Hewitt drew attention to a proposal contained in the accounts to pay £8,000 out of the general fund to meet the deficiency in the accounts of the electric light undertaking. The annual accounts had not yet been presented, and therefore he maintained that the proposal was most irregular. He moved that the item be referred back to the Finance Committee for reconsideration. It was pointed out that the bank had asked the Council to reduce the overdraft on the electricity account of £13,000, and the borough treasurer suggested £8,000 as the amount which would have to come from the general funds of the Council to make up the possible loss on the electric light account. The proposal to refer the matter back to the Committee was carried.

Poplar.—The Electricity Committee reports that it has further considered the report of the engineer on the provision of generating plant to meet next winter's demand. The Government adviser has had the position before him in relation to Poplar and adjoining boroughs, and is prepared to sanction the erection of a new 5,000-KW. generating set at Poplar provided an additional cable is laid to Stepney. The Committee recommends the provision of an additional 5,000-KW. generating set and the laying of an additional E.H.T. cable from the generating station to Stepney boundary, at a cost of £30,500.

Morocco.—Proposed Exploitation of Water Power.—According to the local Press, a consortium, comprising the French companies and firms of Schneider (Creusot), Pavillier, Giros and Loucheur, Compagnie Marocaine, Compagnie Générale, and the P.L.M. and Orléans Railway Companies, has been formed to exploit the water power of Morocco. The consortium, it is stated, proposes, in the first place, to utilise the falls of the Oum-er-Rebia River, and probably later the river heads in the Atlas Mountains.—*Board of Trade Journal.*

Newcastle (Co. Down).—Street Lighting.—At a meeting of the Urban Council, a letter was read from the Irish Towns Electric Light and Power Co., offering to renew the contract for street lighting for three years for £240 per annum, an increase of £38—this increase to be a set-off against rates payable in respect of plant—the cost of private lighting, 6d. per unit, to remain unchanged. The Council was of opinion that, in view of the restrictions on lighting, the ratepayers were not getting adequate value for outlay, and decided to postpone consideration of the matter.

Richmond (Surrey).—The Richmond Electric Light and Power Co., Ltd., is applying for an Act covering a number of electric supply provisions, alteration in price for electricity, amendment of agreements, &c.

Rochdale.—Price Increase.—The T.C. has approved the Electricity Committee's recommendations that the prices for current should be increased as from the 16th inst. The recommendation to impose a further increase of 15 per cent. on the charge for current supplied to the tramway department was defeated by 20 votes to 14; members of the Tramways Committee said the proposed increased charge of £1,720 was nearly equal to last year's profit, whilst the tramway reserve was only £24,000, instead of the £70,000 which it ought to be. The chairman of the Electricity Committee said the total estimated increase in receipts from the new charges would be £10,126, including £2,000 as a result of the coal clause now in operation with several firms.

Sunderland.—The T.C. has received a communication from the I.M.E.A. calling attention to the need for more adequate representation on the Committee appointed by the B. of T. to consider the report on the further supply of electrical power, and asking the Council to pass a resolution urging the matter. Alderman Bruce moved accordingly, adding a proposal that the town clerk should bring the matter before the Corporate Municipal Association. This was agreed to. In reply to a question whether the Committee was getting higher prices for current than formerly, Alderman Bruce stated that the bulk of the supply was furnished under contracts entered into 10 or 15 years ago. The flat rate price of current for householders had been increased about a year ago.

Wolverhampton.—Loan Sanction.—The L.G.B. has sanctioned the borrowing of £2,410 to lay electricity mains to local works.

At the monthly meeting of the T.C., a resolution urging that municipal electrical authorities should have more adequate representation on the B. of T. Committee on Electricity Supply, was adopted.

Worksop.—Price Increase.—The U.D.C. has decided to advance the charges for current by ½d. per unit.

TRAMWAY and RAILWAY NOTES.

Bingley.—In reference to the recent consultations between the Bingley and Keighley authorities with a view to the possible extension of the tramway service, so as to link up completely Bradford, Bingley and Keighley, the Bradford Tramways Committee has now intimated that it is prepared to consider laying a line from Cross Flatts to Keighley, provided the widening and improvement of Stock Bridge is first satisfactorily settled amongst the authorities concerned.

Blackpool.—Revenue Estimates.—The receipts from the Corporation tramways are estimated this year at £80,000, as against £94,000 last year, with a surplus of £5,000, as against £19,300 last year. Income-tax in 1913 was £876, but it is estimated at £6,000 during the present year. War allowances and interest and sinking fund charges make the war responsible for over £19,000 extra expenses.

Darwen.—The Tramways Committee has sustained a loss of £2,720 on the year's working.

Keighley.—War Bonus.—The conductresses on the Corporation tramways have sent in an application for a war bonus, but the Committee, considering the matter last week, felt that the women were receiving wages equal to those paid to women workers generally in the town, and that many of them, in addition, were receiving allowances as soldiers' wives. The women conductors have been in service a little over a year, and their average wage is £1 7s. per week, apart from the ticket bonus system, which, according to the April returns, yielded them about 9s. each for the month. Some of the women are members of the Tramwaymen's Union, but the application has not come from the Union: the women number about 30.

The tramway service was suspended on Saturday morning, owing to a strike of the women conductors with a view to obtaining the full war bonus: the men also supported the women. The Tramways Committee points out that a loss of £168 resulted on the last year's working, and that the prospects are that a much greater deficiency will result from the present year's working.

London.—L.C.C.—The Highways Committee reports that, as a result of its negotiation in connection with the arbitration award for the purchase of the portion in London of the undertaking of the London United Tramways, terms have now been agreed which the Committee considers will provide for a satisfactory settlement, both as regards purchase and the working of the tramways. The lines affected are situated in the Metropolitan Borough of Hammersmith, are about 5½-route miles in length, worked on the overhead trolley system, and include the London termini at Hammersmith Broadway and at Shepherd's Bush Green of the system of the company, which extends to Hampton Court, Hounslow, and other points in the county of Middlesex. The arrangements now proposed include provision for running arrangements between the Council and the company. The amount to be paid by the Council for the lines about to be acquired is £235,000, and, in addition £12,000 towards the company's costs of the arbitration and subsequent proceedings. The Chiswick power station, including the whole of the plant, will be transferred to the Council. The Finance Committee, reporting on the matter, states that the total capital expenditure involved will be £320,899, including, in addition to the £247,000 paid to the company, £10,000 for counsel's costs, and £63,899 for reconstruction of part of the purchasable lines. In addition, further expenditure will be necessary for junction lines, &c., necessary to give effect to the proposed through-running arrangements. The Finance Committee understands that it is expected that this will be recouped by the increased traffic due to through-running arrangements, and that, on the basis of an annual mileage of 1,200,000, it is estimated that the balance of receipts over working expenses (including renewals, but excluding power, which will be supplied by the company free of cost) will amount to £22,917 a year. The total debt charges in the first year will be about £26,870, decreasing annually by £545. The Council is to complete the purchase not earlier than the declaration of peace, and not later than 12 months afterwards. The Council approved the capital estimate at its meeting this week.

Newcastle.—War Bonus.—The Tramways Committee has reconsidered the increased war bonus given to motormen a fortnight ago, and, after hearing a deputation of the men, increased the bonus from 4s. to 5s. weekly.

Wolverhampton.—Amended terms for the tramway service intercommunication between Bilston and Wolverhampton and Willenhall and Wolverhampton have been agreed to.

Accident.—Two cars, proceeding in the same direction, collided at Dudley, on Thursday, last week; one passenger was slightly injured.

TELEGRAPH and TELEPHONE NOTES.

Australia.—In the matter of an industrial dispute between the Marine Radio-Telegraphists' Institute of Australasia and the Amalgamated Wireless Association and others, the parties have arrived at an agreement, which provides for the payment of wages to wireless operators, who are required to hold first-class certificates of efficiency, if they are members of the union, at rates per month as follows:—First year, £9 a month; second year, £10; third year, £11; fourth year, £13; fifth year, £14; sixth year, £15; seventh year, £16; eighth and subsequent years, £16 a month; every operator, excepting when on leave, to have meals and proper living accommodation provided on respondents' vessels, or to be allowed, when temporarily ashore, 5s. a day at a home port or 7s. 6d. per day at any other port. When permanently on shore, an extra allowance to be given of £43 per annum. Thirty-eight days' leave of absence on full pay to be allowed annually. Ordinary duty to be eight hours in every 24.—*Sydney Morning Herald*.

Illicit Wireless.—The Portsmouth magistrates have committed for trial at the Hants Assizes R. G. Cole, electrical fitter, apprentice in the dockyard, on a charge of having apparatus for receiving messages by wireless telegraphy, as mentioned in our last issue. The defendant was released on bail of £10.

United States Censorship.—On May 1st an executive order signed by President Wilson was published, providing for the censorship of cable telegrams out of the United States and of telegraph and telephone messages into Mexico.

Wireless Litigation.—The United States Court of Appeal has given a unanimous decision in favour of the Marconi Co. with reference to the Fleming valve patent. The appeal was from a judgment given by the Court of First Instance in favour of the Marconi Co. in an action for infringement of this patent which it brought against the De Forest Telegraph & Telephone Co. The Fleming valve is the most sensitive detector of wireless waves so far discovered, and its value, especially in respect of long-distance wireless telegraphy and telephony, is difficult to over-estimate. The De Forest Co. included among its contentions a counterclaim for the alleged infringement of seven of its own patents. The Court of Appeal has, however, decided that there has been no infringement of six of these patents and that the seventh invalid.—*Financial Times*.

Wireless Spies in Norway.—It is reported that signallers at a fort near Bergen recently set up a wireless station, with the surprising result that the first message received consisted of the name of a ship and the time of her departure. The message had obviously been sent from a secret station by a spy. The ship mentioned was attacked a few hours after her departure, but escaped by a lucky accident.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY. August 22nd. N.S.W. Government Railways and Tramways. Thirty-six induction motors (Specification No. 488). September 19th.—One 225-H.P. synchronous motor (Specification No. 489). Particulars from Electrical Engineer's Office, 61, Hunter Street, Sydney.

MELBOURNE. July 25th. Victorian Railways. Step-down transformer and sub-station equipment for Sandringham-Black Rock electric tramway. Particulars from the Chief Storekeeper, Railway Offices, Spencer Street.

Manchester.—May 25th. Corporation Electricity Committee. Various stores for 12 months. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall.

Spain.—The municipal authorities of Finisterre (Province of Corunna) have lately invited tenders for the concession for the electric lighting of the town until the end of 1919.

Warrington.—May 22nd. Electricity and Tramways Committee. Underfeed mechanical stoker. See "Official Notices" May 4th.

Winchester.—Corporation. Coal for the electricity works. Electrical Engineer.

CLOSED.

Farnborough.—U.D.C. Pulsometer Engineering Co., at £112 10s.: motor and pump for the sewage works. The tender of the Aldershot Gas Co., at £74, for laying the cable and fixing the transformer, has been accepted.

Gillingham (Kent).—T.C. Transformer: British Electric Transformer Co., £137.

London.—L.C.C.—Highways Committee. Six auto-transformers in connection with the supply of additional power in the Woolwich district, £596: British Electric Transformer Co., Ltd. (the only tender received).

WAR PENSIONS BOARD. Electric bell and fire-alarm installation at Duke of York's Schools, Chelsea: Napier, Kimber, Ltd.

Malvern.—U.D.C. Meters for a year: Electrical Apparatus Co.

Southend.—T.C. Accepted tenders:—

Worthington Pump Co. Centrifugal pump for the supply of water to the electricity works, £53.
John Sadd & Sons.—Meter boards, £48.

Spain.—With reference to the projected underground electric railway system in Madrid, H.M. Consul there reports that the contract for the construction of the earth and masonry works of the line No. 1 of the Metropolitan Railway in Madrid has been awarded by the concessionaires of the railway to a Spanish firm.—*Board of Trade Journal.*

Sunderland.—Council. Tenders accepted:—

F. Smith & Co. Copper rod.
Stewart & Lloyds, Ltd. Steam and water pipe work, &c.
J. Blakeborough & Sons.—C.I. sluice valves.

Wolverhampton.—T.C. Staveley Iron & Coal Co., Ltd.: cast-iron condenser pipes, at £825.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, May 18th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Paper on "The Construction of Turbine Pumps," by Mr. A. E. L. Chorlton.

Royal Institution of Great Britain.—Friday, May 18th. At 5.30 p.m. At Albemarle Street, W. Lecture on "The Complexity of the Chemical Elements," by Prof. F. Soddy, F.R.S.

Saturdays, May 19th and 26th. At 3 p.m. At Albemarle Street, Piccadilly, W. Lectures (III and IV) on "The Electrical Properties of Gases," by Prof. Sir J. J. Thomson, Pres. R.S.

Junior Institution of Engineers.—Friday, May 18th. At 7.30 p.m. At 39, Victoria Street, S.W. Paper on "Metric Weights and Measures and Decimal Coinage," by Mr. E. C. Barton.

Institution of Mining and Metallurgy.—Thursday, May 24th. At 5.30 p.m. At the rooms of the Geological Society, Burlington House, Piccadilly, W. Paper on "Shall Great Britain and America adopt the Metric System?" by Mr. W. R. Ingalls. Members of the Institution of Electrical Engineers and other engineering societies are invited to attend and take part in the discussion.

NOTES.

Foundations at Dalmarnock Power Station.—In a paper read before the Scottish branch of the National Association of Colliery Managers, Mr. Sneddon described the method of piling adopted at the new Dalmarnock power station. Difficulty was experienced through river water boiling up during excavating operations: Simplex steel sheet piling was employed in place of timber, the method of jointing and interlocking assuring an efficient and water-tight construction. These piles are driven by a steam hammer, which rests on the top of the piles and drops with them; by a slight rearrangement of the apparatus and the use of a grip the piles can also be withdrawn by the hammer. In constructing the inlet culvert, which is 11 ft. wide and 34 ft. deep, considerable difficulty was experienced owing to a lake of mud being found immediately below the desired depth. Piles which pierced the crust of the mud began to move downward of their own accord. The depth of this lake proved by means of piles was some 60 ft.; some 2½-ft. diameter oak trees recovered from this part were quite fresh, and were considered to be over 1,000 years old.

The Tramways and Light Railways Association.—The annual Congress of this Association will be held at the Institution of Civil Engineers in London on Friday, June 29th, at 2.30 p.m. After the annual meeting, Mr. A. Norton will read a paper on "The Manufacture, Life, and Maintenance of Tramcar Tires," illustrated by diagrams and lantern slides. Among the subjects to be discussed will be:—"Standardisation of Conditions of Labour and Rates of Pay," by Mr. E. H. Edwardes (S. Lancs. Tramways Co.), and "Fares," by Mr. A. V. Mason (S. Metropolitan Tramways Co.). Some of the members will dine together informally and simply in the evening.

The Decimal Association.—The report of the Executive Committee for the year 1916 has been issued. It states that in no previous year since the formation of the Association has there been such a magnificent response to the efforts of the Committee, resulting in a largely-increased membership, while resolutions in favour of the decimalisation of our coinage and weights and measures have been passed by numerous important public bodies. A long list of the latter is given, from which we select the following examples:—

The Executive Council of the County Councils Association and 367 County and Town Councils; Associated Chambers of Commerce, and Chambers generally; Association of Trade Protection Societies; British Imperial Council of Commerce; Council of Manchester Association of Importers and Exporters; Court of Common Council of the City of London; East India Association; Incorporated Associations of Head Masters and Assistant Masters; National Chamber of Trade; National Farmers' Union; National Federation of Building Trade Employers of Great Britain and Ireland; Silk Association of Great Britain and Ireland; Committee on Decimalisation of the British Science Guild.

The Association of Chambers of Commerce of the United Kingdom, at its annual meeting, requested the Executive Council to arrange for the introduction of Bills to decimalise the currency and to substitute the metric system for the existing system of weights and measures, and to urge the Government to make representations to the Governments of the Dominions with the same end in view.

One of the recommendations submitted by the President of the Institution of Electrical Engineers to the Board of Trade Committee on the Electrical Trades, was "that the use of the metric system be made compulsory after a reasonable period, and during this period all trade catalogues make use of both the British and the metric systems."

At the annual general meeting of the London City and Midland Bank, the chairman, Sir Edward Holden, spoke very strongly in favour of the decimalisation of coinage and weights and measures, and supported the system of coinage advocated by the Association. At the annual meeting of the Institute of Chartered Accountants, the President, Sir H. Woodburn Kirby, in outlining what was essential in equipping ourselves to win back our foreign trade from the Germans, emphasised the importance of establishing the metric system of weights and measures and a decimal system of coinage. Of the replies received in answer to a questionnaire, kindly sent out by Messrs. Geo. S. Smith Dalby Welch, at their own expense, to 25,000 of the largest firms in the United Kingdom, asking if they were in favour of the decimalisation of the coinage and the adoption of metric weights and measures, 99 per cent. were in favour. Of the replies received in answer to a similar questionnaire sent out by the British Engineers' Association, 90 per cent. were in favour of the early adoption of a decimal system of coinage, and 85 per cent. in favour of the compulsory use, after a short transition period, of the metric system of weights and measures.

Manchester, which was formerly a stern opponent of the projected reforms, is rapidly becoming a decimal stronghold, and possesses a Decimal Association of its own.

Various methods of decimalising the coinage were put forward for consideration, and were also very fully discussed in the Press. Whilst admitting that there was something to say in favour of each, particularly the dollar and cent of the United States and Canada as being the coinage of the largest section of the English-speaking people, and most readily adaptable owing to the cent being equal to our halfpenny, the Committee came to the conclusion that the most practical scheme for British use would be one that would permit of our maintaining our sovereign subdivided into 1,000 mils, or the sovereign as 10 florins, with the florin subdivided into 100 cents. Of these, the latter was preferred, as it possessed the advantages of the former whilst being simpler for accounting and general use.

Owing to the almost universal use of the metric system, no alternative system of decimalisation could be put forward with any chance of support; there were some associated rather more with the works side than the sale side of business who, whilst admitting the advantage of decimal calculation, felt that the decimalisation of the foot or yard, or some other British measure, would meet the desired change, but the Committee thinks that even these are now convinced that there is no alternative to our mystifying methods of to-day but the metric system.

The recommendations of the Dominions Royal Commission on the desirability of introducing metrical weights and measures, and a new style of coinage based on the decimal system, state that there is clearly in the Dominions a considerable body of opinion in favour of this change. The members of the Commission are of opinion that the termination of the war will bring with it an unequalled opportunity for securing this much-needed reform, and recommend that the Government, and the Governments of the Oversea Dominions, should then co-operate to establish throughout the Empire a uniform coinage based on the decimal system, and uniform weights and measures based on the metric system.

Our Consuls have continually drawn attention to the necessity of adopting the metric system of weights and measures and cataloguing and invoicing in the language of the country in which trade is sought, and have emphasised time after time how contracts and orders have been lost through neglect of these essentials. Our allies in this world war are also most anxious that we should adopt the metric system of weights and measures, with a view to increasing our trade with them after the war.

The Committee strongly commends to the notice of educational authorities and public bodies the formation of a Central Institute of Commerce in London, with a Sub-Institute for each country or group of countries speaking the same language, in which young men could qualify as representatives to such countries, or for positions in firms trading with such countries at home, not only by learning the language, but also by obtaining a thorough knowledge of the traditions, customs, and manners of the country, in addition to up-to-date methods of introducing business. In such institutions should our aspirants for Foreign Office, Legation, and Consular appointments graduate, and from such institutions should our manufacturers and shippers be able to obtain not only their accomplished men, but all necessary information to assist them in successfully competing in the world's markets.

Pending the formation of such institutions and the adoption of the reforms of coinage and weights and measures, the Committee advocates the use of the metric weights and measures, and the language of the country in which business is being sought, in all catalogues, estimates, and contracts now being prepared.

Owing to the extent of propaganda work projected by the Committee in 1916, it was decided to delegate the arrangement of it to a Sub-Committee composed of the following members:—Sir Richard Bubridge, Bart. (chairman), Mr. G. F. Garnsey, Dr. W. W. Hardwicke, Mr. A. J. Naughton, Mr. Theodore McKenna.

The large number of lectures given in various parts of the kingdom during the year were most successful, generally resulting in a vote in favour of the projected reforms. Most of these lectures devolved upon Mr. E. C. Barton, who, being an Australian, was in a position to speak as to the disposition of some of the Dominions whilst advocating the adoption of the reforms by the Mother Country. He has recently been elected a member of the Executive Committee.

The accounts show income £606, expenditure £518, surplus £88.

A meeting will be held at the Mansion House, under the presidency of the Lord Mayor of London, about the middle of June, to further the movement towards the adoption of decimal coinage and metric weights and measures. Full particulars may be obtained from the secretary of the Decimal Association, Finsbury Court, E.C. 2, by whom the meeting is being organised: application for free tickets of admission should be made as early as possible.

Volunteer Notes.—County of London Engineer Volunteers (Field Companies).

Orders for the Week. By Lieut.-Colonel C. B. Clay, V.D., Commanding:—

Monday, May 21st.—Technical for No. 3 Company, Right Half Company, at Regency Street. Drill No. 3 Company, Left Half Company. Signalling Class.

Tuesday, May 22nd. Lecture, 6.30, Company Commander Castell, "Knots and Lashings and Trestle Bridging." Physical drill and bayonet fighting, 7.30 to 8.30.

Wednesday, May 23rd.—Drill, No. 1 Company, Left Half Company, 6.15.

Thursday, May 24th.—Drill, No. 2 Company, Left Half Company. Ambulance Class by M.O., 6.30. Signalling Class.

Friday, May 25th.—Technical for No. 2 Company, Left Half Company, at Regency Street. Drill, No. 3 Company, Right Half Company. Recruits' Drill, at 6.30 to 7.30.

Saturday, May 26th, and *Sunday, May 27th.*—See Special Orders.

(By order), Macleod Yearsley, *Company Commander and Adjutant.*

Foreign Trade.—The April Figures.—The official returns of imports and exports during last month contain the following electrical and machinery figures:—

	April. 1917.	*Inc. or dec.*	*4 months*, 1917. *Inc. or dec.*
Imports.			
Electrical goods, &c. ...	106,177	− 42,398	+ 45,583
Machinery	597,541	− 40,376	− 144,251
Exports.			
Electrical goods ...	220,705	− 52,669	− 13,518
Machinery	1,281,765	− 2,583	+ 1,233,861

The Board of Trade Committee on Electricity Supply and the I.M.E.A. The Council of the I.M.E.A., on May 4th, resolved that the President of the Board of Trade should be urged to give more adequate representation to local authorities upon the Committee appointed by him to consider and report on the supply of electrical power in the United Kingdom, and circularised the members, requesting that each local authority should adopt resolutions on the lines of those passed by the City of Bradford on May 3rd, and transmit the same to the President of the Board of Trade and to their local members of Parliament at the earliest possible date.

The Bradford resolution was almost identical in terms with that passed by the West Ham Electricity Committee, and reported in our issue of May 4th: it sets forth that the Council is of opinion having regard to the important part at present played by local authorities in the supply of electrical energy and the extensive character of the capital commitments in relation thereto, that local authorities owning electrical undertakings are inadequately represented on the Committee appointed by the President of the Board of Trade to consider and report on the future supply of electric power for all classes of consumers in the United Kingdom, and strongly urges upon the President of the Board of Trade the necessity of increased representation being given to them, in the interests of both the ratepayers and the consumers of electrical energy.

In a letter to Sir Albert Stanley, dated May 7th, the hon. secretary of the I.M.E.A., Mr. H. Faraday Proctor, emphasised the inadequate representation of the local authorities, and stated that the interests which the local authorities have at stake, and the services which they render in the supply of electricity, far outweigh those of all other undertakers, the energy supplied by them being more than double that supplied by companies.

L.C.C. Employes' Wages.—The Rolling-Stock Conciliation Board of the London Council's tramway department has granted an advance of 5s. a week, to be regarded as war wages, to the undermentioned employés at car-sheds: Bodymakers, brakesmen, brakesmen's mates, controller repairers, controller and motor cleaners, fitters, greasers, plough repairers, re-wheelers and truckmen: to employés at the central repairs depôt: Armature winders, bodymakers, coach painters, colourmen, brush hands, controller repairers, magnet and coil winders, crane drivers, engineering labourers, lorry drivers, plough repairers, writers, tire-setters, wheelwrights and wiremen. Armature winders: The advances to commence as from and including April 1st, 1917.

The Highways Committee reports that requests have been received from wiremen and wiremen's mates in the electrical section of the tramway department for an increase of 2¾d. and 2d. an hour repectively in their rates of pay: also from persons employed in the traffic section of the tramway department, for an increase in wages of 1s. 8d. a day, or 10s. a week, and payment at the rate of time and a half for overtime. The Committee recommends that both applications be referred to the Conciliation Boards.

Fixation of Atmospheric Nitrogen. — The *Scientific American* gives an account of an address delivered by Prof. J. E. Bucher, of Brown University, U.S.A., at the recent annual Conference of Chemical Engineers in New York, in which he announced the fixation of nitrogen from the air by a purely chemical process involving no electric power consumption.

A mixture of soda ash, powdered iron or iron ore, and powdered coke is subjected to ordinary furnace heat, and air is passed over the heated mixture. This results in the production of sodium cyanide, the iron remaining unchanged after acting as a catalytic agent. The cyanide produced is treated in one of three ways: (1) Treated with steam to produce sodium carbonate and ammonia, the latter of which serves as the basis of the nitrogen products used in the manufacture of fertilisers, explosives, dyestuffs, &c.: (2) treated with the carbon dioxide from the furnace to produce urea, a substance three times as rich in nitrogen as nitrate of soda, and twice as rich as ammonium sulphate, and which is, consequently, a highly concentrated fertiliser having the added agricultural advantage of non-acidity; or (3) decomposed electrolytically to produce metallic sodium and cyanogen. The former of these products has great commercial value, while the latter, by absorption by hydrochloric acid, yields oxamide, which is an invaluable fertiliser containing 30 per cent. nitrogen, but hitherto unavailable on account of its high price.

The production of artificial nitrates by the fixing of atmospheric nitrogen has for 20 years been hindered as a commercial process by the necessity for cheap and unlimited electric power, and the industry has been, consequently, confined to Norway, the United States of America, and other countries possessing abundant water power. The present urgent demands for these products, both for munitions of war and in agriculture, make Prof. Bucher's announcement of great interest, and the successful commercialisation of the process, which is still in the laboratory stage and undergoing large-scale trials, would have far-reaching results.

The matter is of importance to the electrical industries in view of the threatened competition with the electrical processes at present employed.

Parliamentary. In the House of Commons, on Monday, the West Kent Electric Power Bill was read a third time. The Lancashire Power Construction Co.'s Bill and the Nottinghamshire and Derbyshire Tramways Bill were read a second time.

Export Standardisation Rules.—Mr. D. N. Dunlop, secretary of the B.E.A.M.A., writes as follows:—"The recent announcement in the technical Press to the effect that the Council of this Association have issued a set of British export standardisation rules for electrical machinery having unfortunately given rise to misapprehension, I am desired to state that these rules are in no way intended to replace the British standardisation rules for electrical machinery which are issued by the Engineering Standards Committee to cover British made plant for home and export trade, and in the drafting of which the Association is closely and cordially co-operating."

Canadian Water Powers Report.—We have received from the Canadian Department of the Interior. Water Power Branch. the annual report for the year ending March 31st, 1916. A summary of the year's work is as follows

1. The amendment to the Dominion Lands Act to prevent the disposition in any other way, except under the Water Power Regulations, of lands valuable for water-power purposes.

2. The re-purchase for $100,188·51 by the Government of the land dominating Silver Falls site on the Winnipeg River, thereby ensuring for all time to come the control by the Government of all the natural fall on the Winnipeg River between Lac du Bonnet and Lake Winnipeg, representing a total power capacity, under regulated flow, of 190,000 continuous 24-hour H.P.

3. The commencement of investigations of the water-power resources of the Province of Nova Scotia, under co-operative agreement with the Nova Scotia Water Power Commission.

4. The completion and installation of the water power exhibit in the Canadian Pavilion at the Panama Pacific International Exposition, and the participation by Canadian engineers, in co-operation with the engineers of this branch, in the proceedings of the water-power section of the International Engineering Congress, held at San Francisco during the Panama Pacific International Exposition.

5. Completion of the extensive power and storage investigations on the Winnipeg River.

6. Satisfactory progress of the presentation of the water-power case before the International Joint Commission in the Lake of the Woods Reference.

The report is of an interesting character, and replete with views, diagrams, maps, &c., and is fully in line with the Government policy of making Canadian water-power resources known throughout the world. In this connection it is interesting to note that one suggested method of attaining this end is the use of moving pictures, films for which it is considered would be welcomed by engineering professional societies and most of the American Universities—the States being the country most likely to assist in the financial and commercial development of such water resources.

One section of the report on the prospects of electrical fixation of nitrogen deals with a subject which is much in evidence at the present time, although the author apparently holds out no very favourable prospects for such development for Canadian use in the near future, due, so far as fertilisers are concerned, to the possibilities of continuous cereal growing on the prairies at the moment, and the negligible amount of such fertiliser which would be needed with this soil if judicious rotation of crops were adopted in the future.

In summarising the position as regards the supply of nitrogen, the author points out that before the war Chile produced 2¾ million tons of sodium nitrate a year, of which 2½ millions were exported, and appearances indicate that 50 years may pass before this source becomes short, and therefore the price of Chile saltpetre will for years regulate the market value of combined nitrogen.

As regards industrial sources, in 1913 the ammonium sulphate produced from coking plants was 1,365,700 long tons; the world production of cyanamide for the same year was 114,093 tons, and of Norway nitrate, 79,000 tons.

Combined nitrogen is important in more valuable forms as a constituent of coal-tar dyes and other coal-tar derivatives, explosives, collodion, celluloid, and other pyroxglins, prussiates, cyanides, nitrates, &c.

The electrochemical methods of obtaining atmospheric nitrogen consist principally of the Birkeland-Eyde, Schonherr, Pauling, and cyanamide (Caro-Franck) which have been described at various times in our pages. Data is given showing that 2,000 lb. of nitrogen produced by the cyanamide process, only require 2·44 H.P. years, as against 9·52 H.P.-years for a similar production by the arc process.

Of the artificial sources, coke ovens have been mentioned; there is also the Haber process (not electrical) of combining hydrogen and nitrogen in the presence of a catalytic agent to form ammonia, which is largely employed in Germany at the present time.

[The author makes no reference to the Ostwald process which is being exploited in this country by the Nitrogen Products and Carbide Co.—in which nitric acid is manufactured from ammonia, the latter being derived from calcium cyanamide; it is reported that plants are projected for 36,000 tons per annum in this country.]

The author concludes that arc processes are inefficient, and can only prove commercially successful when power can be cheaply obtained and the cost of marketing the product is low. The cyanamide process is successful, and is being developed in Canada by private interests: the Haber process is not electrical, and is possibly the most successful of all. [Again no reference is made to the Ostwald process.]

The author concludes that present action should be confined to securing an option on large blocks of power where required, and considering the question of establishing an experimental works.

Russian Electrification Project.—A semi-official journal, the *Torg. Prom. Gazeta*, says —Some large Moscow capitalists have for some time been turning their attention to the mining and metallurgical industries of the Donetz Basin, and now these gentlemen have taken up the provision of electrical energy for all the metallurgical industries of South Russia, for which purpose a share company, under the style of Ugletok (Coal Current), with a capital of 150,000,000 roubles, is being formed. The statutes of the Ugletok concern, according to an official Russian paper, have already been drawn up and submitted to the proper authorities for confirmation. The organising bureau of the Ugletok has been installed in Kharkoff, and leading engineers and leading authorities are taking part in its operations.

In the explanatory report accompanying the statutes it is shown that the war has brought Russia face to face with a series of problems of first-class Imperial importance. Amongst these problems the most pressing is certainly the supply of fuel and metal. At the close of the war the country's needs in these respects will increase rather than diminish. The Ugletok Co. undertakes the execution of all the work of electrifying the national industry in regard to the wide region commonly known as metallurgical South Russia, which includes the Donetz coal and anthracite industry, blast furnaces, and metallurgical factories, the Krivoirog and the Nikopol manganese and iron mines, the salt industry, and a great variety of manufactures; besides a rapidly developing and extensive agriculture and quickly growing towns, all of which are making a continuously growing demand for electrical energy.

A preliminary estimate of the total power of the electrical stations in the collieries of the Donetz Basin gives the figure of 75,000 KW. If we take as a basis the possible maximum consumption of electrical power in the coal and anthracite concerns of the Donetz Basin, the total quantity of power used there would be 173,000 KW., that is almost two-and-a-half times greater than at present.

Besides the coal mines, the metallurgical concerns of South Russia are large consumers of electrical energy, amounting to about 287,000,000 KW.-hours per annum, and using, in most cases, blast-furnace gas for its generation. If the metallurgical works were to approximate their consumption of electrical energy to the proportion that has been attained in some individual factories in South Russia, the total annual consumption of energy might rise to 420 million KW.-hours. The difference between this and the above-mentioned figure represents the excess which apparently cannot be provided by the existing electrical power-producing plants in the metallurgical districts of South Russia, and offers a ready market for the disposal of the energy to be produced by the generating stations of the Ugletok Co.

Further, one of the serious results of the present war is the need for the development of the agricultural industry; and in that respect, the cheap electrical energy of the Ugletok may prove of invaluable assistance. The application of electricity for ploughing, for local transport, for the carriage of agricultural products, &c., constitutes a problem the solution of which lies within the province of electrical stations. Finally, the central stations of the Ugletok will be able to supply town factories and populations with electrical energy very much more cheaply than at present.

The Ugletok proposes to assist the mine owners in the electrification of their equipment by offering credit, by installing machinery, and purchasing such abroad, and so on. Finally, to emphasise the importance of the matter to the coal and anthracite industry of the Donetz Basin, it may be pointed out that, with the existence of the central stations of the Ugletok, new concerns from the very beginning would have all the advantage of the application of cheap electric power for the production of fuel and its transport to the railway stations. They would be freed from the need of finding good water for steam raising; and, what is particularly essential, they would be in a favourable position regarding labour, as the electrification of the mines effects a great economy in the use of man power. The normal annual increase in the production of mineral fuel in the Donetz Basin, calculated moderately at 10 per cent., makes a quantity of 150,000,000 poods a year, which is sufficient to occupy one main line in normal times. In other words, in order that the lack of railways may not choke the normal development of the production in the Donetz Basin, it is necessary to construct a new railway every year. It is hardly practicable to calculate on such a rate of construction: and under such circumstances, the *rôle* of the Ugletok, which will reduce the unnecessary wear of rolling stock, gives it a character of Imperial as well as local importance.

Cheap electrical energy supplied by the Ugletok will save the town the trouble of finding coal for its own electrical stations, and make it possible even for poor people to use electric lighting; whilst electric tramways with cheap power will assist in solving the question of dwellings, which is now acute.

To accomplish all the purposes mentioned above, the Ugletok proposes, in the first place, to erect in the coal-producing districts of the Donetz Basin three large electric stations of 75,000 H.P. each. The current from these stations it is proposed to supply to the mines and factories in the basin itself, as well as to the towns and villages and industrial concerns in the governments adjoining the basin. But in the opinion of the founders of the Ugletok, the project can only be carried out if it is recognised as of Imperial importance; for the basic idea of "central" stations presupposes the laying of conductors over great distances, which means the expropriation of proprietorial rights, and the alienation and use of property belonging to others.

Central Station Employes.—With reference to our note of last week, Mr. H. H. Morton writes to say that it is impossible for him to reply to all requests for particulars of the National Engineering award, but anyone interested can obtain particulars at any meeting night of the 16 London Branches of the Electrical Trades Union, or direct from the General Secretary, 137, Great Clowes Street, Broughton, Manchester. The London Station Engineers' Branch (No. 1), meets every Monday at "The Old Queen's Head," London Road, Elephant, London, S.E.; Station Branch (No. 2) meets every Tuesday at "The Cross Keys" Hotel, Theobald's Road, Clerkenwell, and on Tuesday, May 22nd, a special meeting, to which all station engineers and switchboard attendants are specially invited, will be held at "The Cross Keys" Hotel.

Electrical Trades Union.—The following is a copy of the award of the Arbitrator in the matter of the National Federated Electrical Association and the Electrical Trades Union :—

"1. A difference arose between the National Federated Electrical Association (hereinafter referred to as 'the Association') and the Electrical Trades Union (hereinafter referred to as 'the Union') in connection with an application for an advance of wages made by the Union on behalf of electrical wiremen, electrical fitters, and their assistants employed by the firms in the Association. The difference not having been settled by the parties was duly reported to the Chief Industrial Commissioner's Department of the Ministry of Labour, who referred the matter for settlement by a single Arbitrator and appointed me, the undersigned, one of His Majesty's Counsel, to act as Arbitrator therein.

"2. I heard the representatives of the parties at No. 5, Old Palace Yard, Westminster, on March 12th, 1917.

"3. Since the outbreak of the war the electrical wiremen and electrical fitters in the London district have received two advances—namely, by an award of August 13th, 1915, an advance of ¾d. per hour, and by an award of July 15th, 1916, a further advance of ½d. per hour, with *pro rata* advances to their assistants.

"4. The normal week is one of 53 hours.

"5. Including the above-mentioned advances, the present rate for electrical wiremen and electrical fitters is 11¾d. per hour, and for assistants 8½d. per hour.

"6. The Union claimed a further advance of 2d. per hour.

"7. Having examined and considered the evidence, the contentions of the parties, and the various circumstances of the case, I determine and award :—

"That on and after the first full pay in April, 1917, the electrical wiremen and electrical fitters shall receive an advance of 1d. per hour, calculated as from and including the first day of April next, with a *pro rata* advance to their assistants, that such advances shall be regarded as war wages, and to be recognised as due to and dependent on the existence of the abnormal conditions now prevailing in consequence of the war, and that the said rates as increased by this award shall remain in force without alteration until August 1st, 1917, and thereafter subject to four weeks' notice by either the Association or the Union after the said August 1st.

"(Signed) William W. Mackenzie.

"Dated *March 17th*, 1917.

"9, King's Bench Walk, Temple."

In reply to an inquiry by the Electrical Trades Union as to the meaning of the term "boys and youths" in the finding of the Committee on Production of March 1st for the Engineering and Foundry Trades, Sir G. R. Askwith says that the Committee had in mind that the 5s. per week having been granted to meet the increased cost of living, should be given generally to all male persons of 18 years of age and upwards. The intention of the Committee was that apprentices should be included in the term "boys and youths," and the 2s. 6d. per week awarded to them should be paid to all boys and youths under 18 years of age, in addition to any increases or bonuses, whether these were granted prior or subsequent to January 1st, 1917.

Science and Industry.—It has already been announced that the estimates for the Board of Education contain a grant of £1,000,000 towards the establishment of a new and permanent Department of Scientific and Industrial Research. This money will be paid to the account of the Imperial Trust for the encouragement of such research, and the Committee of the Privy Council will be authorised to order grants for an agreed period to approved trade associations, by way of supplement to the funds of these associations. An item of £7,250 appears in the Civil Service Estimates for the creation of the staff of the department, £1,500 being for the salary of a secretary and an assistant secretary. Men of science desire an explanation of the meaning and use of the new venture, and to this end Sir Joseph Larmor, Unionist member for the University of Cambridge, has given notice of his intention to move the reduction of the vote by £4,000.—*Daily Telegraph.*

National Insurance (Unemployment) Acts, 1911 to 1916.—Contributions are payable in respect of :—

2,224 X. Workmen who are employed in an establishment carrying on any trade insured under the National Insurance (Part II) (Munition Workers) Act, 1916, and who are engaged in shunting railway vehicles which are used mainly on the premises of the establishment.

2,226 X. Workmen engaged in the manufacture, installation, and repair of instruments for sending or receiving sound under water.

2,237 X. Workmen engaged in the manufacture of electrical cooking and heating apparatus.

Contributions are not payable in respect of :—

2,248. Workmen (other than those engaged in sawmilling or machine woodwork) engaged in the work of handling, preparing, and creosoting telegraph poles and other timber.

Bill Relating to Company Directors.—In the House of Commons, on Tuesday, Sir Albert Stanley (President of the Board of Trade) presented a Bill to provide for the disclosure of certain particulars respecting the directors of companies, and it was read a first time.

British Empire Producers' Organisation.—At the luncheon meeting of this organisation, on May 24th, at the Savoy Hotel, Sir Edward Carson will be the guest, and Admiral Lord Beresford will preside.

Institution and Lecture Notes.—Illuminating Engineering Society.—The seventh annual report was presented at the annual meeting on the 15th inst. The Society, dealing with the scientific and the industrial aspects of a wide subject, unites on common ground electrical engineers gas engineers, manufacturers of lamps and shades, physicists, ophthalmic specialists, architects and surveyors. This branch of engineering has been recognised by the appointment under the Department of Scientific and Industrial Research, of a Joint Committee on Illuminating Engineering. The successful union of these various interests is largely due to the efforts of the hon. secretary, Mr. Leon Gaster, during the last 10 years. Mr. Gaster is a British subject of Roumanian origin, and is thus doubly associated with the cause of the Allies. All the male members of his family in Roumania and in England who are of military age are fighting in this cause, and one of his nephews was recently killed in Roumania.

The Aeronautical Institute of Great Britain.—A paper is to be read by Mr. E. A. Allcut, of Messrs. W. & T. Avery, Ltd., on "The Testing of Materials for Aeronautical Construction," before the Institute on May 24th, at 8 p.m., in the Central Hall (facing Westminster Hospital). Our readers are invited by the Institute to attend the meeting.

Institution of Electrical Engineers.—The Newcastle Local Section Committee has addressed the following letter to Mr. C. P. Sparks, President :—"The members of the Newcastle Local Section Committee beg to send greetings to you on the occasion of the annual general meeting of the Institution in London, and to convey their appreciation of the progressive measures which the Council have entertained during the period of your presidency. They realise that a very large amount of your valuable time must have been devoted to this work, and are confident that this will have a most important bearing upon the immediate and future development of the electrical profession. On behalf of this Local Section, they wish to thank you for the attention given to proxy voting, and other steps having for their object a closer touch between the Council and the provinces.

"In their desire to be of more assistance to the Council, they welcome your proposal to advise the Local Sections periodically by letter of any matters of moment which the Council consider opportune to confide in the Local Section Committee.

"The members of the Committee also beg to tender their loyal support to your successor in office, Mr. C. H. Wordingham, and respectfully to declare their whole-hearted approval of his nomination as president."

The result of the election of Council of the Institution, announced last night at the annual general meeting, was as follows :—President, Mr. C. H. Wordingham ; vice-presidents, Messrs G. W. Partridge and W. B. Woodhouse ; hon. treasurer, Mr. J. E. Kingsbury ; ordinary members of Council, Messrs. Ll. B. Atkinson, W. A. Chamen, J. S. Highfield, Sir W. Slingo, Lieut.-Colonel H. C. Sparks, and Mr. A. P. Trotter.

Institution of Mining and Metallurgy.—On Thursday next, May 24th, at 5.30 p.m., a paper by Mr. W. R. Ingalls, on the question "Shall Great Britain and America Adopt the Metric System?" will be read and discussed, at the rooms of the Geological Society, Burlington House, Piccadilly. The presence at the meeting, and participation in the discussion of the paper, of members of the Institution of Electrical Engineers and other engineering societies will be welcomed by the Council of the Institution of Mining and Metallurgy. Mr. Ingalls is the President of the Mining and Metallurgical Society of America, and of the American Institute of Weights and Measures, which was recently formed expressly to combat the rapidly-growing movement towards the adoption of the metric system in the United States ; the tenor and purpose of his paper may, therefore, be easily predicted.

Appointments Vacant.—Assistant for mains testing, &c., and electrician-in-charge, for the Borough of Hornsey Electricity Works. See our advertisement pages to-day.

Electric Chicken Brooding.—The *Journal of Electricity*, in the course of a short article on the above subject, states that the electric brooder is built in round, square, or oblong shape, in capacities from 50 to 1,200 chicks. The tops of the hovers are usually made of wood, insulated inside with asbestos, and supported on short legs. Strips of canvas or oilcloth reach to the floor and retain the heat, the strips being cut into small flaps to allow the chickens to pass in and out. The circular-top hover has a central heater in the top ; the other types have coiled elements arranged round the top. The air, when heated, banks against the insulated top, and settles down upon the backs of the chickens ; suitable air vents are also provided for ventilation, and a thermostat for automatically regulating the temperature is fitted a few inches below the top.

A well-constructed brooder is usually provided with about 100 watts capacity per 100 chicks, and the energy consumption averages about 20 KW.-hours per 100 chicks.

The electric brooder has almost all the advantages of the electric incubator, being a time and labour saver, and producing stronger chickens than those brooded by fuel heat.

Statistics show that an average of less than 50 per cent. of the chicks are raised to the roosts with many brooders now in use, while actual tests over 18 months with a large number of electric brooders show that the proportion with them has been raised to above 85 per cent.

The relative cost of producing heat per 100 chickens, with 600 B.TH.U. gas at $1 per 1,000 cb. ft., is $1·00 ; with distillate, at 8c. per gallon, $·45 ; with electricity, at 2c. per KW.-hour, $·40.

The improved results obtained with electricity would, in any case, warrant a higher heat cost.

Electric Invalid Chair Appeal Case.—Some months ago we drew attention to the proceedings before the Hampstead magistrates when Mr. Elieson was summoned, and a nominal fine imposed, for using an unregistered motor-car and for driving a motor-car without being licensed—the "motor-car" in question being the little electrically-driven bath chair for invalids, of which he is the inventor. Notice of appeal was given, and, according to the *Times*, the Lord Chief Justice, in the Divisional Court, on Tuesday last, dismissed the appeal, Justices Ridley and Avory agreeing.

From this it follows that users of these little vehicles, requiring about ¼ H.P. to drive them at a speed of from 2 to 3 miles per hour, will have to secure both a licence and registration, as, according to the Lord Chief Justice, it was impossible to say that this vehicle was not a vehicle impelled by mechanical power according to the definition of "light locomotive," and therefore it was within the statute!

Really one wonders how the glow worms have so long escaped the lighting restrictions.

Fatality.—A Dudley electrician named Joseph Beaumont was on Saturday showing two officials of his firm round a transformer house, and explaining the 5,500-volt switchgear, when he accidentally touched a live wire and was killed, death being instantaneous. The body was badly burned, and holes were burned in the sheet iron casing of the switchgear.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The salary of Mr. Neville Appelbee, borough electrical engineer at Ashton-under-Lyne, has been increased by £50 per annum, as from April 1st. Three years ago it was suggested that an increase of £100 be given, but owing to the war Mr. Appelbee agreed to the withdrawal of the application at that time.

The Southend-on-Sea T.C. has appointed Mr. J. T. Fayle, traffic superintendent of Leyton Corporation Tramways, to be traffic superintendent of the tramway system at Southend, at £3 10s. per week, rising by annual increments of 5s. to £4 per week. Mr. J. Daniels has been appointed driving instructor to the Southend tramways, at £3 3s. per week.

At Erith recently, Mr. H. A. Munday, chief clerk in the electricity and tramways department, was presented with a case of cutlery on the occasion of his marriage. Mr. J. C. Williams, engineer and tramway manager, made the presentation. Mr. F. J. Griffiths presided.

General.—Mr. Leo Sunderland, of Messrs. Leo Sunderland and Co., has just received the Freedom of the City of London as Liveryman of the Worshipful Company of Glaziers.

Captain T. Prestige has resigned his membership of the Electrical Conciliation Board of the L.C.C. Tramways. The Highways Committee recommends the appointment of Mr. W. H. P. Gibson to fill the vacancy.

Roll of Honour.—Private R. W. Sainsbury, a member of the staff of the Bristol Corporation electricity department, who has been serving in the R.A.M.C. in France for two years, has been awarded the Military Medal.

The death is announced of Mr. John Marshall McCulloch, of Litherland, Liverpool. He was employed as an electrician on board a hospital ship which was torpedoed.

Private F. C. Stanford, Northumberland Fusiliers, who was employed in the permanent way department of the Leeds City Tramways, has been killed in action, aged 26.

Private H. A. Leach, R.A.M.C., who has fallen in action, enlisted after many years' service on the Brighton Corporation Tramways.

Lance-Corporal L. P. Crouch, who has been severely wounded in action, was until his enlistment last year articled to Mr. Hesketh, at the works of the Folkestone Electricity Co.

Private C. Batchelor, who joined the Royal Warwickshire Regiment four months ago, whilst in the turbine department of the B.T.H. Co., at Rugby, has been killed in action.

The *Times* states that Captain Cyril W. K. Hook, Manchester Regiment, who was killed on April 23rd, aged 21, was the second son of Mr. J. J. Hook, engineer of the Tata Hydro-Electric Co. When war broke out he was with Messrs. Mather & Platt, in Manchester.

Private Frank Scotton, Oxford and Bucks Light Infantry, who was on the Rugby staff of the B.T.H. Co., has fallen in action.

Private H. Jones, Oxford and Bucks Light Infantry, who was in the machine shops at Rugby of the B.T.H. Co., has been killed in action.

Rifleman M. Burton, K.R.R., who has fallen in action, was engaged at the B.T.H. works at Rugby.

Private Frank Poole, Royal Warwickshire Regiment, engaged at Rugby with the B.T.H. Co., has fallen in action.

P.O. J. Armstrong, R.N.D., who has fallen in action, joined the service whilst an apprentice in the electrical department of the Carlisle Tramway Co.

Private G. W. Carron, Machine Gun Corps, who was an electrical engineer with Messrs. Longdon & Co., Ltd., of Derby, has fallen in action, aged 27 years.

Bomb. F. A. Alcock, R.F.A., who was in the Corporation electricity department at Sheffield, has been killed in action, aged 24 years.

Private G. T. Clark, who was with Messrs. E. J. Philpot, electrical engineers, of St. George's Street, Canterbury, has fallen in action.

The death in action, in France, is reported of Sapper R. Vine, R.E., who was on the staff of Messrs. Dick, Kerr and Co., Ltd.

CITY NOTES.

British Westinghouse Electric and Manufacturing Co., Ltd.

Following upon the speech of the chairman (Mr. J. Annan Bryce, M.P.) at the recent annual meeting (Elec. Rev., May 4th, p. 495), it is now announced that extraordinary meetings of the company are to be held next week (21st inst.) to consider resolutions increasing the capital from £1,150,000 to £1,395,000. It is proposed to create 110,000 pref. shares of £2 each, and 500,000 deferred of 1s. each. The position is explained in the following interesting extracts from a circular issued to the shareholders, and published in the *Financial Times*:—

"You are doubtless aware that the Westinghouse Electric and Manufacturing Co., of Pittsburg, U.S.A., and its connections, control a majority of the preference and ordinary shares of our company.

"In view of the sentiment produced in this country by the war, and of the possible changes which may result in international economic relations, your directors have for some time been desirous that the control of the company should be transferred to Great Britain, and with this object your managing director went last autumn to America. Our American friends fully appreciated the reasons for the proposed change, but, as you may imagine, the difficulties were great, and it was only after lengthy negotiations that a basis of settlement was reached. This took the form of an agreement of option exercisable on or before June 1st, 1917, to purchase the whole of their preference and ordinary shares, together with their debenture stock, of which also they hold a majority.

"The agreement provides that a holding company shall be formed in Great Britain to buy the shares and debenture stock belonging to our American friends, and that this holding company shall issue to the American sellers in payment approximately £1,250,000 five per cent. first lien bonds, redeemable in 10 years, creating a first charge upon all the property, present or future, of the holding company.

"The holding company will have a capital of £500,000, divided into 300,000 six per cent. preference shares of £1 each, and 200,000 ordinary shares of £1 each. It is at present proposed to issue only 200,000 preference shares and 100,000 ordinary shares. One-half of the ordinary shares issued are to be allotted to the American vendors in part payment of the purchase consideration.

"Your directors consider this stipulation reasonable. The American company's holding in shares cost them nearly 20 years ago about £1,175,000, on which they had no return till the last four years, while their debenture stock cost them about £645,000. For their net cash investment of £1,820,000 they are to receive slightly less than £1,250,000 in 10-year bonds and half the profit beyond 6 per cent. of the holding company. The transaction is not of their proposing—they had no desire to part with their holding, and it is fair that they should retain some interest in an investment which, after having for so long given no adequate return, is just beginning to be profitable. Moreover, your directors are of opinion that it is for the advantage of your company that our American friends should retain such an interest in its profits as will make it worth their while to continue in the future to assist in its development, as they have done in the past. Our relations, extending now over nearly 20 years, have always been most harmonious and for our mutual benefit. They have taken a broad-minded view of these relations, as is shown by their willingness to fall in with the present proposals, and have always been ready to advise us and give us the benefit of their immense technical experience, without using their control to interfere in our management or limit our activity. Your directors are therefore anxious to have the benefit of their continued co-operation.

"It is provided that the holding company shall, in order to give additional security for the first lien bonds, acquire not less than 110,000 preference shares of £2 each in the British Westinghouse Co., and it is for the purpose of sanctioning the creation of these shares that you are now called together.

"Since the option agreement was made in December of last year there have been continuous negotiations with a view to putting your directors in a position to exercise the option, but you will easily understand that under the conditions produced by the war it has been difficult to bring them to fruition. Under British law it is not possible for a company to buy its own shares, and while it would, of course, be possible for individual shareholders to combine to do so, such a combination was not possible under present circumstances.

"Under these conditions the only method was to find a financial group which would furnish the large sum necessary to carry through the provisions of the option agreement. Your directors are glad to inform you that a powerful group has now expressed its willingness not only to find the necessary funds for the holding company, thus enabling it to subscribe for the 110,000 new preference shares of your company, but also to give an undertaking to subscribe, as and when required, £500,000 in second debentures of your company on condition of an immediate issue to the holding company at par of 500,000 deferred shares of 1s. each, entitled to a dividend at the rate of 7½ per cent. after payment of dividends at the rate of 15 and 30 per cent. respectively on the preference and ordinary shares respectively, and carrying one vote for each share.

"As the proposals to be submitted to you possess the twofold advantage of the transference of control to this country and of the provision of a substantial and much-needed addition of about £750,000 to your capital, your directors strongly recommend their acceptance."

Calcutta Electric Supply Corpn., Ltd. During 1916 there were 23,575,211 units sold, as against 21,081,928 in 1915; number of houses connected increased by 693 to 9,461. The gross revenue increased from £224,206 to £237,353, and the net revenue from £162,922 to £167,370, exchange being calculated at 1s. 4d. per rupee. Including the amount brought forward and interest received on money at deposit, the profit is £199,847. After paying the preference dividend, putting £40,254 to depreciation and renewals, £2,500 to reserve, and paying 9½ per cent. on the ordinary shares, £2,500 is allocated to directors' extra remuneration, and £65,150 is carried forward subject to demands in respect of excess profits duty. The reserve for depreciation and renewals is increased to £215,835, and the reserve stands at £131,528. The expenditure on capital account during the year was £91,058, making the total £1,406,938. The demand for energy continues to increase steadily. Under the terms of its licence the company is bound to meet any demands for supply of current that may be made, but, on account of the difficulty in procuring additional plant, it has been found necessary to publish a notice that the company regrets its inability to accept applications in excess of the capacity of the available plant. Units generated 30,493,938, sold 23,575,211, used on works 5,909,355, not accounted for 1,009,372. Maximum supply demanded 8,750 KW. The public lamps number 196, and the public lighting units 687,253.

Kalgoorlie Electric Power and Lighting Corpn., Ltd. In their report for 1916 the directors state that operations in Kalgoorlie have been continuously maintained, and all important customers are still taking current, though, in some cases, in less quantity than formerly. The continuation of the war has accentuated the shortage of labour, and from this shortage the most important of their difficulties, and largely those of the whole of the goldfield, have arisen; it has also caused a further increase in the cost of supplies and in taxation. The result of these unfavourable factors is shown in the decrease of gross profit for the year of £4,167, and (due to heavier taxation) in the net profit of £4,926. Notwithstanding the reduced profit, the dividend of 4 per cent. has been paid on the preference shares. £7,000 has been added to the debenture redemption fund, and £2,000 depreciation has been written off the value of the property. £1,007 is to be carried forward. The payment of the debenture issue falls due on December 31st next. Arrangements have been made to repay £31,200 of the amount upon the due date, and the balance by annual payments of £7,500. These deferred payments carry an additional 1 per cent. interest. The property has been maintained in good condition, and notwithstanding some difficulty in getting renewals and supplies, the machinery is in thorough working order. Annual meeting: May 24th.

Shanghai Electric Construction Co., Ltd. The accounts for 1916 show a profit of £48,123 (plus £1,387 brought forward), against £31,084 for 1915. There has been put to reserve for renewals £10,000, and to reduction of preliminary expenses account £5,000. Dividends on the ordinary shares amount to 10 per cent. for the year, less income-tax, and £2,510 is to be carried forward. The loss by exchange on subsidiary coinage was £38,751 (12.11 per cent. on the capital). Transactions in Shanghai have been converted into sterling at an average rate of 2s. to the Mexican dollar, as against 1s. 9d. for the preceding year. During the year the general tendency of sterling exchange was favourable, owing to the rise in the price of silver. The percentage of loss by depreciation of subsidiary coinage has been sensibly lower during the past six months than the average rate experienced in 1916. The traffic and net receipts for the first four months of 1917 show improvement. 15 trailers have been added, making 70. Including seven railless cars, there are 167 passenger vehicles. Railless cars continue to operate successfully on one mile of route. A considerable expansion of business would result from an extension of this form of traction, and powers are being sought from the Municipal Council, which may be exercised when financial and construction cost conditions are more favourable. A site has been purchased on Soochow Road (cost Tls. 53,000) for the erection of new offices.

Buenos Aires Lacroze Tramways Co., Ltd. The report for 1915-16 gives the following results:—Gross receipts, $5,883,262; decrease $217,389 m/n. The working expenses amount to $3,895,787, an increase of $135,005. The causes which have had a decided influence in these results are the large number of persons who have left the country owing to the European war, and the stoppage of works in general, which has resulted in thousands of workmen being unemployed. These have caused a decrease in the number of passengers, notwithstanding the liberality of services afforded. The figures cited leave a working balance of $1,987,475, from which must be deducted the amount of debenture interest and amortisation of municipal concessions, paving accounts, &c., leaving $644,519, plus $83,638 brought forward. Five per cent. of the total goes to the reserve fund, $32,225; 5 per cent. to the directors, $32,225; ½ per cent. to the syndic., $3,222; to the shareholders, $625,000; and there is to be carried forward $35,683.

Peel-Conner Telephone Works, Ltd.—The net profit for the year ended March, 1917, was £16,238, of which £2,000 has been put to reserve for depreciation. After adding £3,959 brought forward, paying the preference dividend £5,000, and a dividend of 2s. per share on the ordinary shares, £5,188 remains to be carried forward. The result for the year does not compare favourably with previous years, owing to the works having been mainly engaged on special work of a varied nature, with the result that a number of departments have at times not been fully employed. This conditions of affairs is likely to continue until the company can resume the manufacture of its normal productions. Annual meeting: May 21st.

South Wales Electrical Power Distribution Co.—The report for 1916 states that business showed an increase, the units sold amounting to 30,058,461, an increase of 1,090,805 units. After payment of all working expenses and interest on prior lien debenture stock, and making provision for depreciation of new plant, there was a surplus of £8,554, as compored with £6,756. This surplus, together with £3,999 in hand, enabled payment to be made of the full year's interest, £10,000, on the old debenture stock, and leaving £2,553 to be carried forward.—*Financial Times.*

Kidderminster and District Electric Lighting & Traction Co., Ltd.—The net receipts of the lighting undertaking for 1916 were £2,900, plus £2,782 dividends received in respect of investments, and £1,457 brought forward, making £7,141. After deducting administration and general expenses, interest on temporary loans and debenture stock, and providing £500 for renewals, there remains £2,499. There is to be put to reserve £500, the preference dividend absorbs £1,500, and £499 is to be carried forward.

Anglo-American Telegraph Co., Ltd.—For the year ended March, 1917, the dividend payments absorbed altogether £262,500, being the rent paid by the Western Union Telegraph Co. for the year, equal to 3¾ per cent. on the ordinary stock, 6 per cent. on the preferred stock, and 1½ per cent. on the deferred stock. The balance at credit of revenue account (£69,456) includes £3,831 interest received, and £65,625 is available for the dividends for the quarter to March, 1917. Meeting: May 25th.

Merthyr Electric Traction & Lighting Co., Ltd.—The report for 1916 states that the revenue from all sources amounted to £27,179, as compared with £26,235. After deducting all expenses chargeable to revenue (including £3,456 for debenture and other interest), and providing £2,000 for renewals, the available balance, including £907 brought forward, is £5,408. A dividend of 6 per cent. per annum is to be paid on the ordinary shares, carrying forward £507.

Italy.—According to recent statistics, the capital invested in new industrial companies and additions to capital of existing companies in 1916 amounted to 438,100,000 lire. Of the companies in question, electrical concerns stood for 60,600,000 lire, chemical and electrochemical undertakings for 37,500,000 lire, and metallurgy (in which, presumably, electrometallurgy is included) for 132,600,000 lire.

Lewes & District Electric Supply Co., Ltd.—Total revenue for 1916, £3,338; expenses, £2,078. Interest produced £40, and there was brought forward £303. Debenture interest absorbs £440, there is to be put to renewals fund £600, and to be carried forward £595.

Calcutta Electric Supply Corporation, Ltd.—Final dividend on the ordinary shares at the rate of 12 per cent. per annum, for the six months ended December 31st, 1916, making, with the interim dividend paid in November, 1916, 9½ per cent. for the year.

Kidderminster & Stourport Electric Tramway Co., Ltd.—The profit for 1916, after providing for renewals, is £2,658, plus £99 brought forward £500 is put to reserve, 3½ per cent dividend requires £2,002, and £256 is to be carried forward

Taunton Electric Traction Co., Ltd.—The receipts for 1916 were £2,900 £250 has been placed to renewals (says the *Times*), and £19 is to be carried forward

STOCKS AND SHARES.

Tuesday Evening.

There is not much going on in the Stock Exchange. Russia, the industrial disturbances, the age limit, the submarines, and the daily expenditure upon the war make up a quintet of factors not exactly conducive to commercial enterprise. The British Government loans keep steady, and hold the other investments markets in firmness. In most first-class securities, the principal complaint still is that there is no stock to supply buyers when the latter come along, though these have shown a dwindling quantity of late, and there are some people putting their money on deposit instead of diverting it into Stock Exchange channels or subscribing to the Exchequer Bonds that are on offer.

The atmosphere is charged with uncertainty; and the question of the moment—from the financial point of view, at all events—is the length of time it will take the United States to become an effective force in the fighting lines. Judged from the many experiences of officers and men home from the Front with whom one comes into contact, there is more cheerfulness in the B.E.F. than there is at home.

Electric railway stocks are heavy, and in some cases lower, in consequence of the threatened strike of the 'bus drivers. Rumour had it on Monday that the tubes, trams, and 'buses would suspend running at six o'clock on the evening of that day; and although this turned out to be exaggerated, the situation was sufficiently unpleasant to lead to a little selling of Underground income bonds and Metropolitan consolidated stock. Optimists profess that the industrial unrest is the direct outcome of the fine weather, claiming that most men have been overworked for some time past, and that the sunshine offers them irresistible temptation to play. According to this theory, the various difficulties will adjust themselves in the course of a few days.

The engineers' strike is in part averted; but, in this particular section, dissatisfaction has been increasing, and want of tact on the part of some of the masters certainly aggravated the position. Engineering shares in the Stock Exchange lists have been scarcely affected at all, except in the negative way that when they come to market they are not quite so easy to place as they were a month or two back. Babcock & Wilcox hold their rise of 2 15/16. British Aluminiums are a trifle lower at 26s. 9d. Henleys 4½ per cent. debenture stock has risen to 81, an improvement of 2 points.

London shares keep good in the electricity supply group. Counties have further hardened to 10½. Cities are ⅛ up at 11¾. The rest of the list is very hard, although there is not much doing. General Electric ordinary at 15 is 10s. up, and the preference have been changing hands during the last few days at 9⅞.

Marconis are showing marked activity in consequence of the success of the company in its recent lawsuit. The price of the shares hardened to 2⅞. The preference rose to 2 5/16; but the principal performer in the group, so far as business is concerned, is the Marconi International Marine, the price of the shares spurting from 37s. 6d. to 45s. Some of the demand responsible for this improvement is stated to emanate from the United States; and American Marconis have been good as well, with business done as high as 16s. 3d. Canadian Marconis remain neglected in the neighbourhood of 8s. 6d.; and Spanish & General Wireless Trusts keep about the same figure.

Cable shares are steady. Eastern Extensions are nominally 10s. down at 13½, but the dividend accounts for 7s. of this. Eastern Telegraph ordinary stock at 138 is 3½ lower, this, however, representing the dividend of the same amount. At 138, Eastern Telegraph ordinary pays £5 16s. on the money; and as the dividend is distributed free of tax, this is equal to 7¾ per cent. gross.

Eastern Extension pays slightly more; and having regard to the scarcity of good industrial investments, the recovery of the dividend is more than probable as soon as general conditions grow more favourable again. The Anglo group is firm, with a rise of 1½ in Anglo-American preferred. The ordinary stock has improved to 56½. Direct United States ordinary, at 6, were ex 2s. dividend last Friday.

Mexicans again stand out as one of the few bright spots round the markets, and the bonds of the Tramways Co. are both up 2½ points, the Firsts rising to 40, the Seconds to 30. Mexican Light & Power common has advanced to 14½, and the rest of the issues in this section are very firm, notwithstanding the lack of confirmation that Mexico had thrown in her lot on the side of the Allies. The weak tendency of the British Columbia stocks has made further progress, the deferred giving way 3 points, and a fall of 2½ occurring in the preferred.

Brazilian Tractions and Rio Tramway bonds, on the other hand, are better, thanks to the steady way in which the exchange advances. The Brazilian Traction directors, it may be recalled, decided to pay no more dividends this year, because of the drop in the rate of exchange. Since the company's report came out, however, the Rio rate has been mounting daily, with scarcely a break; and, from a little under 1s. it has risen to 13¾d. It is scarcely hoped that the Brazilian Traction board will change their decision in regard to the non-payment of a dividend at present, but the rise in the exchange will enable them to put the finances of the company upon a much more solid foundation, and this is justly held as a strong bull point. The preference shares rose to 90, and at the present price the return comes to £6 13s. 4d. on the money.

The British Westinghouse Co has issued an important circular to its shareholders, convening meetings for the purpose of reorganising and increasing the capital of the company. The first meeting will be held next Monday, when no doubt further information will be given than is contained in the present circular. Put very briefly, the idea is to secure control in this country from the Westinghouse Electric Co. of Pittsburg, which at present holds a majority of the preference and ordinary shares of the British Westinghouse. A shrewd estimate of the reason for this might be that the company, as at present controlled, cannot expand as freely, in view of the Defence of the Realm Regulations, as it might be able to do under purely British control. No change has taken place in the price of the shares, which remain at 2 5/16. They are, of course, of the nominal value of £2 each, fully-paid.

British Aluminium fell 6d., but other shares of similar character remain firm. Armament shares are mostly better. Much interest and little business have attended the latest jump in the price of tin, the metal. The rubber market is quieter altogether. How the incidence of the excess profits tax will fall is still a matter of speculation, although it is capable of being estimated with more accuracy than on the occasion when the principle was brought into being. The general conditions which are militating against activity in Stock Exchange things as a whole play their part in the rubber market also; so that, while prices keep firm, the volume of daily business has substantially declined.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend		Price May 15, 1917.	Rise or fall this week.	Yield p.c.
	1915.	1916.			
Home Electricity Companies.					
Brompton Ordinary	10	9	6½	—	£6 18 6
Charing Cross Ordinary ..	5	5	8½	—	7 2 10
do. do. do. 4½ Pref..	4½	4½	8¼	—	6 18 6
Chelsea	4	3	2⅞	—	5 4 4
City of London	8	8	11¾	+ ⅛	6 16 2
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10½	+ ¼	6 13 4
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	7	10	5½	—	5 11 7
London Electric	3	8	1	—	Nil
do. do. 6 per cent. Pref.	6	4	8¾	—	5 6 8
Metropolitan	8	8	2⅛	—	6 0 0
do. 4½ per cent. Pref.	4½	4½	8⅛	—	7 4 0
St. James' and Pall Mall ..	8	8	6¼	—	6 8 0
South London	5	5	2¾	—	7 5 6
South Metropolitan Pref. ..	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	5⅝	—	6 5 9
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	96½	+1½	6 4 2
do. Def.	83/6	1½	22½	—	6 13 4
Chile Telephone	8	8	6 15/16	—	5 15 4
Cuba Sub. Ord.	5	5	8½	—	5 17 8
Eastern Extension	8	8	13½ xd	—	*5 18 6
Eastern Tel. Ord.	8	8	138 xd	—	*5 16 0
Globe Tel. and T. Ord.	7	7	12¼	—	*5 14 8
do. Pref. ..	6	6	10	—	6 0 0
Great Northern Tel.	22	22	38	—	5 15 9
Indo-European	13	13	49½	—	6 11 4
Marconi	10	10	2⅞	+ 1/16	8 9 6
New York Tel. 4½	4½	4½	99	—	4 11 0
Oriental Telephone Ord. ..	10	10	2⅛	—	4 14 1
United R. Plate Tel.	8	8	6⅝	—	*6 0 9
West India and Pan.	6d.	6d.	1	—	2 10 0
Western Telegraph	8	8	14	—	*5 14 4
Home Rails.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	23	— ¾	4 7 0
do. District	Nil	Nil	16	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A" ..	Nil	Nil	5/-	—	Nil
do. do. Income	6	5	79	—1½	*6 6 7
Foreign Trams, &c.					
	Dividend				
	1914.	1915.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	3⅛	—	8 16 0
do. 2nd Pref. ..	5½	5½	2⅝	—	—
do. 5 Deb. ..	5	5	69	+ ½	7 5 0
Brazil Tractions	4	4	47	+1½	Nil
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	60	—	8 6 8
do. do. Preferred	—	Nil	42½	– 1½	Nil
do. do. Deferred	—	Nil	34½	—3	Nil
do. do. Deb.	4½	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	40	+ 2½	Nil
do. 6 per cent. Bonds	—	Nil	30	+ 2½	Nil
Mexican Light Common ..	Nil	Nil	14½	+ 1	Nil
do. Pref.	Nil	Nil	23½	—	Nil
do. 1st Bonds ..	Nil	Nil	37½	—	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	2 15/16	—	5 2 0
British Aluminium Ord. ..	5	7	26/9	— 6d.	7 7 10
British Insulated Ord.	15	17½	12¾	—	6 17 3
British Westinghouse Pref. ..	7½	7½	2 5/16	—	6 9 10
Callenders	15	20	13¼	—	7 11 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	8 5/16	—	6 13 0
Edison & Swan, £3 paid ..	Nil	—	5/16	—	Nil
do. do. fully paid ..	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	69½	—	5 15 2
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9¾	—	6 3 1
do. Ord.	10	10	15	+ ½	6 13 4
Henley	20	25	15½	—	8 1 8
do. 4½ Pref.	4½	4½	4	—	6 12 6
India-Rubber	10	10	11⅞	—	*8 8 4
Telegraph Con	20	20	87	—	*6 9 10

* Dividends paid free of income-tax.

WAYLEAVES.

In connection with the discussion on Mr. Vernier's paper, Mr. W. A. Chamen has addressed the following important communication to the *Journal* of the Institution of Electrical Engineers :—

As chairman of the Joint Committee of the Incorporated Association of Electric Power Companies and the Incorporated Municipal Electrical Association appointed for the purpose of drafting a Bill which it is hoped may be presented to Parliament at the earliest opportunity, I may say the question of wayleaves has engaged the attention of that Committee to a very considerable extent, and the following clause (No. 11) appears in the draft Bill :—

"11. The undertakers may within their area of supply or any extension thereof under section 6 of the Electric Lighting Act, 1909, or otherwise construct maintain repair alter and remove electric lines either over ground or under ground across over or under private property or common lands, rivers, railways, canals, tramways, aerial ropeways, pipelines, water channels, and the like, subject to the consent of the owners thereof, or without such consent (notwithstanding the provisions of section 7 of the Gasworks Clauses Act, 1847, as incorporated with the Electric Lighting Act, 1882, by section 12 thereof, and of section 10 proviso (*b*) of the Schedule to the Electric Lighting (Clauses) Act, 1899) subject to the issue of a certificate of the Board of Trade declaring the construction of such lines to be desirable on the ground of public utility and authorising their construction subject to terms and conditions as are hereinbefore provided. Any undertakers requiring to obtain such certificate shall make application therefor to the Board of Trade. Such application shall set out the purposes of the lines, the advantages of the routes proposed over any routes available by the exercise of their existing powers, or that there are no such routes, and shall be accompanied by a map showing the route or alternative routes proposed to be followed, the easements required for access thereto, the lands and other properties concerned, a schedule of such lands and their owners, and a certificate that copies of the map and notices of application have been served upon all such owners. Copies of any agreements which may have been made with any of the owners concerned in the construction of any part of such lines or of any consents given by such owners may be submitted with the application, or at any time thereafter until the Board of Trade shall have decided to grant or withhold the certificate.

Upon the receipt of any such application the Board of Trade shall notify the owners concerned, other than those last above mentioned, and invite them to forward to the Board of Trade in writing within one calendar month, any observations which they may wish to offer upon the construction of the lines or the routes proposed so far as their own properties are concerned. The Board of Trade, if it sees fit, may thereafter hold a local inquiry, or may decide to issue or withhold the certificate without such inquiry. The certificate issued shall be accompanied by a plan showing the route or routes approved by the Board of Trade with or without limits of deviation, but such routes or limits of deviation shall be confined to the properties scheduled by the undertakers in their application. The undertakers shall within six months of the receipt of the certificate serve upon all the owners concerned notices of their intention to construct such lines showing the proposed course thereof, and of the easements for access thereto, and at the same time serve notices to treat for the determination of the compensation to be paid where that has not been previously agreed upon.

The Board of Trade shall make regulations prescribing the scale of the maps, the forms of notice and observations, and the information to be submitted with applications and notices.

When the Board of Trade has decided to withhold the certificate, the undertakers shall not for twelve months, or for such period as may be determined by the Board of Trade, repeat their application, and then only subject to such regulations as the Board of Trade may make.

The exercise of the powers conferred by this certificate issued by the Board of Trade shall be subject to the following provisions numbered (1) to (6), and failing agreement between the undertakers and any owner of any lands, &c., as to the matters set out in the provisions of this section, the question shall be heard and determined by a single arbitrator to be appointed by the Board of Trade, and so far as possible all questions arising in respect of the line or lines authorised by any certificate of the Board of Trade shall be heard and determined by the same arbitrator sitting continuously.

(1) Payment by the undertakers to the owners of the property by way of lump sum or annual rent charge of such sums as may be agreed upon or awarded as compensation for the reduction in value of the lands by reason of the easements for the construction maintenance and repair of the line and access thereto.

(2) Payment by the undertakers to the owners of such compensation as may be agreed upon or awarded for damage done in the course of construction maintenance repair and alteration of such lines at any time arising.

(3) In arranging whether any wayleaves shall be granted in perpetuity or for any term of years due regard shall be had to the liability of the undertakers to continuously maintain any supply of electricity once given by them.

(4) Alteration from time to time of the route followed by any line on across over or under any lands upon such terms and conditions as may be agreed upon or awarded, but so that the alteration shall not cause any interruption to the supply of electricity.

(5) In making any award it shall not be competent for the arbitrator to decide against the express wishes of any landowner or occupier that any electric line shall be run overhead across any ornamental park garden or pleasure ground so as to spoil the amenity thereof.

(6) The Board of Trade may at any time revoke any certificates granted by them under this section upon such terms and conditions as they may determine, having due regard to the liability of the undertakers to continuously maintain the supply given by them."

It is not proposed under the Bill to proceed in any other way than through the present existing authority to whom all such matters are referred by the Electric Lighting Acts, namely, the Board of Trade, but if any other authority should be set up by Parliament for dealing with this question of wayleaves and/or any other questions at present dealt with by the Board of Trade, the transfer of this matter, along with any other such matters, to any other body, would of course be provided for in the Act appointing such new body. The procedure with regard to wayleaves in other countries has been considered, but it has been deemed advisable to proceed with the drafting of this clause on lines which fit in with the least possible trouble or alteration with the existing conditions in the United Kingdom. The Committee hope that the provisions of this clause give such power to undertakers and to the Board of Trade as it is reasonable to expect that Parliament will give, while at the same time safeguarding the interests of property owners, especially in instances where it might, from a purely utilitarian point of view. be desirable to run overhead lines across ornamental parks, gardens, or pleasure grounds in such a way as to disfigure and spoil the beauty of any such lands. Experience seems to show that the bare fact of the existence of such powers as those set out in this draft clause would suffice in nine cases out of ten, if not, indeed, in 99 cases out of 100. to cause the property owner to make reasonable agreements without the actual powers contained in the clause having to be called into operation at all. In present circumstances it is possible for one landlord possessing only a small amount of land to completely upset a scheme for the construction of any electric line not only overhead, but also underground, because he will not allow it to cross his property, or, if he is willing to allow it to cross, the conditions under which he is willing to do so render the scheme impracticable.

There is another point altogether, which has been referred to by the author, namely, that of the alleged right of veto by a local authority against the construction of any lines whatever overhead, even on private property. This alleged right of veto I do not think was ever intended by Parliament. It is not contained in section 14 of the Electric Lighting Act, 1882, and it is really only brought into section 10 (*b*) of the Schedule to the Electric Lighting (Clauses) Act, 1899, indirectly, and I cannot believe for a moment that the Committee of whichever House of Parliament first passed this wording intended that it should give to a local authority the power to prevent overhead lines being constructed on private property, where the public safety and convenience is in no way concerned. Section 1 of the Schedule to the Electric Lighting (Clauses) Act, 1899, states clearly that the provisions of the Schedule are to be read and construed subject in all respects to the provisions of the Electric Lighting Acts, which means the Electric Lighting Acts 1882 and 1888, and it is quite unreasonable to suppose that it was the deliberate intention of any Parliamentary Committee to place any further restrictions upon the erection of overhead wires than those contained in section 14 of the Electric Lighting Act, 1882, so far as the consent of local authorities is concerned. The wording of section 10 (*b*) of the Schedule to the Electric Lighting (Clauses) Act, 1899, is, of course, unfortunate, and it taken literally, as lawyers in these days seem to insist upon taking things, it may be held to give these very wide powers of veto to local authorities, but if the question were taken before any judge who would take a broad, intelligent, and common-sense view of the whole situation, I cannot think he would decide that this clause gives power to local authorities to prevent the erection of overhead lines across moorland or agricultural land or other tracts of country. As, however, the Board of Trade have maintained that section 10 (*b*) of the Schedule to the Clauses Act, 1899, does give an absolute veto to local authorities, without appeal in any shape or form, the Joint Committee have added the following section to the draft Bill :—

"12. Notwithstanding the provisions of section 14 of the Electric Lighting Act, 1882, and of section 10 proviso (*b*) of the schedule to the Electric Lighting (Clauses) Act, 1899, the consent of the local authority shall not be required for the placing of any electric line above ground, excepting along, over, or across any street, and such consent for the placing of any electric line along, over, or across any street shall not be unreasonably withheld. Any question whether such consent is unreasonably withheld shall be decided by the Board of Trade.

"This section shall only apply to the works of authorised undertakers carried out by them, remaining their sole property, and in regular use by them."

The effect of this is to take away all possibility of any claim by the local authority to have any power of veto over the construction of overhead lines on private property, and at the same time it provides that the consent of the local authority shall not be unreasonably withheld to the erection of any electric line above ground, along, over, or across any street, and provides a right of appeal to the Board of Trade, to decide whether any refusal to give such consent by any local authority is unreasonably withheld or not. It must always be remembered that there is no necessity for the local authority to set themselves up as guardians of the public safety, because the Board of Trade are already charged with that duty, which they carry out very scrupulously and effectively. If any local authority should know of any overhead electric lines being erected in such a way as to endanger the public, all they have to do is to draw the attention of the Board of Trade to the matter, and the Board of Trade will very effectively and efficiently do the rest. Many people may ask why these powers of which we complain should not be given to the local authorities as representatives of the public, who, they may say, can surely be relied upon to use them with all fairness and moderation. But the experience of many of us has proved only too clearly that these powers may be, and are, very grossly misused. For instance, a local authority owning a gas undertaking may, and sometimes does, make use of these powers to hamper the development of electric light, or even electricity supply generally for power purposes, within its district, being under the impression, apparently, that by so doing it is best serving its own ratepayers' interests by preventing competition with its gas undertaking. Then, again, any councillor having a grudge against an electric power company or other electricity supply undertaker, may so influence the council of which he is a member, as to cause that council to refuse to give the necessary consent. It is, therefore, quite wrong that these powers of veto, without appeal, should be placed in the hands of any local authorities. No one asks or wants free powers to electricity undertakers to run overhead mains along or across streets without reasonable and proper safeguards in the interests of the public as represented by the local authorities, or across private property without safeguarding the interests of the property owners. But I think that these two clauses in the draft Bill give the necessary relief to electricity supply undertakers, whilst at the same time amply safeguarding the public and the property owners.

HIGH-TENSION OVERHEAD TRANSMISSION LINES.

By G. V. TWISS, A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

(*Continued from page* 510.)

Choice of Type of Insulator.

Pin insulators necessarily transmit their load to the structure at a more or less long leverage. The proper function of pin insulators is, therefore, to support conductors in positions where comparatively small loads are to be dealt with, *e.g.*, on intermediate poles where the load is merely that due to the wind on the conductors. They may, however, also be used on small angles, the resultant load of which is of the same order as the transverse load. Where heavy loads are to be dealt with, such as at the termination of the line and at large angles, insulators which transmit their load direct without leverage, such as the shackle or straining type, should be used.

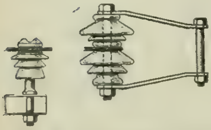

Fig. 6.—A Pin and a Shackle Insulator of Equal Insulation.

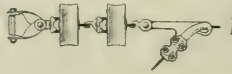

Fig. 7.—Strain Insulator of Disk Type.

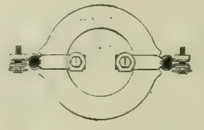

Fig. 8.—Spreader.

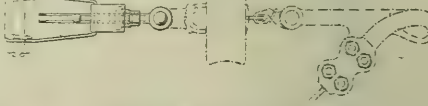

Fig. 9.—Strain Insulator with Adjusting Device.

The shackle insulator, whilst sound mechanically, becomes excessively large, even at comparatively low voltages, owing to the fact that the upper and lower halves of its insulation are in parallel, so that it is only equal to a pin insulator of one-half its size (see fig. 6). This is often lost sight of, with the consequence that the straining points of some lines have only about one-half the insulation of the remainder of such lines.

Comparable insulation can, however, be readily obtained by the use of strain insulators of the disk type (see fig. 7), which can be made up of one, two, or more disks as required; and this practice is rapidly superseding the use of shackles.

The economical limit for pin insulators is 66,000 volts.

Merz-Hunter Split-phase System.

The two conductors of each split phase are sometimes supported on separate insulators as if they belonged to separate circuits, but more often they are supported on the same insulator specially made with two side grooves. This necessitates insulators having specially deep heads, and whilst this is permissible with the smaller sizes, it is questionable with large sizes, for the reason of expansion and contraction stresses referred to later.

When suspension insulators are used, the split conductors are attached to reel insulators attached to the lowest unit. It is important to short-circuit the insulation of one of the reels or to make it of a conducting material, otherwise the effect is that of a small capacity in series with the larger capacity of the disk, and the reel may be in a state of continuous flashover even at working voltage.

When the two conductors making one split conductor are mounted on one insulator it is necessary to provide insulating distance pieces, known as spreaders, in the span. The usual spacing of these is from about 30 to 40 ft., depending upon the size of, and tension of stringing, the conductors. The form of spreader now largely adopted consists of a porcelain ring with two grooves in the periphery for the conductors, which are fastened thereto by means of small "stirrup" clips of copper (see fig. 8). In view of the vibration the bolts and nuts are locked by a soft copper locking device, which is pressed over the head of the bolt.

It is necessary that the two conductors making one split conductor should be strung with as nearly the same sag as possible, otherwise the result is unsightly, and the split conductors may "capsize," causing touching. It has been found difficult to obtain this exact adjustment of sag by ordinary means, and on some recent lines the strain insulators have therefore been provided with an adjusting device, as shown in fig. 9.

Poles.

It seems to be the general idea that wooden poles are not efficient for spans of more than 200 ft. or so, but in some cases they can be used at their greatest efficiency for much longer spans. Moreover, it has been considered that on pressures in the neighbourhood of 100 kilovolts, the length of the cross-arm necessary prevents the use of wooden poles. It is therefore of interest to note that one recent 100-kilovolt transmission line (the Montana Power Co., U.S.A.) is erected on wooden poles, the pole structure consisting of two 45-ft. wooden poles connected together by a single horizontal cross-arm from which the suspension insulators depend.

Poles made of single metal tubes are employed for telegraph and telephone lines and small electrical lines of the nature of overhead distribution lines, but they are not as a rule economical at loads approaching those which come upon an important transmission line.

There is a special type of tubular pole, namely, the Kay pole (fig. 10), which is a British invention, and is capable of being applied to transmission lines of the highest voltage. The facilities offered by this class of structure, particularly in regard to ease of transportation and erection, merit careful consideration, especially when a pole line has to be erected on the side of sloping ground or mountainous country.

Lattice Steel-work Poles (usually called masts).—Most of these structures fall within one or other of two classes, namely, narrow-base structures and broad-base structures.

Narrow Base.—In this class of structure the load is transmitted to the foundations by the lift on the one side and the thrust on the other side of the base, forming relatively to the structure an inverted T (see fig. 11). This class of structure is usually designed to transmit its load down to the horizontal base members and thence to the ground. There is, therefore, slight movement and considerable horizontal force at the ground-line, point A, and if this slight movement be resisted very considerable stresses will be introduced in the bracings B far beyond those which they would otherwise have to carry.

It would seem to be sound practice to design the base members as for the assumed condition of the structure acting about the point A, which, of course, would require the introduction of a suitable strut at the ground-line C. The design is not as a rule very efficient, and it is only justified where conditions of space prevent a broader base.

Broad Base.—With this design of structure, owing to the wide spread, there is usually little horizontal reaction at the ground-line, and the base members, *i.e.*, stub ends, have merely to take thrust and pull (see fig. 11). This type lends itself to efficient design, but owing to the long lengths of bracings, &c., it is desirable that the ratio of the length to the radius of gyration for struts should be limited to a reasonable figure (say, 100 or so), otherwise a design which shows its full theoretical factor of safety may fail at a lower figure owing to the weakening of long struts by slight bends incurred in transit, or even due to sagging under their own weight.

Tension Members and Struts.—With a strut under an increasing compression load there is little change until it cripples, which it does quite suddenly, and it would develop its full theoretical factor of safety before crippling.

With a tension member under an increasing tension load, however, as soon as the elastic limit is reached it begins to stretch, and the point of the structure which such tension member should hold is no longer held in the manner intended. Hence an entire redistribution of the stresses takes place throughout the structure, which consequently fails at a lower load than that calculated.

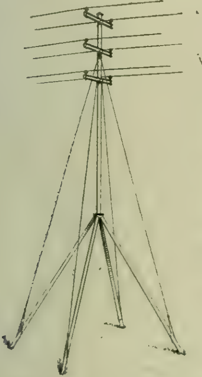

Fig. 10.—Kay Pole.

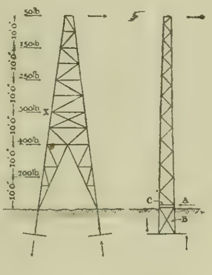

Fig. 11.—Lattice Steel Masts.

It would therefore appear that when designing structures such as lattice steel-work masts, as the factor of safety for struts is taken upon the crippling load, the factor of safety for tension members should be taken upon the elastic limit, and not upon the ultimate strength.

Testing.—The usual practice is to test lattice steel-work poles by applying a pull at the top representing the load in the wires + the wind load on the pole itself equated to the top. The wind load is naturally distributed over the structure, and the design of a mast, to be correct, must therefore deal with this wind load as it occurs.

Fig. 11 shows a mast with a wind pressure of 10 lb. per sq. ft. equally distributed over it. The wind load on the lower bays will obviously be greater than that on the upper. If we equate the wind load by taking moments round the base of the mast, we find that it equals a load of 740 lb. applied at the top. If, however, bending moments are taken round the point X, it is found that the designed bending moment at this point = 7,000 ft. lb., whereas the equated load of 740 lb. gives a moment at this point of 22,000 ft. lb., or over three times more than the structure at this point is designed for. Hence the mast similar to that shown in fig. 11, tested with an equated wind load, failed at 25 per cent. less than its designed load, in one of the higher bays (near the point X), owing to such bays carrying not only their own load, but the equated increment of the large bays below. To equate the wind load in this way for the purpose of test would therefore seem to be unfair to the structure.

Line Insulators.

A line insulator from the electrical point of view must be regarded as a more or less complicated electrostatic condenser with dielectric plates of porcelain (a dielectric of high specific capacity) and air (a dielectric of low specific capacity), the condenser plates being the conductor and its fastening, the pin or other attachment, and perhaps the layers of cement. All laws relating to condensers must be reasonably observed under what amounts to changing size and shape of the condenser plates due to rain, dirt, &c., and under frequencies ranging from normal to possible surge frequencies. At the same time, the insulator must sustain more or less heavy mechanical stresses caused by outside loads, and by inside stresses due to expansion and contraction under heat and cold of the different materials, individually and relatively.

Up to comparatively recent times it was the practice to design insulators merely to give certain flash-over tests dry and wet, and with sufficient thickness to ensure that under test, flash-over should occur before puncture. Considerable importance has also been attached to the leakage distance over the surface. Such figures are of little value, as the surface resistance given by such leakage distance will vary with the width of the leakage path, which, of course, varies considerably with different sizes and shapes of insulators. Insulators have also been specially designed with extra long leakage paths to work in situations exposed to deposits of dust, salt, &c. It would seem better to obtain the additional surface leakage distance required by using a correctly designed insulator of larger size than by altering a correct design to make it give a greater surface leakage distance for the same size.

Ability to withstand a flash-over test without puncture is not necessarily a criterion of good design in an insulator, as an insulator of indifferent design may still give such tests. An indifferently designed insulator may have badly balanced shells and air spaces, causing some portions to be unduly stressed electrically. Under increasing test pressure the air contiguous to such over-stressed portions breaks down, *i.e.*, becomes ionised and glows. Such ionised air, being a conductor, tends to increase the capacity of such portions and decreases the over-stressing, so that when the insulator is at its flashing-over point, it may be quite well balanced, not by its design, but by the corrective balancing action of the ionised air. Air, however, takes a definite (though minute) period to ionise, and a steep wave-front condition may not give time for the corrective balancing action of the ionised air, and the over-stressed part may break down and result in the puncture of the entire insulator. It would seem, therefore, that an insulator should be designed for surges with steep wave front rather than for normal conditions.

Lightning may directly strike an insulator and shatter it as by a mechanical blow, with or without electrical effects such as puncture or flash-over. Suspension insulators are, however, largely protected by the cross-arms, and pin insulators are generally somewhat protected by the poles or earthed metal-work projecting above them, so that an actual stroke on an insulator is fortunately not very frequent.

A lightning stroke though appearing to the eye to be one discharge, may be several separate discharges, each inducing in the wires a potential which may rise to almost any extent —only limited by the pressure necessary to arc from the line to earth—and the rate of rise may be of almost any magnitude, as, for instance, equal to that of a ¼ cycle of a frequency of a million per second.

Switching and arcing surges may rise to a potential of twice the line voltage, and will set up oscillations with a frequency depending upon the constants of the line or, say, 1,000 to 5,000 periods per second, which indicates the steepness of the front; but whereas the switching surge may only continue long enough to permit of two or three wave-trains, the arcing surge may continue for much longer, depending upon how quickly the arc is suppressed.

The first requirement is to balance the parts of the insulator so that under steep wave-front conditions it does not depend upon corona to relieve the over-stressing. To obtain correct balancing the following considerations must be taken into account:—

The mutual capacity of the parts.

The concentration of flux upon a relatively small electrode, as, for instance, the pin. (This tends to increase the potential gradient on the shells near such small electrode.)

The capacity of parts to earth. (This increases the capacity current, and hence the potential gradient on the shells nearest to the line.)

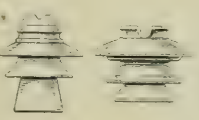

Fig. 12.—Comparison of Insulators.

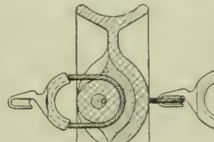

Fig. 13.—Hewlett Type of Insulator.

In addition to being balanced, the insulator should be proportioned to withstand the surges and oscillations of limited potential and frequency as set up by switching and arcing with an adequate margin against flash-over or puncture, and also so that when the almost unlimited rises of lightning surges occur, the insulator will be protected therefrom. This protection may be obtained by making use of the low dielectric strength of the air surrounding the insulator as a protecting gap or safety valve through which it may arc to earth and thus relieve the stress before damage can occur to the porcelain.

All well-designed insulators will be recognised under test by the small amount of corona formation prior to flash-over.

Pin-type insulators were first designed many years ago without great regard to the balance of dielectrics and their ability to withstand surges. These designs are generally tall, small headed, and elegant looking. If, however, these requirements are regarded, the resulting design becomes more squat and wide to obtain the protecting air path and free arcing characteristic, whilst maintaining electrostatic balance, and thicker in the head to obtain the puncture strength and reduce the flux.

Fig. 12 shows a comparison of the earlier design of insulator with an insulator primarily designed for balance and ability to withstand high frequency, and the comparative behaviour of these insulators under test is characteristic.

Suspension insulators are usually of one or other of two types, viz., the Hewlett or interlinked type, and the metal hooded or cemented type.

Hewlett Type.—From the electrical standpoint the interlinking of the fittings causes a concentration of flux at the point where the interlinked fittings come closest together, *i.e.*, at the point of crossing. Practice has proved, however, that provided the insulators are made of high-quality porcelain, as, for instance, English porcelain, they give satisfactory service. The insulators as supplied in this country are fitted with endless steel-wire grummets connected together by an S-shaped fitting devised by the author (see fig. 13). The grummets are made on the insulator itself, and then cemented in to prevent the wearing of either the porcelain or the grummet. The cement being hygroscopic also has the effect of what amounts to increasing the area of the electrodes, and thereby reducing the flux density, and consequently improving the electrical characteristics of the insulator. As previously stated, this type of insulator is eminently suitable for use in conjunction with pin insulators on the straining points of the line. This design of insulator is also used on very high voltages, as, for instance, on the 88,000-volt lines of the Victoria Falls and Transvaal Power Co., and those made of sound porcelain, *e.g.*, the English ones, have given good service. On the very high voltages, however, the metal-hooded insulator is more generally used, presumably owing to its better electrical characteristics.

The Hewlett insulator as used for working in the horizontal position at straining positions has two flanges which cause it to have an excessively high flash-over voltage dry, which reduces the margin against puncture. As the result of experiments, the author has found a means of reducing the dry test by short-circuiting one flange in a position on the periphery opposite to the midway point between the two grummet holes (see fig. 13). The position is important, otherwise the spray test is also reduced, which vitiates its use. The following are comparative tests with and without the short-circuiting of the flange or "over-pressure release."

HEWLETT INSULATORS (SINGLE 6-IN. DISK).

	Ordinary without over-pressure release. Kilovolts.	With over-pressure release. Kilovolts.	Comparison with usual rating of pin insulator. Kilovolts.
Working	6	6	6
Flash-over under spray ...	35	35	37
Flash-over dry	80	56	54
Puncture (uncertain) ...	80	80	80

Metal-hooded Type.—The characteristic of the metal-hooded or cemented insulator is the concentric arrangement of the parts and the even distribution of flux, which makes the insulator very good from the electrical point of view. Considered individually, the suspension insulator is of very simple electrical design, but when arranged in a string in series, as for working at high voltages, some interesting features arise.

That the distribution of potential along a string of suspension insulators is not equal is well known, but it is desirable briefly to refer to it here in order to lead up to other matters. Suspension insulators arranged as a string have a capacity to one another which might be called "series capacity," and a capacity to earth which might be called "shunt capacity." The unit nearest to the line has therefore to carry the "series capacity" current, which is uniform throughout the string, plus the "shunt capacity" current of the units above it. Each successive unit above has a less amount of "shunt capacity" current to carry. The voltage gradient will therefore be steepest on the line unit, and less on each successive unit, the topmost unit nearest to the cross-arm having the least potential across it. The unbalancing will be the greater, the greater the ratio of shunt capacity to series capacity. Insulators, therefore, with large thicknesses of porcelain, such as a double piece or an extra-thick single piece, will have the smallest series capacity; and though such insulators may be of excellent design considered individually, yet a string of them in series may have very bad characteristics.

Such extra thickness becomes necessary with poor qualities of porcelain which have a relatively low dielectric strength, but such porcelain has a relatively low specific inductive capacity, so that the effect of bad porcelain in increasing the out-of-balance is cumulative. Inversely, the better the porcelain the higher the capacity due to the material itself and the thinner it can be for a given strength. With English porcelain which has high dielectric strength a 10-in. suspension disk, ⅞ in. thick, has a flash-over value of 70 kilovolts, and a puncture strength of 156 kilovolts, and such a unit will give a much superior balance than, say, a two-piece insulator or an insulator 1 in. thick, particularly if of poorer porcelain. It will be noticed that whereas with the pin insulator it was desirable to get a thick dielectric, with the suspension insulator the opposite appears to be the case. With pin insulators, however, the shunt capacity is smaller in respect to the series capacity, and in any case the shells are readily proportioned (*i.e.*, graded) to suit; whereas with suspension insulators the effect is greater, and though feasible it is not very practicable to grade the units to provide for this. The series capacity can, however, under certain conditions be slightly increased by reducing the spacing.

One effect of the uneven potential distribution is that the flash-over of a string of, say, n units is less than the flash-over of one unit × n. The ratio of these two figures has been called the "string efficiency ratio," and is an indication of the out-of-balance of the string. It is to be noted, however, that just as with pin insulators, the effect of corona is to increase the capacity of the most stressed shells or automatically to grade them, so that under test at normal frequency the string efficiency ratio may indicate a better potential balance than is actually the case under normal working voltage. If the units are spaced over a certain length apart, flash-over will take place between the metal-work of each unit (fig. 14A), and further spacing apart will not materially alter the flash-over of the string. If, however, the spacing is reduced, the flash-over will take place over the entire string (fig. 14B), and when this condition is first reached the flash-over of the string might be slightly increased due to the better flux distribution. The spacing can, however, be further reduced up to the limit of the minimum spacing required by the fittings, and if this is done, the flash-over will be decreased, thereby lowering the string efficiency ratio.

Fig. 14C shows the effect of these movements. The spacing of the units closer together will have the following effects:—

1. The flux distribution will be better, due to the shortening of the path for such parts of the flux as pass through the air between the units.
2. The arc will be thrown out from the porcelain instead of drawn in, and so will reduce the possibility of shattering the shells.
3. The stresses on each unit will be reduced.

The last reason is a very important one. Under pin insulators it was shown that it is desirable to reduce the air gap or increase the thickness of the porcelain. The necessity for not increasing the thickness of porcelain in the suspension-type insulator has been discussed, so that the only course open is to reduce the air gap, and thereby the stress which can come on any unit, including the line unit, and at the same time to reduce the time lag under high-frequency conditions. Yet that which provides the above important advantages and efficiency is to be stigmatised as bad efficiency, as judged by the string efficiency ratio.

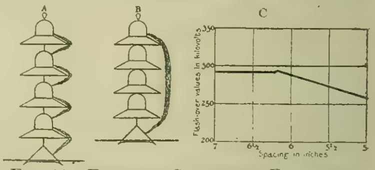

FIG. 14.—EFFECT OF SPACING ON FLASH-OVER.

The string efficiency ratio appears to be a reasonably accurate guide to the out-of-balance of a string up to the point of maximum flash-over for a given string; beyond that point, however, the string at least maintains its previous string efficiency, but gains in security by the reduction in potential which can come on to any unit.

This factor might be termed "string security factor"

$$= \frac{\text{maximum flash-over of string}}{\text{flash-over with reduced spacing.}}$$

Under rain conditions the balance of the string is improved owing to the increase of series capacity due to the wet conducting surfaces, and also due to the leakage current over such surfaces, which adds itself to the series capacity current. In consequence, after a certain number of units are added to the string, the flash-over under spray may become even greater than the dry.

(*To be continued.*)

Electroculture in Cheshire. — Lord Tollemache, of Peckforton Castle, Tarporley, Cheshire, has taken up the system of electro-culture with enthusiasm, and with the professional assistance of Mr. S. E. Britton, borough electrical engineer, Chester (Chairman of the I.M.E.A. Committee on Electricity in Agriculture), is applying the system to a 14-acre plot. The apparatus is now in course of erection. We understand that Mr. Britton has also made all arrangements on behalf of his Corporation to experiment on a 1½-acre plot within the city, in connection with which he will have the assistance of the Corporation's horticultural and chemical experts, and that in Cheshire farming circles the idea of applying electrical methods to agriculture is being very favourably received, the only real hindrance being the difficulty of obtaining equipment under present conditions.

ELECTRICITY SUPPLY IN SHANGHAI.

We have received from Mr. T. H. U. Aldridge, M.I.E.E., engineer-in-chief and manager of the electricity department of the Shanghai Municipal Council, a copy of his report for 1916, which states that, notwithstanding the shortage of generating plant and trunk cables, a large expansion of business took place during the year. The plant being overloaded in the winter of 1916, the full supply for ordinary lighting, heating, and power could not be maintained without placing some of the more recently connected power users on a restricted supply between 4 and 10 p.m. There being few opportunities to clean or overhaul the boilers at the Riverside works, owing to the excessive demand for electricity, difficulties were met with in keeping them in working order, to which was added the breakdown of the No. 3 A.E.G. 5,000-kw. alternator (reported in our issues of July 21st and December 1st, 1916), the third of the four German machines to fail. The units generated at Riverside amounted to no less than 69¾ millions, an increase of nearly 15 millions, and at Fearon Road to 7¾ millions, an increase of 318,000 units, the whole of the available plant being run with practically no spare plant at all. A slight reduction in works costs was effected, the cost per unit sold being 0.531d. The plant capacity totalled 19,600 kw.; the load factor was 38.2 per cent., and the units generated 77½ millions. The units sold were distributed as follows: Private lighting, 14,285,888; public lighting, 1,058,772; heating and cooking, 899,585; power, 42,042,853; traction, 3,873,698. While lighting showed little increase, the consumption for heating and cooking increased 32.3 per cent., for power 37.2 per cent., and for traction 14.1 per cent., the all-round increase being 24.9 per cent.

During the year 144¾ miles of overhead cable were erected, and 20 miles of extra-high-tension cable laid underground. Transformers of 10,507 kw. were installed, and of 8,221 kw. disconnected, mainly owing to the substitution of three-phase for single-phase supply. The remainder of the public arc lamps were replaced by half-watt lamps.

A record number of motors was connected during the year, the total reaching 20,340 h.p.; the new connections represented an increase of 240 per cent. upon the h.p. connected during the previous year, and the aggregate increased by 25 per cent.

Electric vehicles were first introduced into Shanghai in 1916, the electricity department having purchased four light cars, a two-ton truck, and a 700-lb. truck. These have all proved so satisfactory that two more trucks have been ordered. Careful records show that the cars effect a saving of 9 per cent. per annum compared with cheap petrol cars, on a basis of 25 miles run per day; with a daily mileage of 50 miles the saving is about 30 per cent. There are three private cars in the city, and more are on order.

After meeting all interest charges, special depreciation on the old Fearon Road generating station (the steam generating plant in which will be scrapped in a few years), reserve for bad and doubtful debts, brokerage, and other special charges, in all amounting to £47,318, and after writing off £43,178 for depreciation, there was a net profit of £48,250. The result of the year's working was to yield a gross profit of 8.9 per cent. on the capital outlay.

The four 22,000-volt split-conductor trunk mains, made by the British Insulated & Helsby Cables, Ltd., connecting Riverside with the Fearon Road power station, are nearly completed. Preparations are being made for installing two 10,000-kw. turbo-alternators, the new 22,000-volt B.T.H. switchgear, &c., the designs for the concrete foundations and buildings having been made by the staff of the department. In spite of the difficult conditions, the General Electric Co.'s (U.S.) 10,000-kw. turbo-alternator has been delivered, a similar set by Messrs. Parsons is well advanced, and a 5,000-kw. turbine by Messrs. Fraser & Chalmers is nearly ready for shipment; a quantity of the auxiliary machinery has already arrived. Difficulty has been experienced in obtaining steelwork for the building from the United States. Mr. Aldridge compliments the British manufacturers on the progress made with the new plant in view of the restrictions and difficulties under which they are labouring.

The report is illustrated with a number of half-tone views of the newer plant, &c., and curves showing the progress of the undertaking.

RESERVED OCCUPATIONS.

Electricity Works Employés.

On April 24th Mr. H. Faraday Proctor, the hon. secretary of the I.M.E.A., wrote to the Secretary, Badges and Protected Occupations Section, Ministry of Munitions of War, 6, Whitehall Gardens, London, asking, on behalf of the members, whether it was desirable at this stage to apply for (*a*) protection, (*b*) substitution, for men over the age of 32 years (on January 1st, 1917), such as engine drivers, stokers, &c., &c., who were essential to the operation of certified undertakings, but who were not referred to in the Schedule of Protected Occupations (M.M. 130), or whether opportunity would be afforded for doing so when the calling up age was raised above 32 years.

In reply, Captain C. B. Joyner wrote under date May 1st:—"I am to inform you that as men over 32 in works engaged on munitions are not at present to be called up for Military Service, it will not be necessary for any applications to be made for their protection in cases where they are not included in the Schedule of Protected Occupations. If, however, it should in the future prove necessary to set free such men for Military Service claims may be made for their retention upon Form M.M. 81, as stated in paragraph 12 of Circular Letter M.M. 18. If substitutes will be required for such men in the event of their release at any future date, claims should be entered in column (P) of M.M. 82S in accordance with paragraph 9 of the directions for filling in that form."

Under date May 9th, Mr. Faraday Proctor communicated with members of the I.M.E.A., replying to the large number of inquiries that he had received on the above matter. Copies of the letters referred to were distributed with his communication. We quote the following extracts from the latter:—

"Sir Stephenson Kent informed our representatives on April 26th, 1917, that engine drivers and stokers in electrical generating stations are not protected under the code numbers 1601, 1604, and 1605 (White List M.M. 130). Protection will presumably be given under 'Professional Occupations and Administrative Staff,' code numbers 2001 and 2017, and has actually been given in at least one instance."

On careful perusal of the documents, it will be observed:—

"1. That 'Scheduled Occupations Certificates' Army Form 3476a, will be issued to every man entitled to protection under the White List, M.M. 130.

"2. Temporary protection will be issued to those men of military age who, although not covered by the White List, are not to be called up for the present.

"3. If a man is called up who is not protected, a claim may be made to the Dilution Officer on form M.M. 81 for his retention, provided always that

"4. Special claims should be reduced to the absolute minimum.

"5. It is men under 32 years of age who are to be called up.

"6. If, in the event of any man being liable to be called up either now or at any later date, a substitute is necessary, the claim for a substitute should be filled in *now* on form M.M. 82S.

"7. The claim for a substitute should be made, whether or no you are of opinion that an efficient substitute can be found.

"It is probable that the reason why the schedule of protected occupations is not wider is that in some exceptional cases it has been found possible for the work in these occupations to be carried out by men over age, or wholly or in part by female labour. This justifies the exclusion from protection of the male employés *as a class*, even though it be found necessary in nearly every case to protect such employés *as individuals, as groups of individuals, or according to locality*. Some of our members have refrained from claiming substitutes for men who should be protected although not coming under the White List, on the grounds that they are sure efficient substitutes cannot be found. In my opinion column (p) should be filled in in every case where the work of a man is necessary and it is not clear that means will be forthcoming for the carrying out of that work in the event, however remote, of that man being called up. I consider that it is better to claim even the impossible than to have no claim outstanding. In the event of the man in question not being protected or substituted the alternative is then for the man to remain at work, although unprotected."

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

UNION OF SOUTH AFRICA.—In the Budget speech which was delivered in the Union Parliament on March 30th, it was stated that the Customs duties for the year 1917-18 remain unchanged.

A recent decision by the Commissioner of Customs places the rate of Customs duty on electric starters for motor cars as follows:—

	Rate of duty.	Rebate for U.K. and reciprocating Colonies.
Chains	20 p.c. *ad val.*	3 p.c. *ad val.*
Adjusters and parts	3 p.c. *ad val.*	Whole duty

SWEDEN.—The exportation of the following, among other articles, has been prohibited as from the dates mentioned:—

March 18th: Accumulator plates, and wooden boxes for accumulators, lined with lead; insulating tubes, steel armoured tubes and other kinds, and bends for conduits, also boxes for insulating pipes. March 31st: *Copper and alloys thereof (with zinc, tin, or other non-precious metal, also aluminium and nickel, &c.; electrical machines—such as generators, motors, converters, transformers, and damping-coils, also stators, rotors, current collectors, magnet coils, brush holders, and armature coils exported separately—provided that they are composed mainly of materials (other than iron) of which the exportation is prohibited; *zinc, unmanufactured, and manufactures of zinc.

* Extension of existing prohibitions.

NETHERLANDS.—The exportation of metals (except iron and steel) in any form has been prohibited as from April 10th.

By a recent decision the Customs duty on electric blowing machines for organs has been determined at 5 per cent. *ad val.* The value to be declared, for Customs purposes, of transformers (dutiable at 5 per cent. *ad val.*) should include the value of the quantity of oil contained in the transformers. This oil need not then be declared and subjected to duty separately.

ITALY.—A Royal Decree was published in the *Official Gazette* of April 4th prohibiting the importation of all foreign goods with the exception of (*a*) goods for account of the State; and (*b*) foodstuffs and raw materials for industries—to be designated by decree of the Minister of Finance. Provision is made for the issue of licences in respect of goods affected by the prohibition. The Royal Decree was to take effect on April 19th, *i.e.*, the day following that upon which the Ministerial Decree referred to in (*b*) was published officially.

SWITZERLAND.—A Federal Decree, dated March 28th, fixed April 1st as the date of coming into force of the new statistical tax on goods passing over the Swiss Customs frontier—see the Electrical Review of March 16th.

UNITED STATES OF AMERICA.—The Supreme Court of the United States gave a decision on March 6th the effect of which is to annul the "5 per cent. rebate" clause of the United States Tariff Act of 1913, under which a discount of 5 per cent. of all duties imposed by the Act was to be allowed on such goods as were imported in vessels admitted to registration under the laws of the United States. The Court held the clause to be inoperative because it conflicts with existing treaties.

AMERICAN WEST INDIA ISLANDS.—An Act of Congress, dated March 3rd, provides for a temporary government for the West India Islands recently acquired by the United States from Denmark. Section 4 of the Act states that, until otherwise provided, all laws now imposing taxes in these Islands, including the Customs laws and regulations, shall in as far as compatible with the changed sovereignty, and not otherwise provided in the Act, continue in force and effect except that articles of United States growth, product, or manufacture shall be admitted free of duty.

PERU.—According to the official *Peruano*, an additional duty of 2 per cent. will be levied on all merchandise imported through the Custom House at Pisco, with the exception of imports in transit to the interior. The proceeds from this duty are to be devoted to the installation of new water supply and sewerage systems for Ica, Pisco, and Chincha Alta. The duty will continue to be levied until the completion of the project

TERRITORY KNOWN AS "GERMAN EAST AFRICA."—It has been officially announced at Mombasa that until it is possible for the Administration in the territory known as "German East Africa" to establish its own Customs stations at Lake ports, all duties, &c., on goods imported from, or exported to Bukoba and Muanza (the only ports now opened) through the port of Kisumu, must be paid at Kisumu. On presentation of drawback specifications showing marks, numbers, description, and contents of packages exported to "German East Africa," and the number of the East Africa import entry on which the import duty has been paid, such specifications being duly certified as to the actual landing at Bukoba or Muanza of the goods covered by them, and after payment of the "German East African" import duty, refund of East Africa import duty will be granted. No drawback of duty will be allowed on goods from open stocks.

All duties on goods consigned under the regulations by the Voi-Military Railway must be paid at Mombasa, refund of East African import duty being payable at Mombasa only.

Further official announcements notify that the ports of Bagamoyo and Pangani have been opened as Customs stations. Hitherto these ports have been open for coastwise traffic only, no direct foreign trade being allowed (see the Review for March 16th).

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

6,053. "Working signals, &c., by electric currents." J. John & W. J. John. April 30th.

6,054. "Intercommunication telephone systems." J. W. Dungey & C. B. Kersting. April 30th.

6,081. "Electric torches." R. Fallows. April 30th.

6,094. "Systems of electric motor control." British Thomson-Houston Co. (General Electric Co., U.S.A.). April 30th.

6,098. "Ignition magnetos." E. C. R. Marks (Soc. Anon. des Etablissements L. Blériot). April 30th.

6,110. "Electric ignition apparatus for internal-combustion engines." C. A. Atherton. April 30th.

6,132. "Electric cut-outs, leakage detectors, &c." J. John & W. J. John. May 1st.

6,150. "Secondary batteries." D. P. Battery Co. & B. M. Drake. May 1st.

6,164. "Electrodes." E. F. Greville. May 1st.

6,177. "Magnetically-controlled apparatus and methods of operating same." C. O. Bastian. May 1st.

6,185. "Combined electric switch, plug, and socket devices." V. Hopp. May 2nd.

6,196. "Electric irons, &c." Cable Accessories Co. P. W. Davis & F. H. Reeves. May 2nd.

6,216. "Spark plugs for internal-combustion engines." J. A. de Vilbiss. May 2nd.

6,255. "Controllers for electric motor circuits." Cutler-Hammer Manufacturing Co. (Igranic Electric Co., U.S.A.). May 2nd.

6,280. "Electric heating devices." British Thomson-Houston Co. (General Electric Co., U.S.A.). May 3rd.

6,285. "Electric welding apparatus." W. J. Mellersh-Jackson & T. E. Murray. May 3rd.

6,287. "Means for improving starting-torque and simplifying starter of single-phase induction motors." H. J. Eley & M. W. Woods. May 3rd.

6,298. "Sparking plugs." T. E. Possot. May 3rd. (France, June 26th, 1916.)

6,308. "Electromagnetic lock-out switch or contactor." V. Breeze & A. West & Co. May 3rd.

6,309. "Electric motor-control systems." Cutler-Hammer Manufacturing Co. (Igranic Electric Co., U.S.A.). May 3rd.

6,320. "Electric heating apparatus." A. F. Berry. May 3rd.

6,334. "Cooling appliances for engines and dynamos." G. E. Bradshaw. May 4th.

6,335. "Detector for wireless telegraphy." M. L. Lancaster. May 4th.

6,341. "Receivers for wireless telegraphy." M. L. Lancaster. May 4th.

6,343. "Electric switches." G. O. Donovan & W. Donovan. May 4th.

6,344. "Electrical apparatus for detecting, measuring, indicating, or recording deviation of boreholes." H. Briggs. May 4th.

6,364. "Means for automatically recording calls in telephone systems." A. E. Woods. May 4th.

6,383. "Electro-medical apparatus." E. E. Greville. May 4th.

6,399. "Insulation for switches." H. H. Berry. May 4th.

6,437. "Automatic micro-telephones." H. Symes. May 5th. (New Zealand, June 26th, 1916.)

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

245. Receivers for Wireless Signals. Marconi's Wireless Telegraph Co. and G. M. Wright. January 6th, 1916. (102,821.)

246. Receivers for Wireless Signals. Marconi's Wireless Telegraph Co. and G. M. Wright. January 6th, 1916. (102,822.)

247. Receivers for Wireless Signals. Marconi's Wireless Telegraph Co. and G. M. Wright. January 6th, 1916. (102,823.)

484. Magnetic Separators. Fried Krupp Akt. Ges. Grusonwerk. February 6th, 1915. (100,062.)

2,058. Dynamo-electric Machines. G. Schroeder. February 11th, 1916. (102,406.)

3,376. Magnetic Separators. A. Davies and E. Allen & Co. March 7th, 1916. (105,354.)

3,566. Protective Device for Alternating-current Systems. A. E. McColl. August 17th, 1916. (105,356.)

3,603. Methods of and Means for Obtaining High Vacua. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 10th, 1916. (105,357.)

4,775. Carbon Brushes for Dynamo-electric Machines. J. E. Grant and Morgan Crucible Co. March 31st, 1916. (105,361.)

9,442. Means for Connecting Electric Lines, especially suitable for use in Telephony. Relay Automatic Telephone Co. & L. C. Bygrave. April 4th, 1916. (Patent of addition not granted. Cognate application, 14,039/16.) (105,363.)

4,983. Electrically-controlled Apparatus for Indicating Liquid Levels, and the Rise and Fall of Gas-holders and Contents Thereof. L. V. Bourne. April 5th, 1916. (105,366.)

5,014. Fog Signals and Course Sounders for Vessels. D. Jones. April 5th, 1916. (105,369.)

5,054. Means for Protecting the Ignition Apparatus of Internal-combustion Engines. Sunbeam Motor Car Co. & L. Coatalen. April 6th, 1916. (105,374.)

5,092. Methods of and Means for Electrically Bonding Rail-ends. J. C. Lincoln. April 6th, 1916. (105,378.)

5,194. Accumulator Cells and Similar Vessels. C. C. Rattey. April 8th, 1916. (105,385.)

5,458. Telephone Receivers. Soc. Française Radio Electrique. December 28th, 1914. (100,281.)

5,477. Apparatus for Displaying Illuminated Pictures, Announcements, or other matter. W. G. Rider. April 13th, 1916. (105,410.)

5,521. Tubular Earths for Electrical Conductors. K. W. Hedges. April 14th, 1916. (105,411.)

5,933. Electrical Switches. L. G. Caunter. April 25th, 1916. (105,422.)

6,476. Vibrating Make-and-break Devices for use in Electric Signalling. A. C. Brown. May 5th, 1916. (105,432.)

7,026. Means for Locking Electric Lamps in their Holders. J. R. Clay. May 17th, 1916. (105,440.)

7,303. Shade Holders for Artificial Lights. A. Hague. May 23rd, 1916. (105,443.)

7,963. Controllers or Switches for Electric Motors and the like. F. J. Decker. June 5th, 1916. (105,453.)

8,625. Distributors for High-tension Magnetos. Morgan Crucible Co. and G. S. Holland. June 19th, 1916. (105,462.)

10,184. Insulating Sleeves for Electrical Transformers. Haefely et Cie., E. October 20th, 1915. (101,861.)

16,145. Electric Contact-breakers or Interrupters. G. F. Cocke. November 10th, 1916. (105,519.)

17,539. Electric Condensers. G. Giles. December 9th, 1915. (102,619.)

THE
ELECTRICAL REVIEW.

VOL. LXXX. MAY 25, 1917. No. 2,061.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: May 25, 1917. [No. 2,061.

Page
Co-operation in the Electric Vehicle Business 561
The I.E.E. Articles 562
Electric Vehicle Notes (*illus.*) 562
Hustling and Team Work, by "Tramp Royal" 563
Some Notes on Electric Fires, by G. W. Stubbings 564
Factory Repairs and Renewals in War Time 565
The Determination of the Sequence of Phases from Wattmeter Readings, by G. Kapp (*illus.*) 566
The Institution of Electrical Engineers... 566
New Electrical Devices, Fittings and Plant (*illus.*) 567
Correspondence—
Wiring with Tough Rubber Compound Cables 567
Legal 568
War Items 569
Reviews 570
The Future of the X-Ray Industry 571
Business Notes 572
Notes 575
City Notes 578
Stocks and Shares 581
Market Quotations 582
Surge Breakdowns in Networks 583
The Tungar Rectifier (*illus.*) 584
High-Tension Overhead Transmission Lines, by G. V. Twiss (*concluded*) (*illus.*) 585
New Patents Applied for, 1917 588
Abstracts of Published Specifications 588
Contractors' Column ... ... Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. *Established 1872.*

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE 1—4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson, & Co., Gresham Street.
AUCKLAND N.Z: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.
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NEW YORK: D. Van Nostrand, 25, Park Place.
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto 1 307.
SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.
WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE "ELECTRICAL REVIEW'S"
ELECTRICAL & ALLIED TRADES DIRECTORY
(THE RED BOOK),

1917 EDITION

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CO-OPERATION IN THE ELECTRIC VEHICLE BUSINESS.

LAST month a meeting of the leading manufacturers of electric vehicles in the United States was held in New York, at the instigation of the Electric Vehicle Section of the N.E.L.A., with a view to arriving at some definite co-operative action with the central-station interests, in order to assist the electric vehicle movement in the States. Four papers were read, dealing generally with the problem of marketing the electric vehicle, and a resolution was submitted, and unanimously approved, which will be presented for further action to the Council of the N.E.L.A

As this resolution is of considerable interest to central-station managers in this country, we briefly summarise its contents on another page. Essentially it is a proposal to finance an educational and organising campaign throughout the country, and for the vehicle manufacturers and central stations jointly to subscribe to the expense; it also embraces the preparation of a pamphlet for distribution to central stations which will contain such information as will facilitate the introduction of electric-vehicle business.

The success which has attended the efforts of our American friends to promote the popularity of the electric vehicle up to the present has been so pronounced, that we are liable to overlook the immense territory which is still awaiting development in the States; apparently consideration of this, coupled with the possibility of expanding the electric vehicle business in existing markets, has led to the movement for closer co-operation by all concerned.

We, in this country, have good reason for being satisfied with the progress of our own electric vehicle movement despite the difficulties introduced by the war; with well over 900 vehicles and a large number of industrial battery trucks in use, and battery charging arrangements provided over an extensive area—as shown in the map published in our issue of April 6th last—the nucleus of an imposing business after the war has been formed, though we, too, can profitably look round with a view to taking the necessary steps to reap the fullest possible benefit from the preliminary work already accomplished.

At the present time we have an Electric Vehicle Committee representative of, in addition to the municipal electrical fraternity, through whose foresight it was formed, some 17 other bodies, all more or less (and some apparently but very slightly) interested in the future of electric vehicle work, and comprising 30 members; we have also some 180 supply authorities who officially cater for the charging of electric-vehicle batteries, together with a few garages which undertake similar work.

We have also the increasing goodwill represented by public appreciation of the merits of the electric vehicle, which should, in the ordinary course of events, lead to a great expansion in its use after the war. On the other hand, it is pertinent to ask whether, in the event of greatly increased business arising, our electric vehicle manufacturing resources are likely to be in any way adequate to meet the requirements on a price and time-of-delivery basis.

British electric vehicle makers are few in number—say half-a-dozen at most: and while this number of factories organised for the production on a large scale of standard vehicles would probably be the best commercial solution of the vehicle supply problem, there is no present indication of such conditions, and, so far as one can see, no probability of the home manufacturer meeting the situation.

And failing him, we shall presumably have recourse to imported American vehicles as in the past, *if* they are procurable and *if* our fiscal arrangements allow of their importation at a price which will compete with the home-grown petrol variety, which is at least a matter for speculation. The American manufacturers may themselves be too fully occupied at home on the resumption of normal business, and even before that time if a considerable commandeering of petrol vehicles takes place, while even if it were possible as an alternative for them to organise factories here after the war, despite their proverbial hustle, their products might arrive somewhat late in the day.

Then, again, given a considerable increase of vehicle users we shall inevitably be up against the garage and charging questions, which more or less hang together, and may become acute in the more rapidly developed areas.

This is a branch of the vehicle movement which, so far, appears to have yielded nothing to the enticement of prospective business, though it is obvious that electric vehicles without adequate public charging and repair facilities will be at a discount for many possible users. No doubt the Electric Vehicle Committee is fully alive to these matters, though the actual position of affairs is by no means clear, and it may be that representation on the Committee does not necessarily imply co-operation in its work, where influential rival interests are threatened.

The I.E.E. Articles.

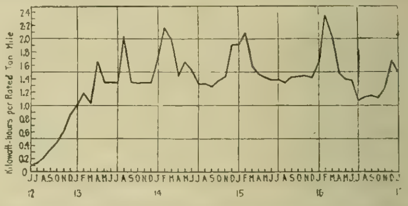
By the adoption of the resolution introducing the system of voting by proxy, last week, the Institution of Electrical Engineers marked the proximate completion of another long stage in its progress towards increased efficiency and usefulness. The need for some means by which the provincial members could participate directly in the decision of important questions without attending general meetings in person has long been keenly felt, and became particularly conspicuous when the new Articles of Association were brought forward in 1911: in our issue of December 8th of that year we suggested that some form of postal referendum was desirable, but nothing was done in that direction beyond providing for the election of Council by postal ballot. However, the lively discussions which took place last year over the expulsion of alien enemies from membership of the Institution brought the matter to a head, and the Council wisely decided to take the necessary steps towards removing the disability under which the vast majority of the members laboured.

That a meeting of a few score of members should be charged with the responsibility of interpreting the wishes of some thousands of absent members was obviously a highly anomalous condition, and the system was liable not only to error but also to abuse. As Mr. Ll. B. Atkinson remarked in the discussion last week, up to the very last moment a determined and coherent group of 100 members could have prevented the expulsion of alien enemies in defiance even of the expressed desire of the overwhelming majority. Mr. J. S. Highfield suggested that the Council, having been elected by the members, ought to be charged with the whole responsibility of deciding such questions. We believe, however, that the Council as a whole has no desire to undertake this burden. The tendency of the age is emphatically away from autocracy and towards democracy: elected representatives are expected not so much to act on their own discretion as to voice the desires of their constituents, and in the case of so widely dispersed a membership as that of the Institution it is obviously very difficult for the members of Council to keep themselves by their own efforts in close touch with the feeling of the general body of members. Hence some method of appealing directly to each member was necessary. While the Council favoured the postal vote as the most satisfactory system, it was constrained by the provisions of the Companies Act to be content with voting by proxy; we strongly sympathise with the views of those members who advocated the former, but in view of the statutory conditions there was no choice, and we believe the meeting acted wisely in accepting the proxy system, which had already been cordially approved of by the Local Sections, in spite of its inherent disadvantages. In future the members, wherever they may be domiciled, will have the satisfaction of taking an active part in deciding all important questions of general policy.

ELECTRIC VEHICLE NOTES.

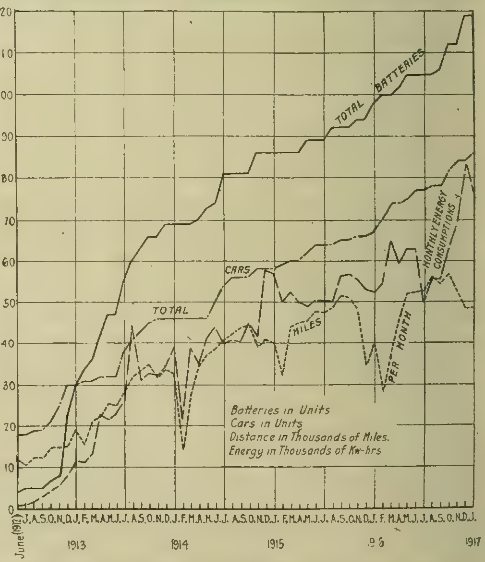
A resolution recently passed by the American manufacturers of electric vehicles, and referred to in our leader, embraces a proposal for co-operation between the central-station interests, electrical vehicle, battery, and accessory manufacturers for the development of the electric-vehicle business in the States.

It sets forth that whereas a meeting of the N.E.L.A. central-station interests, in February last, expressed its confidence in the future of the electric vehicle movement, the manufacturers recommend that a combined fund be raised to defray the expenses of a competent man, operating under N.E.L.A. headquarters, to visit central stations throughout the country, and secure their support for the electric vehicle movement, and to inaugurate electric vehicle bureaus. The man would represent both the central-station and manufacturers' interests, and his expenses are estimated not to exceed $20,000 a year, towards which the manufacturers would contribute 75 per cent. and the stations the remainder, through the N.E.L.A.



Energy Consumption Record per Rated Ton-mile, Hartford E.L. Co.'s Electric Vehicle Department.

It is considered that the arrangement should be for two years, in order to give the plan a thorough trial. It is further recommended that a booklet be prepared for distribution to central stations, dealing with methods of development now employed, plans for establishing electric vehicle bureaus, advertisements for local use, information as to charging apparatus with suggestions as to supplying outfits to public and private garages on deferred payment, also as to local co-operation with dealers, and as to emergency charging at sub-stations. Other recommendations relate to the creation of electric vehicle departments; the charting of towns, showing the situation of charging stations; information as to battery exchange methods, and the adoption of uniform methods by garage men.



Numbers of Cars and Batteries, Monthly Mileage and Energy Consumption, Hartford E.L. Co.'s Electric Vehicle Department.

It is also recommended that the central stations be made familiar with the value of electric vehicle charging as an off-peak, long-hour, low-demand department of their business, with a view to rate revision.

A recent issue of the *Electrical World* contained an interesting article on the well-known battery exchange system of the Hartford Electric Light Co. (U.S.A.). The incentive to establish the system arose from the apathy of local dealers in promoting electric vehicle business; it consists in the customer purchasing from the company a truck without a battery, which latter is supplied by the company fully charged in return for a flat sum for service plus an amount for operation determined on the mileage and size of the truck.

From two to two and one-half minutes are usually required to exchange a battery at the station, which is less than the time required to replenish the petrol in a petrol truck.

The batteries are charged during off-peak hours, and the "exchanging" peaks occur between 6.45 and 8.30 a.m., and round about noon.

It has been found that 1·4 batteries are needed per car, and 88 commercial trucks of various sizes are now operating under this scheme.

In addition to the company's own exchange station, which is part of a sub-station, the service includes a garage owned by the Commercial Electric Garage Co., with whom an arrangement has been come to for garaging cars, repairs, re-charging, &c., from 11 p.m. to 7 a.m.

The garage company owns the building, but all the electrical equipment is owned and operated by the electric light company, whose employés undertake the repair work at night.

Rates are divided into two classes, for cars merely exchanging batteries and for cars in which the batteries are charged in the truck at night, and the truck garaged by the Commercial Co.—the latter class of charge being lower, on the principle that a smaller number of batteries are required.

Efforts are being made by the Electric Light Co. to introduce a mechanical maintenance contract system, under which, in the event of the customer paying more than the actual repair cost, 60 per cent. is returned to him, 20 per cent. going to the Electric Light Co., and, if the owner approves, 20 per cent. to the truck driver as a bonus; on the other hand, if repair costs exceed the contract rate, the customer agrees to refund 50 per cent.

Only 15 of the 88 trucks are maintained on this plan, most owners believing that they can do better by undertaking maintenance themselves. Since the battery exchange system was stated in June, 1912, and to the end of January, 1917, the total mileage has been over 2 millions.

The average mileage per car per month has been 678 (varying from 309 to 810).

The total energy consumption to the end of January last was 2,252,162 KW.-hours, averaging 1·12 KW.-hours per car-mile, with a maximum in the winter months (February, 1916, 1·9 KW.-hours). Ordinarily the rated ton-mile consumes about 1·3 KW.-hours.

The energy used is measured by wattmeters, and includes all losses incurred in transformation and stepping down.

The Edison batteries used in the exchange service at the end of the first 4½ years represented 6,936 cells, and their service was equivalent to 226,812 cell months. Only 225 cells were returned for repairs, 51 being on account of leaks or broken seams, and the rest for other causes, such as failure to charge up or broken terminals. Our contemporary says that, in spite of high first cost, electric vehicles have proved economical, and goes on to suggest that they would sell more rapidly if excess cost over that of the petrol vehicle could be distributed as an operating cost—which the battery service does in part.

The largest electric vehicle garage in this country, which, curiously enough, is run by the Hertford Street Motor Co., in London, houses 120 vehicles, and an important feature of its organisation is the "battery interchange system," in regard to which we must refer readers to the interesting article in our issue of January 19th last, by Mr. R. Borlase Matthews. The methods adopted by this concern, as a result of 15 years' experience, might well serve as a basis for the electric garages which will of necessity be established in the near future.

In conclusion, it may be of some interest to draw attention to the recent decision of the Appeal Court, mentioned in our last issue, under which Mr. Elieson's little electrically-propelled chair falls within the definition of a "light locomotive," necessitating both registration and the obtaining of a driver's licence.

Those who have seen the Elieson chair will realise the incongruity of the legal view, which, moreover, threatens to destroy a promising trade development in its initial stages, as well as to deprive our seaside and other health resorts of an additional means of recreation.

HUSTLING AND TEAM WORK.

By "TRAMP ROYAL."

As the liner enters New York harbour, the Englishman who crosses the Atlantic for the first time receives a gentle awakening from his dream of a hustling America. The slow, deliberate manner of examining him and his Customs declaration papers becomes quite irritating. Ponderous ferry boats, ploughing the harbour waters in all directions and hooting continuously, give him the impression of something old-fashioned, of the nature of sluggish amphibians. Even the "L"-Road and "Underground" only appear calmly active, rather than hustling. A series of annoying delays will make themselves felt until the new arrival has learnt something of the methods of our Yankee cousins. There will grow up within him, in the early days, contempt for the "ich ka bibble" attitude of the American, together with his boasts of "getting a move on."

The fact is, when an American speaks of "hustling," he has a different conception from the Englishman as to the meaning of the word. As an interesting comparison, I should like to give just two experiences.

When I arrived in the States for the first time, some 15 years ago, I spent three days of office hours doing an English hustle along the length, and across from east to west, of Manhattan Island, in a weary, but interesting, search for work. I interviewed managers and others at their dens in avenues, and in streets numbered from units to hundreds, and also outside amidst the upheaval of Broadway, which was having its bowels rearranged by means of noisy engines, banging rock drills, and energetic blasting charges. Eventually I found rest and quiet in a drawing office, where I could recuperate from the expenditure of three weeks' energy in three days, and I felt very satisfied with the fruits of my hustle.

The other experience was learnt some two years ago. A relative of mine, who had got the lay of American methods, completed some work at the San Francisco Exposition. He went to his "digs," and slept in peace. Next morning, he sat at ease in his room, keeping the telephone at his side in constant employment. By lunch time he had fixed up work for 8 a.m. next day, and then strolled round to my bungalow.

To the American, the latter *modus operandi* is hustling, but to us it is laziness. We English seem to insist upon the difficult way of going about things; short, simple methods of working and learning impress us as being quite immoral. Yet we talk of efficiency, and believe "motion study" worth adopting.

In an office building, not so very far from Westminster Abbey, I was once told that my legs were young enough to climb the stairs iinstead of occupying space in one of the four lifts. Yet in America I know fellows who have been fined for using the stairs instead of the "elevator," and thus wasting energy which the firm was buying. Strenuousness calls for extra effort, while efficiency means the conservation of human energy.

I am not endeavouring to prove here that the methods of our cousins across the pond are superior to ours, because I am not convinced that they are: but upon the issue of efficiency and team work I am sure they score. Why, team work is almost unknown over here, and yet most engineers were sportsmen in their early days. As I was a football player, I will now go to the football field for my analogy.

A man can get a considerable amount of exercise by hustling around the field from side to side in a futile attempt to keep to the ball. But that's not football.

I can close my eyes and see my old favourites of Aston Villa coming up the field with the ball. Centre passes to outside right, two opponents are negotiated, and the ball is dribbling in front of the inside left; then over it swings to the inside right, and next second it is on the toe of the centre forward, and then—yes, goal! That's team work. Every man in the place best suited to him, awaiting his turn, with energy in reserve and the interests of the whole team predominating over selfishness.

That is team work in sport; in industry it is just the same; and I have met it in America in the office and in the field. Every man at ease, but turning out his portion of work quickly and correctly. American industry is a big thing, and this *esprit de corps* is not met with everywhere, but it is growing.

All this sounds as though one man is to be capable of only one job; but it must be recognised that, as a captain may find it necessary to change the position of a man during a match, so a captain of industry may find it to advantage to vary a man's employment; and the man should be equal to the occasion.

We are learning many things during this war, and not least are those concerning efficiency—viz., that hurried action is not a substitute for speed of action; that speed and dexterity are based on habit, and that, in accordance with the Law of Diminishing Returns, long hours and overtime defeat their own object. While one cubic yard per hour of excavation in a certain soil may be efficient, to increase the amount to three cubic yards is strenuous, because, after an hour or so, the worker is exhausted.

Who of my readers has not experienced waste of time in rectifying errors, such as in bedplate drillings, cable box borings, steel structural work misfits, or the like, caused through rush work in the drawing office or workshop? System and time-saying devices are the safest roads to speeding-up. "Haste makes waste."

SOME NOTES ON ELECTRIC FIRES.

By G. W. Stubbings.

Electric fires have formed the subject of a number of articles in the technical Press from time to time. The so-called efficiency of the radiator type has been contrasted with that of the convector, without, as far as can be discovered, any definition of efficiency having been formulated. The statement that, in a sense, all electric heaters have 100 per cent. efficiency, in that all the electrical energy absorbed is ultimately converted into heat, has been frequently referred to, sometimes with the apparent idea that it settled the question once for all, and by other writers with some degree of suspicion, as if it were only theoretically, and not practically and actually, true. It seems desirable, therefore, that a closer inquiry should be made as to the way in which a heater of the radiator type is of superior efficacy to that of the convector, and as to what constitutes this superiority of the one over the other.

It may first be useful to interpret the statement that all electric heaters have 100 per cent. thermal efficiency. It should be noted that, although it is stated that all the electrical energy is converted to heat, no mention is made of temperature. The following is a practical illustration:—Suppose two heaters—one a radiator and the other a convector designed to be maintained at a temperature of 10° C. above the surrounding atmosphere—be placed each in a room of the same size and shape, and at the same temperature, having walls of the same material, and both being hermetically sealed; the 100 per cent. efficiency principle states that, if the two heaters absorb equal amounts of electrical energy in equal times, the temperature rise in the two rooms will be equal. This is accurately true, and, moreover, the temperature rise of the air of any room will be approximately the same whether it be warmed by either of the two heaters in question, provided conditions of ventilation be the same. It is, however, quite obvious that the convector, being at an excess temperature of only 10° C., would be a most unsatisfactory heater for an ordinary sitting room, although such a device might be suitable, or even essential, in a drying chamber for some special process.

The above considerations lead to the conclusion that the practical efficacy of an electric fire has very little to do with its thermal efficiency, and that the statement that all electric heaters have 100 per cent. efficiency is irrelevant. There is obviously another factor to be considered. The function of the ordinary fire is to warm the person sitting or standing near to it, and its practical efficacy will be estimated by the ordinary person by the purely physiological effect of comfort and warmth, and not by a careful inspection of a delicate thermometer hung in the room.

A person, or, indeed, any body, can be warmed in two ways. First, by contact with a hot body, and, secondly, by the absorption of radiant energy. The first method is obviously unsuitable to the human person except by contact with warm air, when the process will be slow, unless the temperature of the air be fairly high. To maintain a high air temperature in an ordinary room in which proper provision is made for ventilation would be a very costly matter by electrical means. The second method is independent of the temperature of the air, as radiant energy—which, it should be remembered, is not heat—can pass freely through air without appreciably raising its temperature, and the process can be made as rapid as desired by increasing the absorption. These two considerations can be illustrated by the following examples:—It is a well-known fact that the sun can warm the human person in the winter to such an extent as to make a heavy overcoat uncomfortable, notwithstanding that the temperature of the air may be in the neighbourhood of 0° C. Again, a person coming from a very cold atmosphere, and in a thoroughly chilled condition, would, by remaining in a room at a temperature of 17° C., in time get warm, but would greatly miss the genial glow and ample radiation of a coal fire.

It, therefore, appears that the time element enters into the consideration of what constitutes the practical efficiency of an electric fire, and such efficiency could be roughly described as depending upon the time taken for a person coming throughly chilled from a cold atmosphere, to get comfortably warm by standing at a given distance from it. As has been pointed out, the process of warming by contact with slightly heated air is very slow. Cold people coming into a room choose a seat by the fire, and, when thoroughly warm, usually change to one further away from it. The type of electric fire that will satisfy the condition of rapidly warming a cold person will obviously be one of the radiator class, the radiant energy from which may be rapidly absorbed by the cold person and converted into heat. The radiation from the convector at an excess temperature of 10° C., referred to above, would be negligible, notwithstanding its 100 per cent. efficiency, and perfect suitability for some special purpose.

It is also clear that an electric fire with exposed elements will give the greatest radiation. The old-fashioned lamp radiator, although primarily producing a large percentage of radiation, had an appreciable proportion of such radiation absorbed in the glass of the lamps, and converted into heat. A thoroughly efficacious radiator will, moreover, be as light as possible, for a bulky device, which is maintained at a moderately high temperature, is partly a convector, and therefore loses in practical efficiency. In fine, it should be remembered that all the electrical energy that reappears directly as heat at a fairly low temperature is not usefully employed, as such heat can only be communicated to cold persons by convection and contact.

The above notes, while not being so rigorously reasoned as to be worthy of being called scientific, yet may, it is hoped, assist in giving a rational explanation to what has always been known to, and appreciated by, practical men—the vast difference in the practical efficiencies of electric heaters of the radiator and convector types.

FACTORY REPAIRS AND RENEWALS IN WAR TIME.

[From a Legal Contributor.]

What is the present position of those who are under covenant to repair factory and other premises which they hold on lease?

This is a question which must of necessity give some anxiety to tenants who desire to carry out their legal obligations. No doubt many landlords are ready and willing to make due allowance for the difficulties of the times, but others may not be so complacent. The matter, too, must sometimes be regarded from the landlord's point of view. Some tenants are in possession under agreements entered into before the war. They are paying rent at pre-war rates, and by no possibility can the landlord increase the rent; yet he must pay his income-tax at war rates. It is notorious that, owing to necessary stagnation in the building trade, house property has materially increased in value. Must the landlord stand aside while the tenant, who is paying a low rent, is allowing the premises to go to rack and ruin—pleading, as an excuse, lack of labour and expense of materials?

As the war goes on the cost of labour, and therefore the cost of repairs and renewals, will in all probability increase. The tenant, therefore, who is subject to a repairing covenant may do well to obey the homely maxim that "a stitch in time saves nine."

Repairing covenants, of course, vary considerably. Some are much more onerous than others. It is proposed to discuss the average covenant.

Take the case of a mill or factory which, when let 10 years ago for a period of 14 years, had already been built 50 years. Assume that the tenant was put under covenant to "well and substantially repair, paint, glaze, cleanse, and keep in thorough repair and good condition all the said premises thereby dismissed," and so yield them up at the end of the term. This mass of legal verbiage comes to this. The tenant must repair the premises. What does the word "repair" really mean?

It is plain, at the outset, that before considering the amount of repair which the tenant must effect, the standard of excellence must be ascertained. It is one thing to keep a brand new building in repair; it is another to repair premises which have been in existence 50 years. Time and the elements have operated upon all the perishable parts of the structure. Every particle of wood may have become rotten. Must the tenant replace every joist and every floor, and so—in effect, give the landlord a new building?

One rule has been firmly established—namely, that where a house as a whole, or the subject matter of the covenant as a whole, has by lapse of time fallen into such a condition that it is necessary to rebuild it, the covenant to repair does not apply.

To take a fanciful illustration: Oliver Wendell Holmes, in his poem called "The One-Hoss Shay," describes how a certain vicar, in building a shay, decided to so construct it that no one part should perish before another. All the wearing parts were so proportioned that the whole erection should come to an end at once. In the result, having been driven in fine weather and wet by the vicar and his descendants through certain centuries, the shay suddenly collapsed in a heap on the road. It ceased all at once to exist as a shay. Had its then owner been under covenant to repair it, he would not (according to the above principle) have been bound to rebuild it. So in the case of a house or factory—if, say, the whole interior woodwork, after the lapse of time, were to suddenly collapse, so as to leave nothing but the four external walls standing, the house could not be said to exist as a house, and the tenant would not be liable to rebuild. Similarly, if all the walls were to suddenly collapse, so as to leave nothing but a heap of ruins, the liability of the tenant would be at an end.

But short of giving the landlord a new house, the tenant must repair and renew individual parts which give out owing to the lapse of time—it being a question of degree whether the failure is so extensive as to really necessitate a complete rebuilding.

The law was laid down very clearly by the Court of Appeal in Lurcott *v.* Wakeley & Wheeler (1911) 1 K.B. 905. There a wall forming part of a house 200 years old became so dangerous, that it was pulled down in compliance with an order of the London County Council. It was taken down and rebuilt in accordance with modern requirements. The condition was caused by old age, and the wall could not have been repaired without rebuilding it. The tenant contended (1) that he was not bound to give the landlord a new wall: (2) that the damage having been occasioned by the age of the premises, he was not liable. The Court held him liable.

The Master of the Rolls said:—"Given an old house which in the course of the term, though still a habitable house, is rendered worse by mere lapse of time and the effects of wind and weather, then the loss falls on the landlord. . . . [But] (at page 914) if a tenant under a repairing lease finds that a floor has become so rotten that it cannot be patched up: that it is in such a condition that it cannot bear the weight of human beings or of furniture upon it, can it be said that the tenant is exempt from the liability of replacing that floor, and repairing it in the only way in which it can be repaired, in order to make the house habitable, merely because the state of the floor is due to time and the elements? I am unable to follow the argument. . . . In such a case it is the duty of the tenant, if he cannot patch up the floor so as to make it a floor, to replace that which is no longer a floor by something which is a floor."

Lord Justice Fletcher Moulton said (at page 916): "We must bear in mind that, while the age and nature of the building can qualify the meaning of the covenant [to keep in good condition], they can never relieve the lessee from his obligation. If he chooses to undertake to keep in good condition an old house he is bound to do it, whatever be the means necessary for him to employ in so doing." He emphasised the fact that the covenant extended not only to repair but to keeping in good condition, and said:—"Suppose the case of a ship. A man who covenants to keep the *Mauretania* in good condition must, of course, keep her in the perfection of condition by reason of the fact that she is a vessel of her class and new. Suppose a man covenants for a year to keep in good condition a tramp that has been at sea for 15 years, he must perform the covenant just as much as the man who covenanted to keep the *Mauretania* in good condition. But the keeping in good condition in the second case will mean something very different from that which it meant in the former case; it will mean in good condition for a vessel of that age and nature."

Applying these principles, the following propositions may be advanced:—

1. If a floor gives out it must be replaced.
2. If the window frames become so rotten that they will no longer hold panes of glass, they must be replaced: but if the frames were originally of deal, the tenant need not replace them with oak.
3. If an outside wall perishes through lack of pointing, &c., it must be rebuilt—if it cannot be repaired.

Finally, it should be noted that if the tenant, in carrying out his repairs, gives the landlord the benefit of the methods of 1917 as against those of 20 years ago, that is the landlord's advantage. The tenant can make no claim upon him. For instance, if he were to build a pillar of reinforced concrete, instead of brick, he could not recover the extra cost.

The German Electricity Supply Federation.—The second general meeting took place recently in Berlin of the Federation of Electricity Supply Undertakings, which was founded about a year ago to represent the economic interests of company-owned and other privately-owned supply works. It was reported that in the meantime the membership had increased, and now comprised all the works of any importance, the invested capital represented by the constituents being £125,000,000. Among the subjects discussed was the question as to how to transfer to consumers the financial burden arising from the introduction of a tax on the sales of coal at the pit mouth, and the problem of charges for supply of energy. It was mentioned that production and working costs in general of supply works had advanced through the war to such an extent that ways and means must be devised for obtaining compensation.

THE DETERMINATION OF THE SEQUENCE OF PHASES FROM WATTMETER READINGS.

By DR. GISBERT KAPP.

(*From the Journal of the* Institution of Electrical Engineers. *Abstract.*)

The so-called "two wattmeter method" of measuring the power flowing through a three-phase line may be used to determine the power factor according to the well-known formula

$$\cos \phi = (1 + r)/2\sqrt{(1 - r + r^2)}$$

where r is the ratio between the two readings. This ratio has to be determined by dividing the smaller reading by the larger, and the power factor may then be read off from a chart such as is used in every test-room. The same chart may be used if the two readings are obtained by the well-known modification of the "two wattmeter method" where both readings are taken on the same wattmeter by using a change-over switch for the pressure circuit of the wattmeter.

The chart tells us what the power factor is, but nothing more. It does not tell us whether the current is leading or lagging, nor the sequence of phases. This can only be found if we know, not only the ratio of the two readings, but also their signs as determined by the sequence of phases. Before we can tell whether any particular power factor read off on the chart means a lagging or a leading current, we must know the sequence in which the phases follow each other.

By tracing back the circuit to the generator it is possible to interpret the chart reading as regards the sign of the phase angle: positive for a lagging and negative for a leading current. But it is not always convenient, and is frequently impossible, to trace the circuit back from the point where the power measurement is made to the generator. There may be a distance of miles between the two points, and there may be various transformations within that distance. In such cases some other method purely local must be employed.

The following method is quite practicable; it does not interfere with the power supply to the load, and the additional cost is confined to the provision of a paper condenser of a few microfarads capacity. The arrangement of apparatus is shown in fig. 1. W is the wattmeter as ordinarily used, S is the change-over switch, also as ordinarily used, and K is a condenser which can be short-circuited by inserting the plug G. When the plug is inserted the sum of the wattmeter readings gives in the usual way the total power. If the plug is withdrawn, the condenser is in series with the pressure coil of the wattmeter, and the current through this coil is slightly advanced, as compared with the usual test. The two readings will, therefore, be different from those obtained with the condenser short-circuited, and by analysing the two sets of readings it is possible to determine whether the sequence of phases is A–B–C or C–B–A, and also whether the current supplied to the load is lagging or leading.

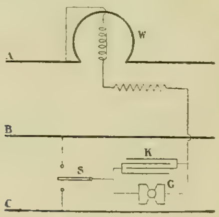


Fig. 1.

If P_c and P_b are the wattmeter readings when the switch is connected to C and B respectively, and P'_c, P'_b the corresponding readings when the plug is withdrawn, the following table applies:

Readings taken in the usual way give	$P_c > P_b$		$P_b > P_c$	
If readings taken with condenser give	$P_b > P'_b$	$P'_b > P_b$	$P'_c > P_c$	$P_c > P'_c$
Then sequence is...	A—B—C	C—B—A	A—B—C	C—B—A
And current ...	lags	leads	leads	lags

In using this table, care must be taken to insert the powers with their proper sign; thus if P_b is numerically smaller than P'_b, but the latter is negative whilst P_b is positive, then P'_b must be considered to be smaller than P_b.

The same table may be used if the measurement is made by two wattmeters in the usual way. In this case the free terminals of the pressure coils must be connected through condenser and plug to the phase line labelled A, and the wattmeter must be inserted into the phase lines labelled B and C.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Annual General Meeting.

On Thursday last week, at the Institution of Civil Engineers, the annual general meeting of the Institution of Electrical Engineers was held, the President, Mr. C. P. Sparks, in the chair.

At the outset, after announcing the result of the election of Council, the President proposed that a telegram of congratulation should be addressed to the American Institute of Electrical Engineers on the entry of the United States into the war. In seconding the resolution, Mr. C. H. Wordingham, President-Elect, said that many industrial Americans had long wished to take part in the war, and these two great nations, after purging themselves of the foul cancer of German influence, might some day form part of a great federation. The proposal was unanimously agreed to.

Moving the adoption of the report, the President drew attention to the account of the doings of the Council and Committees, which were now set out for the information of the members. Students' premiums had not been awarded during the past year, but were being accumulated so that at the end of the war those who were now on war service would be able to share in them. With regard to street lighting, it was impossible to arrive at a unanimous decision, but the majority report would be published in order to place valuable data at the disposal of the members.

Mr. C. H. Wordingham seconded the adoption of the Report, which was agreed to *nem. con.*

The Hon. Treasurer (Mr. J. E. Kingsbury), in briefly presenting the Accounts, pointed out that the previous year's results were printed in the margins of the pages, as suggested at the last annual meeting. The President congratulated the Institution on having attained the largest surplus on record, for which special thanks were due to the Finance Committee and the Secretary, and the accounts were adopted unanimously.

Votes of thanks were awarded to the Hon. Secretaries of Local Sections, the Hon. Treasurer, Solicitors, and Auditors.

A special general meeting followed for the consideration of a resolution altering the Articles of Association, in order to enable members who were unable to be present at annual or special general meetings to record their votes by proxy, in accordance with the practice of limited companies.

In moving the resolution, the President stated that the question arose out of the proceedings in connection with the alien enemy members last year. At the suggestion of the Manchester Local Section, a committee was appointed to consider the matter, and decided in favour of the proxy system. In order to safeguard its operation, when a controversial question was under discussion meetings would be held at local centres in advance, at which the matter would be fully explained to the members, so that they could decide how to make use of their proxies. Several suggestions for other alterations of the Articles had been received, but the President thought it would be better first to amend the constitution of the Society; his successor could then proceed with further alterations on the new basis.

Seconding the resolution, Mr. Wordingham stated that he held the strongest possible views on the necessity of enabling all the members to express their opinions; it was absurd that a small meeting should make fundamental changes in their constitution. In future, any alterations in the Articles would be made by the whole body of Corporate Members.

Mr. A. A. Campbell Swinton pointed out the differences between the Institution and limited companies, and expressed preference for voting by post, regarding the proxy system as a most dangerous suggestion.

The President replied that while the Committee preferred the postal vote, it was not possible under the Companies Act to make that system effective; hence they had no option but to adopt the proxy system, of which, he believed, the Local Sections fully approved.

Mr. J. S. Highfield agreed with Mr. Campbell Swinton, holding that the proxy system was undignified, and that as every possible provision had been made for electing a representative Council, the whole responsibility for decisions should be placed upon it.

Further discussion followed, in which Mr. A. M. Taylor, Mr. Ll. B. Atkinson, Mr. C. A. Baker, and other members took part.

At the invitation of the President, Mr. J. H. Clothier and Mr. R. A. Chattock expressed the desire of the provincial members to take a more active part in the proceedings of the Institution, and to have the power of voting, though unable to be present at general meetings. Mr. Wordingham and Mr. E. T. Williams further emphasised the necessity of complying with the earnest desire of the country members to secure a voice in the proceedings, and the resolution was carried by 28 votes to 4.

A special general meeting will be held on June 14th, at 6 p.m., at the temporary offices of the Institution, to confirm the resolution.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Electric Power in a Cotton Mill.

The Dunlop Tyre Co. have erected a factory the D.R. Cotton Mills—at Rochdale for the purpose of manufacturing their motor-tire fabric direct from the raw material, and have equipped it on the most up-to-date lines, with, of course, electric power transmission. The works are divided into two sections, one making the yarn from the cotton, and the other manufacturing the fabric from the yarn; they occupy an area of 33,000 sq. yards, and are driven by Witton motors aggregating 2,500 H.P., while the lighting is effected by about 1,360 Osram lamps with an average of 40 C.P. each. Electrical energy is supplied by the Rochdale Corporation at 6,000 volts, three-phase, and is distributed through the works at 400 volts for power and 200 volts for lighting. Isolated machines are driven by separate motors, but where large numbers of machines have to be driven in the same room the group system is employed. In most cases the semi-enclosed type of induction motor has been installed, but wherever possible the motors driving groups of machines are housed in special motor-corridors running parallel with the length of the room, as shown in fig. 1, chains being employed for driving the shafting; the motors are started with auto-transformer starters or rotor starters, according to circumstances. The largest motors are of 150 H.P.

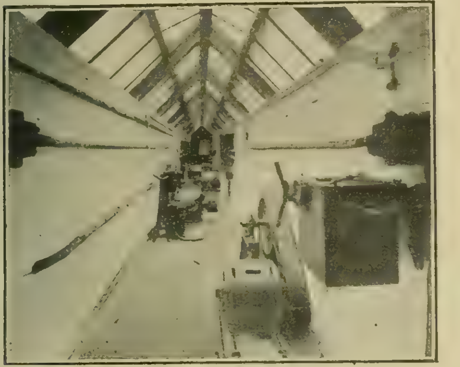


FIG. 1.—MOTOR CORRIDOR, SHOWING WITTON MOTORS WITH CHAIN DRIVE.

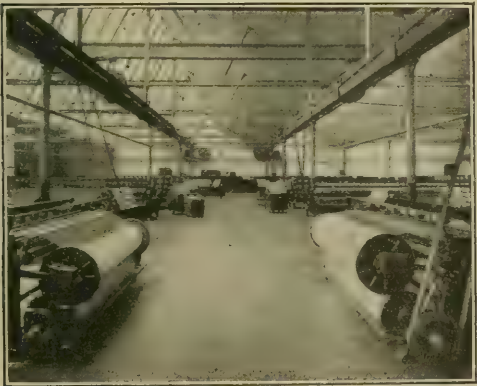


FIG. 2.—GROUPS OF MACHINES DRIVEN BY TWO 10-H.P. WITTON MOTORS.

Every opportunity is taken of reducing labour costs by the use of electric power. The bales of raw cotton and the finished goods are handled by 7-cwt. electric hoists driven by 6-H.P. motors; the hopper feeders are also driven by 6-H.P. Witton motors, and the broken cotton is conveyed to the next machine by a current of air produced by a 6-H.P. electric fan. The bale-breakers are driven by 20-H.P. motors. In one of the corridors are installed two 150-H.P., four 40-H.P., and two 20-H.P. Witton motors, driving the groups of carding machines, stubbing, intermediate, roving and ring spinning frames, &c. The humidifiers are separately driven by 6-H.P. motors, and the fabric-stretching and examining machine by a 20-H.P motor.

The whole of the electrical plant, lamps, cables, &c., was supplied by the **General Electric Co., Ltd.**, of Witton, Birmingham, through their local office at Victoria Bridge, Manchester.

A Novel Primary Cell.

We have received from Mr. J. W. Warr, of 100, Prescot Road, St. Helens, Lancs., a sample of his new primary cell, to which provisional protection has been accorded by the Patent Office. The cell will be made in three sizes: No. 1, 1½ in. diam.; No. 2, 2 in. diam.; and No. 3, 2½ in. dia.—all 5½ in. high.

In this particular sample, which is No. 1 size, and a modification of the Leclanché cell, the active material and depolariser are packed in a dry state, under heavy pressure, round the central electrode, with a perforated electrode outside. The cell has a very low internal resistance and high capacity. To make the cell active it is only necessary to stand it in a glass or earthenware jar (the familiar Leclanché glass jar or an ordinary jam-pot will do) and add water up to ¼ in. from the black varnish round the top. Within a few minutes the cell is ready for use, and after a few hours the short-circuit current will be between 12 and 16 amperes.

The active material, depolariser, and zinc have been proportioned so that exhaustion of all three is nearly simultaneous; but if there is further life in the zinc, the cell can be revived by standing it in a solution of sal-ammoniac. There is no crystallisation on the zinc of a cell that has been in use many months.

In order to prevent a humid atmosphere from attacking the absorbent medium and tending to make the cell active, a perforated celluloid separator is interposed. This makes the cell keep indefinitely in stock, and will be found most effective for cells required for export. A glass jar will, of course, be supplied with the cell when required. The E.M.F. is 1·5 volts. The same principle is adopted for bichromate cells (over 2 volts), Daniel cell (·9 volt), and Lalande (1·4 volts).

The Leclanché type is the one that will be most used for signalling work, and in particular it will be found especially useful in indicating the height of water, or giving an alarm when water reaches a certain height in sump-holes in collieries, basements, trenches, and excavations. For ships' holds, or where there is likely to be flooding in ships' bottoms, it will be found useful.

After the cell has been lifted out of water, in a few minutes it will be found to be inactive; on the other hand, if it comes in contact with water it will become active.

The inventor points out that by consolidating the active salts, depolarising and conducting material, and electrodes into one unit, and placing the whole in water, greater utility of materials, higher efficiency, and low internal resistance are obtained. The stocking of chemicals, porous pots, zincs, &c., is unnecessary.

Another type of cell is being made to be used in place of the dry cell. After immersing in water, the cell will hold sufficient moisture to keep it active over long periods, and this can be repeated until the cell is exhausted.

Arrangements are being made for manufacturing the cell, but communications for the present should be sent to Mr. Warr.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Wiring with Tough Rubber Compound Cables.

Writing under the above heading, in your last issue, Mr. W. Ellerd-Styles wrongly assumes that the "Consumers' Engineer" writes from a "dug-out," whereas his vantage point is a conning tower, from which he surveys the efforts of many good, very good, excellent, and other electrical contractors, and his responsibility does not finish with that of the contractor, but continues until the new method of to-day becomes old, reveals its defects, and gives place to the new methods of to-morrow. His claim to a wider perspective is easily established, both with regard to latitude and longitude, as he was remedying defects on new methods a decade before your contributor claims to have entered the electrical arena; and his range extends from pole to pole.

It can very well be left to your readers to decide for themselves what is meant by the terms "water-tight" and "water-proof," and also whether work so specified should not be done in a permanent manner. Your contributor uses both terms on page 452 of your issue of April 27th when he said:—"The writer favours the use of flat section cable *when the system is not required to be water-tight.* . . . *A water-proof system is obtainable* by using ordinary screwed surface boxes and outlets, as made for ½-in. conduits, adapted by the employment of externally screwed grip nipples. The circular section multicore cable is used, and stout rubber rings effectively bind the cables in the nipples."

Do Mr. W. Ellerd-Styles, "Another Member, &c.," and the Editors still contend that when a water-tight system is required, no attempt is made to provide a permanent job? The only meaning that can be applied to the word "water-tight," is that associated with water-tight bulkhead, water-tight door, water-tight joint, &c. If the word was wrongly used by your contributor, surely it is easier and far more graceful for him to admit it than to waste the time of your readers in trying to defend a position which is untenable.

If his real object is to "obtain a very cheap and reliable method of wiring which would rapidly popularise the use of electricity in directions at present monopolised by 'penny slot meters,'" then the thing to aim at is to interest the "supply authorities' representatives," and not abuse them. Concerted action is necessary if progress is to be achieved in this direction, and any project on these lines will benefit by the inclusion, amongst its promoters, of all those whose experience and judgment entitles them to be contemporaries in a similar capacity to

Consumers' Engineer.

[We did not "contend" anything; our comment was intended to confine the discussion to the legitimate channel, for too much emphasis has been laid upon the word "permanent," which was not used by the author of the article. Personally, with an experience which rivals that of our correspondent in length, if not in breadth, we are of opinion that no wiring system ever was, or ever will be, "permanently waterproof." What the wireman should aim at is to do his work so that it will remain waterproof as long as possible.—EDS. ELEC. REV.]

LEGAL.

JOHN WALSH, LTD., v. WEBSTER.

THIS action, which was brought by John Walsh, Ltd., of Sheffield, to recover money alleged to be due for electrically fitting the defendant's house, came before Justices Rowlatt and Shearman, on May 17th, on a motion by the plaintiffs to set aside an award made by Mr. Wm. Bradley Woodhouse.

MR. HUME WILLIAMS, K.C., in opening the case for the appellants, said that the appeal arose out of the interpretation of the law by the arbitrator, he having come to the conclusion that if the contract was not completed, the defendant was at liberty to repudiate it in its entirety. Mr. Webster, a solicitor, was desirous of having an electric light installation put into his private house, and a contract was entered into between him and John Walsh, Ltd., on March 2nd, 1915, under which the appellant company were to do the work for a total sum of £888. It was, said counsel, a lump sum contract. The defendant alleged that the work was done improperly, and was incomplete. Messrs. Walsh brought an action to recover the amount of the contract price, and the matter was referred by Master Bonner to Mr. Woodhouse, as arbitrator. The arbitrator gave his award on October 25th, 1916, in which he stated that, in his opinion, the work under the contract was unfinished and incomplete, and in certain particulars insufficient and unsatisfactory, and not in accordance with the specification; and that being so, the defendant ought not to be required to accept it. If, however, the defendant were to accept it in its then condition, the arbitrator was of opinion that £50 would be a reasonable sum to be allowed from the total sum to make it complete and satisfactory. The defendant thereupon intimated that he would not accept, and called upon the plaintiffs to take away the installation they had put up, and to pay for the damage done to his house. Counsel submitted that the defendant was not entitled to repudiate the contract. He could only do that where the contractors had failed to do a substantial part of the work, or had neglected it to such an extent that it could be said there was nothing like a fair execution of the contract. That was not the case here, as the arbitrator had found that there was only a failure as to a small part, which £50 would put right. Under those circumstances, he submitted, Mr. Webster was not entitled to repudiate the whole contract.

MR. GREER, representing the respondent, said the real issue between the parties, when before the arbitrator, was that the contractor was suing too soon for his money, especially when the employer was ready and willing at that time that he should complete the work. Mr. Webster was at first quite willing that Messrs. Walsh should finish their contract.

MR. JUSTICE ROWLATT, in giving judgment, said the real question was, what was the meaning of the words unfinished and incomplete in the award? They felt they did not know one way or another. It was, of course, possible that £50 might put the whole thing right; but, on the other hand, something vital to the installation might be missing, or it might only be bad workmanship. The arbitrator had, however, not told them, and therefore the award must go back to him to state whether the installation was still incomplete in the sense that some substantial part had not been done, or whether it was only incomplete in the sense that some of the work was badly done.

MR. JUSTICE SHEARMAN concurred, and the matter was referred back accordingly, the costs of the application being reserved.

ELLIS v. BIRKETT.

ACCORDING to the *Essex Weekly News*, the hearing of the action in which Montague August Ellis, manufacturer of refrigerating machinery, Southend, and H. H. J. Ellis, his son, claimed £100 damages from Robert Birkett, electrical engineer to the Southend Corporation, for alleged breach of an indenture of apprenticeship, was resumed last week at the Southend County Court. The jury found for plaintiffs in the action, awarding £50 to the father and £25 to the son. They also found for Mr. Birkett for £50 in the cross action, the Judge having advised them that there was no defence to this claim, the contract not having been cancelled.

Judgment was given in accordance with the jury's findings.

LONDON ELECTRIC RAILWAYS.

COMPULSORY ACQUISITION OF WESTMINSTER PROPERTY.

ARBITRATORS having failed to agree, Mr. A. Virgoe Buckland, F.S.I., as Umpire, sat at the Surveyors' Institution to hear a claim for compensation, payable by the London Electric Railways Co. to the trustees of Mr. John Smith, in respect of certain property situate near Victoria Street, Westminster, on the exercise by the Railway Co. of their compulsory powers. The property consists of Nos. 29 and 31, The Broadway, which is leasehold, and of freehold land in Maundy Place.

Mr. Eustace Hills was counsel for the claimants, while Mr. Szlumper appeared for the Electric Railways Co.

The hearing of the claim was concluded, and the Umpire will announce his decision in due course.

THE BOSCH MAGNETO PATENTS.

BEFORE the Controller of Patents, Mr. Temple Franks and Sir Cornelius Dalton, the Chesham Supply Co., Ltd., applied in the Patents Court on Friday for licence to use 11 German Bosch patents for magnetos:—23,132 of 1905, 24,288 of 1907, 25,855 of 1908, 24,686, 24,687, and 27,168 of 1910, 8,224, 25,880, 26,928, and 28,518 of 1911, and 4,692 of 1913.

Mr. W. P. Carpmael appeared for the applicants.

MR. O. IMRAY, for the patentee, opposed the application. He stated that the patents had been worked in this country by the Bosch Magneto Co., Ltd., of Tottenham Court Road, where a sale of the goodwill, the very large premises, and the effects had this week been effected to Messrs. Vickers, Sons, & Maxim, who were going to carry on the business through the Wolseley Car Co. He thought the hearing should be adjourned to give Vickers, Sons, and Maxim the opportunity to attend. The Controller of the Bosch Magneto Co. had just written him that he himself did not need to be represented at the hearing.

The CONTROLLER OF PATENTS observed that the sale of the Bosch Magneto Co.'s premises and goodwill was made explicitly without the patents.

MR. IMRAY replied that he believed that was in order that the purchaser might apply for a licence in the Patents Court. He suggested that Messrs. Vickers, Sons & Maxim should have a prior claim, as they had bought the goodwill.

The CONTROLLER said that Vickers, Sons & Maxims' chance of getting a licence would not be imperilled.

MR. IMRAY explained that he was not acting for Messrs. Vickers, Sons, & Maxim, and the Bosch Magneto Co. was not in a position to transfer the patents, because all the patents stood in the name of the German Bosch.

Presenting the application, MR. CARPMAEL said the company was all-British, and gave financial support to the various cab companies, including Unic Motors, Ltd. The firm also had a manufacturing branch at King's Cross, known as Motormeters, which would manufacture the magnetos. The enemy Bosch company held an extraordinary number of patents, about 100, he gathered.

Evidence was then called. MR. P. C. MIDDLETON, applicants' managing director, reported that their capital was £300,000—250,000 preference and 50,000 ordinary. At the present moment they were making aeroplane parts. Before the war Messrs. Bosch and Co. supplied 90 per cent. of the magnetos in the British trade. The applicant's private demand before the war was 2,500 a year. They wanted them for the Unic taxicabs, of which there were 4,000 on the streets at the present moment, and they proposed to put up works to manufacture the magnetos. A great many of the Bosch patents were really patents of ideas of Richard, the inventor of the Unic cars, and the ideas were Richard's in the magneto the applicants wished to use. They proposed to pay a royalty of 5s. or 5 per cent. on each magneto made. They would not use all the patents. They might use only one contact breaker. The armature was not covered by the patents. In his opinion, there was no patent in it that was not used nearly 30 years ago in some instrument or other. It was the combination that seemed to supply "new matter." The thing that frightened the manufacturers of this country was that there was no protection for the manufacturer.

MR. JAMES ARTHUR LINNEY, manager of Motormeters, said they had 40,000 sq. ft. of site available, which could be added to, and upon this they intended to put up buildings for making magnetos. They would also erect automatic machinery. After the war, millions of magnetos would be wanted in this country, and at least a dozen respectable firms could find a ready sale for a good magneto. The applicants, in the meantime, had to face the scarcity of machinery and get in jigs and tools necessary to turn out the magnetos at low prices. His instructions were to make preparations to meet a demand for 2,500 magnetos, to start with. At present, the Army, Navy, and Air Services were claiming every available magneto. There was an enormous demand for the public services.

The CONTROLLER: But not for the service of the public? We have to make that distinction.

MR. LINNEY said they did not propose to meet the public demand immediately. The authorities had advised them to ask for these patents, since they were applying for contracts, and promised, in that case, to give them permits to get machinery.

In concluding the hearing, the CONTROLLER announced that a case had been made out for granting the licence.

MR. CARPMAEL remarked that when the war began the Bosch Co. set up a factory in Springfield, U.S.A., and these magnetos had been imported from America since then.

The CONTROLLER went on to say that the Court had been somewhat surprised that other applications for licences to use these patents had not been forthcoming during the three years of the war. If other applicants came forward it might be that the Court would have to go into the question of royalty again. No doubt there would be other applicants.

WAR ITEMS.

Engineering Industry After the War.—We have received from the London Association of Foremen Engineers a report of a debate which was opened in October, resumed in November, and concluded in January, on "The Position of the Engineering Industry After the War."

Lighting Economy at Copenhagen.—Reuter's agent at Copenhagen, quoting the *Berlingske Tidende*, states that owing to the reduction of electric light to a minimum in the Copenhagen theatres, Herr Max Reinhardt's company has given up its intended visit, although all arrangements had been made for it.

To be Wound Up.—The Board of Trade has ordered the following company to be wound up under the Trading with the Enemy Amendment Act:—

Cedes Electric Traction, Ltd., 112, Great Portland Street, London, W. 1, manufacturers of motor vehicles. Controller: H. E. Burgess, Official Receiver in Companies' Liquidation, 33, Carey Street, W.C. 2.

Coal and Metals: Enemy Shortage.—Reuter's correspondent at Zurich states that owing to lack of coal the Stuttgart Gasworks have shut off the supply from 1 p.m. to 6.30 p.m., and from 8.30 p.m. to 5 a.m. This restriction of gas to 10 hours a day is a catastrophe to many factories using gas power, and is causing intense inconvenience to the whole population.

The Austrian military authorities will requisition in June all brass and copper door-handles and door-plates in every town containing over 2,000 inhabitants. Owners will be given iron substitutes, but no monetary compensation. The authorities expect to obtain 9,000 tons of metals.

German Commercial Preparation for Peace.—According to the *Times*, the *Frankfurter Zeitung* calls attention to the deliberate preparations of German companies for the period of transition from war to peace. It is observed that special reserve funds for this purpose are making their appearance in numerous balance-sheets, and that important concerns are increasing their capital by large amounts, although for the present they are only calling up a small percentage of the new capital. The newspaper says:—

"The fact that the companies are now, while the war is still proceeding at full pace, making such large additions to capital, shows confidence concerning the future and the definite expectation of adequate activity not only during the war, but also in the coming time of peace."

English Cyanamide Interests in Germany.—It is reported from Berlin that the Government has ordered the compulsory administration of the assets in Germany belonging to the North-Western Cyanamide Co., Ltd., of London, the Societa Italiana per il Carburo di Calcio, of Rome, the Société des Produits Azotes, of Paris, the Nitrogen Fertilisers, Ltd., of London, and the Aktieselskabet North-Western Cyanamide Co., of Odda. The latter is apparently identical with the first company mentioned.

The King's Tour of Industrial Works.—In the programme of His Majesty's series of visits to industrial areas last week, the works of Messrs. Vickers, Ltd., at Barrow, held an important place. The King was received by Mr. Albert Vickers, the chairman of the company. In reply to a loyal message sent to His Majesty by Mr. Vickers on behalf of the company and its workmen at Barrow and at the Lancashire factories, the King telegraphed from the Royal Train as follows:—

> I wish to assure you and the members of your staff and workmen who joined with you in the message I have just received, how much the Queen and I appreciate the patriotic sentiment to which it gives expression. We were delighted to have this insight into the everyday life of the men and women of your shipyard and factories, and we were much pleased by the loyal and friendly welcome accorded to us.
>
> I shall, indeed, be happy if the outcome of our visit to Lancaster and Barrow results in further efforts on the part of those employed in these important works to increase the fighting value of my Navy and Army.
>
> I am confident that British workmen will never fail their fellow-countrymen who are fighting our battles on sea and land, but will continue to assist them by every means in their power. GEORGE, R.I.

At a national shell factory in the neighbourhood of Carlisle, Captain F. W. Purse was among those who had the honour of receiving the King and Queen.

The King's visit to the works of the British Westinghouse Electric & Manufacturing Co., Ltd., will long live in the memory of the workers, who were afforded an opportunity of seeing the Sovereign during the progress of an hour's tour of these vast factories. His Majesty "clocked on" on his arrival at 10.10 a.m., and "clocked off" on his departure at 11.7 a.m. Our readers are familiar, after reading the speech of the chairman delivered at the recent annual meeting, with the vastness of the company's operations, its large percentage of female labour, and so forth.

The following gentlemen were presented to His Majesty's during his visit to the works: Messrs. Annan Bryce, M.P. (chairman), W. W. Blunt, Norman B. Dickson, A. Spencer, P. A. Lang, Sir Edward Goulding, M.P., Messrs. A. E. Scanes, H. Mensforth, M. A. Maclean, J. H. Tearle, P. N. Rand, J. S. Peck, G. H. Woods, A. G. Seaman, and L. M. Rogers.

On entering the offices, His Majesty saw an excellent exhibit of interesting manufactures by the company, and also the Roll of Honour of over 2,500 men who have joined H.M. Forces. He then proceeded on his tour of the works. He first entered the coil-making, insulation and transformer department, the superintendent, Mr. Fleming, being presented. His Majesty was extremely interested in the working up of copper and mica in this department. Incidentally, Mr. Fleming is responsible for the works school for training apprentices in special theoretical and advanced studies. His Majesty's was much interested in this work. Passing on to the other section of the works, His Majesty's entered the switchgear section, where Mr. Randolph was presented. Passing on to the electrical machines department, Mr. G. H. Nelson, superintendent, was presented. In the engine department, Mr. G. E. Bailey, superintendent, was presented.

During the tour there were presented the Chairman (Mr. Radcliffe) and the Secretary (Mr. Brooks) of the Committee of Representatives of the Workmen, who help to deal with many problems brought up by the men. Other gentlemen presented to His Majesty were Mr. Allbut, superintendent, iron foundries; Mr. Livesay, Mr. Whitmoyer, Mr. Summerhill, sales managers. Miss Wilson, superintendent, women workers, was also presented to the King, who expressed his appreciation of the work being done by the women. His Majesty completed his tour of the works at the south end, and proceeded to the offices at the north by way of the main road in the works. To either side of the road the workpeople had gone after His Majesty had passed through the departments in which they worked, and hearty cheers were given as he passed along, the road being kept clear by members of the Volunteer Defence Corps. At the offices, His Majesty partook of light refreshments, afterwards being presented with a beautiful album, bound in purple morocco, containing photographs of the works, and the workpeople at work, mounted on vellum.

Exemption Applications.—At Westminster Tribunal (according to the *Daily Telegraph*), the cases of 144 men in the tramways department of the London County Council came up for consideration. Mr. F. W. Brock, for the County Council, said he could not spare a man. The Ministry of Munitions had been pressing them to put on 25 per cent. more cars. In reply to a question as to what would be done if the men went on strike, Mr. Brock said that after the last strike about 1,300 men went straight into the Army, as the County Council refused to take back any man of military age unless he was rejected. It was decided that eight men should be released, the others being protected as being in certified occupations.

At Rochdale, conditional exemption was granted to R. Bentley, chief traffic assistant, Corporation tramways, and temporary exemption to July 31st to A. Clegg (41), driller, E. Kershaw (35) and E. Kendall (37), motormen, and J. Crossley (36), overhead electric wireman.

At Morecambe Tribunal, the case of Mr. Annetts, the borough electrical engineer, was considered very briefly, and the conditional exemption was renewed.

Application was made on behalf of A. Darnborough (32), electrician, class B 1, and H. L. Bentley (36), foreman fitter, class A, both employed at the borough electricity works. The Military Representative (Dr. Watterson) thought there would be little difficulty in finding substitutes, and the military felt the men would be of greater service in the Army, and that substitutes could be got. Mr. Annetts, borough electrical engineer, said he had lost six men, and at the present time the works were being run by himself, 11 men, and a girl. He had advertised for substitutes, without success. If these two men left the sewerage works would stop, and the lighting would have to be cut down. The men's conditional exemption was withdrawn, and they were given temporary exemption to August 31st.

East Kent Appeal Court has granted six months' conditional exemption to Mr. Colin Campbell (41), managing director and secretary of the Whitstable Electric Light Co., Ltd.

Cambridge Tribunal has granted three months' exemption to W. O. Pilgrim (39), electrician, appealed for by Messrs. Baily, Grundy & Barrett, Ltd., electrical engineers.

At Ilfracombe, the Electric Light Co. appealed for exemption for R. Lerwill (18), charge engineer at the generating station, until someone could be secured to take his place. Temporary exemption until September 1st was given.

At Winchester, a firm of electrical engineers appealed for the only man left in their repair shop. The firm are responsible for much electrical work for hospitals, the military, public bodies, and private customers, and they also help at camps with field and other telephones, &c. The Tribunal granted conditional exemption unless and until a substitute is found to their satisfaction.

At Brighton, a firm of electrical engineers appealed for the manager of a branch business at Eastbourne, aged 33, in Class B 1, and for three fitters. In each case a short term of final exemption was granted.

Gloucester Tribunal has granted exemption until August 9th to a storekeeper appealed for by the manager of the light railways on the ground that he is indispensable to the running of the cars.

Weybridge Tribunal has conceded conditional exemption to J. Wheatley (24, in Class C 2), electric wireman, appealed for by the Urban Electric Supply Co.

At Hereford, exemption until September 1st was granted to Mr. E. R. Harding, electrical engineer, of Messrs. Harding Bros., and Mr. C. J. Windgate, director and secretary of the firm.

At Aylesbury, Messrs. Mackrill & Sons appealed for T. Pearce (39, in Class A), electrician. It was stated that they were the only firm of electrical engineers left in the town, and that their work included the repair and maintenance of electrical machinery for munition works. Three months' temporary exemption was granted, on the ground that the man is engaged on work of national service.

Messrs. E. O. Walker & Co., electrical engineers, of Manchester, appealed at Wrexham for Mr. C. A. Gaffney, in Class C 2, manager of the firm's branch in Queen Street. Final exemption until July 11th was granted.

At Ilford, exemption has been refused to H. Cross, motorman on the Ilford U.D.C. Tramways, and two months allowed before the calling up. Exemption, with one month's grace, has also been refused to W. H. Myers, iron and wire worker with the Sterling Telephone Co., of Dagenham.

At Aldershot, the Traction Co., Ltd., appealed for two fitters, and temporary exemption for substitution was granted.

Bath Tribunal, with the assent of the military, has, on the ground of certified occupation, given conditional exemption to a driver (40, in Class B 1), and a body builder (41, in Class C 1), appealed for by the Electric Tramways, Ltd.

At York, conditional exemption, on the ground of indispensability, has been renewed to a young electrician on the Corporation staff, and similar certificates held by five employés in the Corporation telephone department have been withdrawn on a review at the instance of the Military.

Melton Mowbray Rural Tribunal has granted conditional exemption to an electrical engineer in business at Cold Overton, on condition that he works two days per week for a neighbouring tradesman who has lost a man.

REVIEWS.

Depreciation and Wasting Assets. By P. D. Leake. London: Sir Isaac Pitman & Sons, Ltd. Price 10s. 6d. net.

The published printed matter on the theme of depreciation has been mainly of a sectional and fragmentary nature, but the volume before us appears to be the consummation of an attempt to present the subject to the reader in a concrete form. To what extent success attends the effort is a matter of individual opinion, which must be left to the knowledge and judgment of the reader. Without, however, exposing the reviewer to any charge of carping criticism or grudging estimate, it may be stated at once that there is in the book much that is distinctly good without being new, and much that is academic amid considerable observation and less penetration. In the writer's praiseworthy effort to uplift, he often fails to get underneath. There is a vast difference between the interpretation of *de facto* and *de jure*, which is often reflected and accentuated in practice. However, the book is interesting, and will repay perusal.

It seems to us that the writer and compiler of the work, without incurring any disadvantage arising from poverty of illustration and the type of condensation that so often results in futility, could have compressed his discourse into much less space than it now occupies, whilst certain elimination and substitution would have added to its value. Moreover, he might have avoided imposing on the reader, as he does with wearying frequency and pertinacity, the use of the somewhat grandiose expression of expired or unexpired capital value and other terms.

The preface contains some sweeping generalised statements which, as such, are unsupportable, though we can readily concur in the view that they may be truthfully applied to specific cases.

In referring to some remarks of the President of the Engineering Section of the British Association, the question appears, "but do the dividends paid reflect the true annual profits of industry?" Generally, the answer in the formal language of the members of the National Gas House is in the negative, but each instance must be considered in the light of its surrounding circumstances. Economically, the payment of dividends (so-called) out of capital is of common enough occurrence. We are unable to discern any particular virtue or commendation in the statement that the views of the Ministry of Munitions as to the proper treatment of depreciation of plant coincide with those advocated in the work.

The writer is somewhat dull and obvious in parts. Under the heading of "Natural Raw Material and Recurring Crops," quoting the capital applied for by prospectus for mines, oil, rubber, estate and land, the writer proceeds: "The greater part of all this capital will be laid out in the purchase of natural raw material, or in the cost of planting and developing estates to yield recurring crops, and the lives of such classes of property are finite. Payments made for the purchase of all this property are without exception payments made in advance on revenue account. The property is in each case wholly dedicated to the purpose of earning profits or increase. It is not intended for resale in its existing form, and therefore, as has been pointed out, subsequent marked fluctuations due to the operation of law of supply and demand cannot affect the question of the annual amount of depreciation necessary to be provided out of revenue receipts of each year to replace the expired outlay or cost of this perishable property."

Again, "in preparing such a scheme it should be borne in mind that the outlay of planting and developing assets of all kinds falls under several heads, each having perhaps a varying degree of permanence. The original cost of cleared jungle land and draining and road making, for instance, may in some cases be considered of so permanent a nature as to entitle it to be placed in the same category as the site value of the land, so that, therefore, no provision for expired capital outlay need be taken back out of revenue receipts of each year; but this, at best, is a doubtful policy." We can only conclude that the writer's practical knowledge of estates generally is unimportant.

The author points out the inconvenience of repaying capital in the form of ordinary dividends, and he recommends an alteration in the English statute law to enable undertakings of the character named gradually to repay the capital of the shareholders by annual instalments. There is a widespread poor opinion of much of the legislation that is already in existence in regard to limited liability companies, which, *inter alia*, it seems to us, is chiefly designed to swell ever-increasing on cost, and to benefit the pockets of lawyers, accountants, and mortgage lenders in particular at the expense of labour and of shareholders. We may add, however, that we believe that all French companies are required to state in their Memorandum the period for which they intend to pursue the objects of the company. This period, however, may be extended by resolution.

Apart from providing for depreciation, French companies are required to place at least 5 per cent. of the annual net trading profit to reserve, more appropriately called the *réserve légale*. It is not uncommon for French companies to pay off by drawing some of the capital out of cash representing accumulated profit. When this is done, the share certificates or other documents are surrendered in exchange for the nominal amount of cash paid up on the shares, the shareholders receiving concurrently certificates for a similar number of shares, these latter shares being termed *actions de jouissance*. Such *actions de jouissance* are entitled to the same rate of dividend as those of the same class that may be unredeemed; but they are not entitled to receive the annual interest of 5 per cent. (commonly paid by French companies) on the unredeemed shares as well as the dividends declared.

With regard to electric tramways and electric lighting and power, the author appears to us not to advance anything that is not already well known to those engaged in those industries.

The writer reviews under the heading of "The 'then value' of Plant" the case of the National Telephone Co. and H.M. Postmaster-General. The problem to be solved was as under:

"The value on the 31st December, 1911, of all plant, land, buildings, stores and furniture purchased by the Postmaster-General in pursuance of the provisions hereof shall be the then value (exclusive of any allowance for past or future profits of the undertaking or any compensation for compulsory sale or other consideration whatever) of such plant, land, buildings, stores and furniture, having regard to their suitability for the purposes of the Postmaster-General's telephone service, and in determining the value of any plant no advantage arising from the construction of such plant by leave of the Postmaster-General upon any railway or canal over which the Postmaster-General possesses exclusive rights of way for telegraphic lines shall be taken into account."

The Postmaster-General adopted what is called the straight line method of calculating depreciation, contending that the depreciation was properly measured by the ratio which the expired life bore to the whole life of the plant, or that the value on the 31st December, 1911, was represented by the proportion which the life still anticipated bore to the whole life. The company's mode of estimating depreciation was by way of a sinking fund. They submitted that when the life of a class of plant was as far as possible ascertained a sinking fund should be formed by the investment every six months of an amount which accumulating at compound interest would produce at the end of the estimated life an aggregate sum equal to the original value of the plant when new. At any point in the life they contended that the difference between the original value and the amount which had at that point accumulated in the sinking fund was the value which should be paid by a purchaser, *e.g.*:—

Cost of plant, £100. Life, 20 years.

Annual revenue. £8 a year for the whole of its life.

Plant sold at end of 10 years.

Assume that both vendor and purchaser borrowed the necessary capital. The vendor having borrowed the £100 to install the plant, his annual revenue of £8 is allocated :—

Interest on £100 (5 per cent.) £5
Sinking fund to produce £100 in 20 years
at 5 per cent. £3

At the end of 10 years the sinking fund amounts to £38. If the purchaser pays £62 (borrowed) for the plant, the vendor gets, with the £38 in the sinking fund, the original £100 to discharge his debt.

The purchaser is then in possession of plant yielding an annual revenue of £8, which he allocates :—

Interest on £62 (5 per cent.) £3
Sinking fund to produce £62 in 10 years
at 5 per cent. £5

and on the expiration of the life of the plant the purchaser can renew the plant costing £100 to enable him to continue the business by reborrowing the £62 yielded by the sinking fund and borrowing a further £38. He is then in the position of the vendor when the original plant was installed.

Alternating Currents: Their Elements Explained and their Calculation Effected Without the Use of Hyperbolic Functions. By H. R. Kempe, M.Inst.C.E., M.I.Mech.E., M.I.E.E. London: Crosby Lockwood & Son. Price 3s. 6d. net.

In this handy little volume the late Electrician to the British Post Office shows how some of the fundamental formulæ connected with alternating currents may be produced without having recourse to hyperbolic functions, but simply by the methods of algebra and trigonometry. If it be wondered why Mr. Kempe chooses this particular method in preference to the other, his answer is ready: "I have put together in the present handbook some notes which I had made from time to time dealing with certain problems which had interested me, and in reference to which I had been unable to find any sufficient explanations. The fact . . . that in certain problems the application of 'complex quantities' enables correct formulæ to be obtained, may be all-sufficient explanation. It has not, however, satisfied me, and I know that it has not satisfied many others." The student, therefore, who opens this book will be under no illusions as to the author's attitude towards the works of such writers as Steinmetz, Kennelly, Drysdale and others.

The volume comprises nine chapters, which deal with alternating currents and inductance and capacity, effect of angle of lag, joint resistances, combinations of resistance, inductance and capacity, telephonic transmission, reflection, and the practical measurement of alternating currents.

The first five chapters call for little comment, except to point out that the statement on page 13—"the maximum value E is attained before (*i.e.*, in advance of) the maximum value E_{11} is reached" is not in accordance with the curves shown on page 11, if the time axis is towards the right.

Chapter VI is, perhaps, the most interesting in the book. After restating the main portion of the paper by A. B. Kempe (*Journal* Soc. Tel. Engineers, 1875) on "The Leakage of Submarine Cables," the author adapts the results obtained under steady, continuous current conditions to those which obtain when the current is alternating. Long algebraical simplifications have no terrors for Mr. Kempe, as those who have gone through his "Handbook of Electrical Testing" know, and here he is at his best. Time seems only to have quickened instead of dulled his ingenuity in this respect; and, as he works his way towards the final expression for the "attenuation constant," one cannot repress a feeling of admiration as one is led step by step through the several stages of the working. For this chapter alone, if for no other, the book should be in the possession of every student of alternating-current phenomena.

The problem of Reflection on Telephonic Lines is somewhat briefly dealt with, but sufficient is given to enable the student to see how it may be calculated, and how closely the observed agree with the calculated results.

In Chapter IX the author, apart from a passing reference to the hot-wire ammeter and the electro-dynamometer, confines himself to proving by simple integration that the effective value of an alternating current is ·707 of its maximum value.

Unfortunately, there are a number of typographical errors, which will, no doubt, be eliminated in subsequent editions. On page 31, in the numerator of the second expression, "$d^2 (a^2 + c^2)$" should be $d (a^2 + c^2)$. On page 36, line 4, "$L = 0$" should be $L_1 = 0$. On page 39, "s, for insulation resistance," should be "s, for the reciprocal of insulation resistance." On page 42, equation (L), the right-hand member "$\frac{R_1}{R_1 + \frac{R}{2}}$" is inverted, although the final form is correct. On page 52, $y (\cos^2 x - \sin^2 x)^2$ should be $y^2 (\cos^2 x - \sin^2 x)^2$. On page 55, the square bracket is omitted at the end of the sixth line. On page 56, "$L C^2 f^2$" should be $L C f^2$. On page 59, "μH" should be μF. On page 61, "·280 $m C$" should be ·280 μF. On page 75, "hot air" should be hot wire. The expression, "conductor resistance," is also used in places where "impedance" would be the more correct; and non-inductive resistances are shown diagrammatically throughout by spirals, instead of zigzag lines, according to present-day convention.

In recommending the book to all students who are approaching the subject of alternating currents, we would congratulate the author on the consistency of method which has characterised his work from the first contributions on Electrical Testing in the old "Telegraphic Journal"—the Electrical Review of to-day—right up to the present time.—A. F.

THE FUTURE OF THE X-RAY INDUSTRY.

At the May meeting of the Rontgen Society the discussion on "The Future of the British X ray Industry," which had been started at the previous meeting, was resumed. Captain Thurstan Holland, the President of the Society, said that in his view there must first be an amalgamation of manufacturing interests. Our present X ray firms were small, far too small to offer any chance of success when competing with the large concerns found in Germany and America. In the next place, there must be standardisation of apparatus. In one London firm's catalogues he found 76 different X ray tubes listed, and he counted also 18 kinds of valve tubes, and this was by no means a complete list of all the different varieties of tubes on the market. Every practical X-ray worker whose opinion was worth anything could reduce this list to, say, half-a-dozen tubes and two or three valve tubes. Personally, he would not object to reducing it to three varieties of tubes and no valve tubes at all. The reorganisation of industry so that standardisation of apparatus and manufacture of tubes went hand in hand, and the very best form of X-ray machine (coil or transformer) was combined with the best form of tube, would go far to lessen the expense of production, to put a really workable instrumentation in the hands of medical men, and, incidentally, to improve X-ray work. Other things which were necessary, although subsidiary, were research work and facilities for teaching. It was necessary that the education of radiologists from the technical point of view should be insisted on. Indirectly, this teaching would have its effect on the X-ray industry, as the men demanding and using X-ray apparatus would know what was required, and what they wanted. At present the man contemplating X-ray work did not know either, and this had led to all sorts of anomalies in equipment. In one catalogue might be found a description of about 20 more or less elaborate pieces of apparatus for the localisation of foreign bodies, and in addition innumerable bits of apparatus recommended as convenient and suitable for assistance in this work. Anything more absurd, and more cumbersome and costly, than most of them for doing what could be done with equal precision by the simplest apparatus it was impossible to perceive. It was not by putting all this senseless variety of apparatus on the market that they were going to capture the X-ray trade. As to a tariff on goods coming into this country from other countries, this was a two-edged sword. If by this means the manufacturers thought to bolster up inefficient goods it would not work. Nothing would keep out better and more efficient apparatus, and the user would pay the extra price for the best stuff. If, on the other hand, it was meant to put a stop to, or, at any rate, a drag on, unfair methods of competition, then it might be of use. The speaker also went on to suggest that the working-man should be taken more into the confidence of his employers.

Several manufacturers and their representatives took part in the discussion. Mr. S. H. Morphy suggested that a committee be formed, combining representatives of manufacturers, physicists, and medical men, to thrash the whole matter out, and outline the steps that should be taken by the society. Early attention was required for (1) the drawing up of standard specifications for hospital outfits, (2) standardisation of tests and arrangements for carrying out these tests, (3) general publicity for X-ray work, (4) the setting up of an X-ray clinic, and (5) the encouragement of research and publication thereof.

Mr. W. E. Schall referred specially to the absence of courses of instruction in X-ray work. In Germany, before the war, the most important firms held courses of lectures on X-ray apparatus and technique at regular intervals. Physicists on their technical staffs dwelt on the construction and management of the apparatus, and X ray specialists lectured on technique An exact copy of the system would not be possible here, owing to the different conditions, but he thought that something similar might be taken in hand. Then they must, he thought, rely far more on the individual efforts of medical men and technical men. Once the British School of Radiology had become a respected entity whose work was studied and whose advice was sought, the British X-ray industry would stand so firmly on its legs that it need not fear competition, no matter whether tariffs and prohibitions existed or not, and it would produce its own patterns and inventions, instead of relying largely on what was done abroad. And, conversely, an X ray industry which was not connected with a school of radiology, productive of ideas, of invention, and of sound work, would not flourish, no matter how high a tariff or how stringent a prohibition to import might be placed around it.

Mr. A. E. Dean asked how British radiology found itself to-day cut off from "its spiritual home." Had it succumbed to pernicious anæmia? He thought not. He had never seen finer work in any of the hospitals in Berlin, Vienna, Hamburg, or Freiburg than that produced in some of the clearing hospitals in France. And where did the apparatus come from to satisfy the enormous Army demand? From the works of the insignificant little British manufacturer. This it was which was installed in the field ambulances, the casualty clearing stations, the base hospitals, and the hospital ships. It was often abused, and very often misused, by aspiring amateurs and by experts, but it was carrying on, and the job was done. The keynote was not protective tariffs nor State-aid, but Chauvinism. Let them lay their cards on the table, and inaugurate a war exhibition of British radiology. Let the medical men tell them where they fell short, and the academic people tell them in plain language how to put it right. Then they would be doing good to British radiology and, incidentally, to themselves.

Mr. P. J. Neate considered that the commercial remedies for the present condition of things were a reform of the tariff, and combination and standardisation; scientific remedies were the establishment of central research institutes; a recognised journal edited at the central institute, and supported by the trade in the shape both of communications and advertisements, the latter to the exclusion of all other forms of advertising, except trade circulars; active support of more equitable patent legislation, especially in limiting the rights of foreign patentees to the rights given to British patentees in this country; and extension of the foreign origin marks legislation so that it covered parts as well as aggregates. In his own work he had always paid careful attention to his customers' scrap heaps, on the principle that however successful a machine might be, there was no positive indication that it might not be better. Every ounce on that scrap heap told a tale of failure, definite, positive, and capable of rectification, and therein lay the road to useful research.

Dr. F. W. Metcalfe said that one weakness of British industry was an indisposition to give a client just what he desired, apart from the predilections and prejudices of the firm. No small part of the commercial success of the German was due to his greater power of accommodation. Another thing which he thought would be necessary was that catalogues should be printed in the language of the people to whom they were meant to appeal, and not only in the language, but with the weights and measures and the moneys usual in the country to which they were sent.

The discussion was again adjourned to the June meeting of the Society.

BUSINESS NOTES.

Timber for Packing Cases.—The attention of the Board of Trade has been drawn by the Director of Timber Supplies to the large quantity of wood which is consumed in the manufacture of packing cases, intended for the transport of goods both in the home and export trade. They wish to point out that, in view of the necessity of restricting imports and at the same time of supplying essential war requirements, it is absolutely necessary to observe the strictest economy in the use of wood. Great assistance could be rendered by traders, if the use of wooden packing cases and crates were abandoned altogether, or where this is not possible, if crates were substituted for packing cases. The Board of Trade have had under consideration the issue of an absolute prohibition on the export, except under licence, of wooden packing cases containing goods, but they hope that the response of the trading community to the appeal for economy in the use of wood will prove so satisfactory, that the necessity for taking this step may be avoided.

Electrical Trade in Australia.—The Executive Committee of the Electrical Employers' Association of New South Wales, in their annual report, congratulate members on the fact that, in spite of the continuance of the war, the electrical industry in that State has not suffered any considerable diminution of trade, though, in view of the serious falling off in the building trade, they suggest that it would be as well not to expect quite such a volume of trade in the near future as in the past. "In this country, at any rate, the electrical industry is a young industry, and one that should expect to grow under almost any circumstances, and it is for this reason that the trade in this State, while it does not benefit from the existence of the war, has not suffered a serious setback."—*Australian Mining Standard.*

Price Advances in Germany.—The principal makers of wire lamps, including the A.E.G., Siemens-Schuckert, the Auer Co., the Bergmann Co., and Julius Pintsch, have made a further increase in prices as from May 1st, the advance averaging 20 per cent. The makers of machines, switchboards, &c., have also raised prices by 10 per cent. as compared with April, and orders are only being accepted for piecework month by month, whilst prices are to be adjusted at the date of delivery, or when ready for delivery, according to the prices then prevailing.

Electrical Industry.—The annual report of the Wolverhampton Chamber of Commerce states that the demand for electrical plant during the past year has been heavier than ever, although exportation, except for Government work, has been prohibited, and great difficulty has been experienced in obtaining raw material. Local factories have had their share of the electrical business going.

For Sale.—On June 5th, Mr. F. E. Tunbridge will offer for sale by auction, on behalf of the Swansea Corporation, the whole of the electrical plant and machinery formerly used by the Swansea Improvements and Tramways Co. Particulars will be found among our advertisements to-day.

Liquidations.—Excel Water Circulator Co., Ltd.—A meeting is called for June 26th, at 3, St. Helen's Place, E.C., to hear an account of the winding-up from the liquidator, Mr. F. E. Smith.

Kent Electric Power Syndicate, Ltd.—A meeting is called for June 21st, to hear an account of the winding-up from the liquidator, Mr. A. E. Salmon.

Bankruptcy Proceedings.—Cunnington & Allison.—A supplemental dividend of 5¾d. in the £ on £6,565 has been paid to the creditors in this case. Prior to the release of the trustee, dividends amounting to 5s. 5¼d. in the £ were paid, to unsecured creditors.

Hawdon, A. F., electrical engineer, Gosforth.—Trustee (C. Woollett) released, March 23rd.

Russia.—The Electrical (K. Ya. Shmulevitch) Armature Co., Moscow, began operations in February.

Catalogues and Lists.—Messrs. F. Husband, Ltd., Craven House, Kingsway, London, W.C. Price leaflet of electric fans.

S. G. Leach & Co., Ltd., 26-30, Artillery Lane, E.C.—Illustrated list, LF 7, of 12 in.–60-in. diameter exhaust fans, being one of a standard series of fan lists (LF 1 to LF 8), dealing with all types of fans, and containing full particulars of D.C. and A.C. electric fans fitted with Beedle and ordinary box blades; energy consumption, air displacements, speeds, &c.; numbered fan arrangement, plans for convenience in ordering, prices, weights, dimensions, shipping, specifications, and telegraphic ordering code. Both fans and accessories are illustrated, and curves given showing the superior efficiency of the Beedle blade fan.

Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street, London, E.C.—Leaflet illustrating and describing a new patent automatic bag filter.

Italy.—A company has been formed at Rome, under the style of the Società Anonima per la Fabbrica di Isolatori in Livorno, for the manufacture in Leghorn of insulators and other electrical material. Its capital is 2,000,000 lire.

Book Notice.—"The Range of Electric Searchlight Projectors." By Jean Rey. Translated by J. H. Johnson. London: Constable & Co. Price 12s. 6d. net.

LIGHTING AND POWER NOTES.

Aylesbury.—Loan Sanction.—The T.C. has received from the L.G.B. sanction to a loan of £6,000 for extensions to plant at the electricity works.

Ayr.—Loan Sanction.—The Secretary for Scotland has given his consent to the borrowing of a further sum of £10,000 for the execution of capital works under the Ayr Electric Lighting Order, 1890.

Belfast.—The Tramways and Electricity Committee reports that 150 applications had been received for the position of mechanical engineer at the electricity works. The Committee has been notified that in the case of applications for the supply of electricity a special permit must be obtained from the Government department for the cable required, giving proof of the urgency and importance of the supply.

Birmingham.—Wages Inquiry.—The B. of T. arbitrator held an inquiry last week into the application of the employés of the gas, water, electric supply and tramways departments of the City Council, for an advance of wages of 5s. 6d. per week, in addition to the 6s. 6d. already granted.

Continental.—Russia.—In the Caucasus "white coal" is used for generating current for electric lighting, to the extent of 2,500 H.P. only, or less than 1-10th per cent. In various parts of the Caucasus, particularly recently, claims have been sent into the Water Department for the right to use "white coal" for the production of electrical current for industrial purposes. Claims registered are as follows:—Stuart, for 50,000 H.P.; Urbanovitch and Palashkovsky on the Rion, 18,000 H.P.; the French Peroune Co., 8,000 H.P.; the landed proprietor, Nikolenky, 18,000 to 20,000 H.P.; and various others. A number of these requests for concessions is being examined by the Viceroy.

At a conference of the Petrograd T.C., it was decided to suppress the Town Lighting Committee and the Committee for Purchasing Electrical Enterprises. It is proposed to replace both these bodies by a Special Council under the guidance of a member of the Government, and with the assistance of four representatives of the T.C. and four representatives of the servants and workmen of the gasworks. The engineer, amongst the Town Council's representatives, will be Arshauloff.

Coniston.—Price Increase.—The Electric Supply Co. has notified its consumers that the price for current is to be advanced from 6d. to 8d. per unit, which is the maximum charge.

Coventry.—Year's Working.—The electricity department has made a profit on the year's working of £27,814, of which, it is recommended, £6,000 should be allocated towards the relief of the rates.

Ealing.—It was recently mentioned that the overdraft of the electricity undertaking amounted to £9,000, due to shortness of staff, late meter readings, and payment of accounts; the reserve fund of £11,000 will be drawn on to meet the contingency.

The Willesden Council has agreed to a request by the Ealing Council that a conference should be held to discuss the question of a combined bulk generating station to serve the areas of several West London authorities.

Grantown.—An electric equipment, including X-ray outfit, is to be placed in the "Ian Charles" cottage hospital as a public memorial to the late Mrs. Hutchinson.

India.—Good progress has been made with the Andhra Valley hydro-electric scheme for generating electricity in the Western Ghats, the storage dam being placed on the Andhra River at Tokerwadi. The power house will be situated near the village of Bhivpuri, and the energy will be transmitted by overhead cables running parallel to the G.I.P. Railway line to Budlapur, from which point they follow the road and terminate at Mahim on the northern part of the Island of Bombay, where the receiving station will be situated, and from which the electrical energy will be distributed. A tunnel 1½ miles in length is being driven through the face of the Ghats for the supply of water to the pressure pipes above the power house. The driving of the tunnel is to be carried out by electric power obtained from the Khopoli generating station of the Tata Hydro-Electric Power Supply Co. Every portion of the work is well up to time and progressing satisfactorily, in spite of the difficulties at present generally experienced in obtaining plant and machinery.—*Times of India.*

Itchen.—E.L. Proposals.—The U.D.C. has resolved to invite Messrs. May & Hawes to meet it as early as possible to consider an E.L. scheme for the district.

Japan.—The proposed municipalisation of the electrical undertakings in Kobe has at last been approved by the Kobe Electric Co., and confirmation by the Municipal Assembly may be expected shortly.—*Japan Weekly Chronicle.*

The electrical energy capable of being generated by hydro-power, according to the investigations of the Department of Communications, is estimated in horse-power at 3,100,000. The amount easy of access is 2,147,700 H.P. At present another 2,339,000 H.P. is supplied by water power, thus making the whole country's capacity something like 5,440,000 H.P.

Considering the distribution of water-power sites, there are 400 on the shores of the Pacific between Ibaraki and Shizuoka Prefectures. The shores of the Japan Sea rank next, followed by Hokkaido, at a little less than 200. The rest in the order of districts are around the Bay of Ise, and comprise Kyoto, Osaka and Kishu, Shikoku, Sanyo, Hokuroku, and Sanin, all numbering less than 100.

Lancaster.—The T.C. has passed a resolution urging that municipal electrical authorities should have greater represenation on the B. of T. Committee on Electric Supply.

Leeds.—Year's Working.—A summary of the revenue statistics of the Corporation electricity undertaking for the year ended March 31st last, shows that the total receipts amounted to £242,589, as against £187,724 in 1915-16. A great increase occurred in power revenue, from £91,886 in the previous year to £141,099 in the year under review; lighting and heating receipts also increased, while traction revenue declined. The gross profit amounted to £133,135, and after meeting Active Service allowances, income-tax, interest and redemption charges, a net profit of £17,286 remained, or some £200 more than in the previous year. This amount was reduced by £13,125 contributions to capital expenditure, leaving a surplus of £4,161.

London.—The Stepney Electricity Committee recommends the B.C. to support the resolution of the West Ham Corporation, that local authorities owning electrical undertakings are inadequately represented on the Committee appointed by the B. of T. to consider and report on the future supply of electric power.

The Hammersmith B.C. Electricity Committee also concurs in the spirit of the resolution, and considers that the Electricity Committees should combine for the purpose of demanding that the Committee as at present constituted should be dissolved, and that a new Committee, conisting of a small number of competent, unbiassed persons not directly interested in electrical matters, should be constituted in lieu thereof.

L.C.C.—The Finance Committee recommends the sanction of the Council to the borrowing of £31,810 by the Shoreditch B.C. for electricity purposes.

The Hammersmith Finance Committee recommends that application be made to the L.C.C. for sanction to the borrowing by, and advance to, the B.C. of £7,575 for electricity purposes.

Redditch.—Three-Phase Supply Developments.—In September last the new three-phase plant at the Council's electricity works was brought into use. The installation, which resulted from the recommendation of Messrs. Handcock & Dykes in favour of remodelling the old 2,200-volt, single-phase, 70-cycle system of supply, consists of two 1,000-KW. Parsons turbine sets, running at 3,000 R.P.M., and generating three-phase, 50-cycle current, which is supplied to a four-wire distribution with 2,200 volts between each phase and neutral. Two E.C.C. motor-alternators of 150 and 300 KW. capacity respectively are installed to couple the single-phase and three-phase plant, also a new three-phase Bertram Thomas switchboard, with a Brown-Boveri voltage regulator. A new cooling tower and a Babcock boiler of 13,000 lb. per hour evaporative capacity are also installed. The original underground sub-stations have been replaced by five main sub-stations in brick buildings, one being at the generating station; these contain B.T.H. high-tension and British Insulated low-tension switchgear, controlling Ferranti oil-cooled transformers. The four-core H. and L.T. distribution cables were supplied by Messrs. Glover, and laid by the Council's engineer, Mr. R. N. Mayne. It is anticipated that an output of 3,000,000 units per annum will shortly be reached.

Rochdale.—The Electricity Committee has interviewed a deputation from the D.R. Cotton Mills, who desire to increase their power supply; it was agreed that some increase would be given as soon as possible. The company proposes eventually to extend its works capacity by 75 per cent., and to carry out a housing scheme for its employés.

South Africa.—The Johannesburg municipal authorities have issued another notice to electricity consumers asking them to economise in the use of electricity between 5 p.m. and 9 p.m., especially on Friday and Saturday evenings. This arises, as mentioned previously in these notes, from the difficulty of obtaining plant on order in England, which leaves the electricity department short during the winter months.

Tasmania.—A report has been prepared by Mr. R. H. Garvie, engineer for the Launceston Marine Board, in regard to the proposed works at Bell Bay, which site has been decided on for the deep water port for the Tamar. Amongst the works forming the first section to be carried out are the following:—Wharf equipment, consisting of electric cranes and capstans; a power station for generating the electricity required to operate the cranes, capstans, lighting, and other electrical appliances.—*Tenders.*

West Ham.—Loan Sanction.—The L.G.B. has sanctioned a loan of £12,100 for the provision of a water-tube boiler and accessories at the Corporation electricity works.

B. of T. Committee and Municipal Supplies.—The following authorities have agreed with the resolution of the West Ham Council protesting against the inadequate representation of municipal undertakings on the Committee appointed by the Board of Trade to inquire into the question of electrical supply:—Southend, Kettering, Sunderland, Norwich, Battersea, Walsall, Redditch, Wednesbury, York, Luton, Newport, Gillingham, Clacton, Bradford, Watford, Bath. Other Councils are expected to take similar action. The matter has also been brought under the notice of the Municipal Tramways Association, the Urban District Council's Association, the Association of Municipal Corporations (which has referred the matter to its Law Committee), and the Incorporated Municipal Electrical Association (which is in agreement with the action taken by the Council, and had circularised its membership).

TRAMWAY and RAILWAY NOTES.

Australia.—In the course of a recent speech on Melbourne tramway matters, the Minister of Public Works mentioned that there were eight separate bodies controlling tramways in the metropolis—five municipal trusts, a Railway Board controlled line, the Central Tramway Board, and a private company. He added that it was the intention of the Government to introduce a Tramway Bill, with a view to appointing a Board of 14 delegates, 12 of whom would be appointed by the municipalities and two nominated by the Government, one of the latter being chairman. This body would have the exclusive right to manage and control the present tramways and all future extensions sanctioned. All the tramway undertakings would be divided into systems, and the whole of the revenues paid into one account, and, after meeting charges properly chargeable to the general fund, profits would be distributed amongst the municipalities on a car-mileage basis. The control of electricity supply, according to the proposal, would also be taken over by the new body eventually; this was held over until the questions connected with the use of the brown coal deposits of the State were settled.

Birmingham.—Year's Working.—The result of the working of the Corporation Tramways for the year ended March 31st last, shows total receipts amounting to £838,725, and a surplus of £76,290, as compared with £107,749 for the previous year, a decrease of £31,459. Of the net profits £66,205 was carried to reserve fund and £10,085 was applied in wiping off the expenditure on motor-omnibuses. The decrease was mainly due to the frequent stoppage of the tramway services occasioned by the failure of the electricity supply department to maintain an adequate supply of electricity for the working of the cars. The number of passengers carried was 171,445,020, as compared with 163,258,584 in the previous year, an increase of 8,186,436.

Blackpool.—On Thursday, last week, the employes in the tramway and electricity departments of the Corporation threatened to strike immediately unless applications for war bonuses, some of which were made in February and March, were considered. A deputation from the employés was heard, with the result that an offer, as from April 5th, was made of 3s. additional war bonus to men, and 2s. to women and youths under 21, thus increasing the bonuses to 7s. and 4s. 6d. respectively, except that workers with over 30s. a week will receive a total bonus of 5s. 6d. An increased expenditure of £6,500 a year is involved, bringing war allowances and bonuses up to £23,000 a year. At a midnight meeting of the men, addressed by the Mayor, the offer was accepted, conditional upon outstanding matters in the tramway department being settled.

The Improvement Bill before Parliament authorises £35,382 for new tramways, on 30 years' repayment, and £6,954 for their electrical equipment, on 20 years' repayment.

Brighton.—YEAR'S WORKING.—The working of the Corporation Tramways shows a surplus of £7,521, after payment of £3,538 in war allowances and £1,615 in war bonuses. The total number of passengers carried was 13,678,251, as compared with 12,295,198 in the previous year. The engineer states that £12 5s. per ton was received from the sale of old tramway rails, being nearly double the price paid for them 16 years before.

Continental.—NORWAY.—Owing to the growth of traffic towards the outskirts of Christiania, it has been decided to extend the existing underground railway by a length of 2·1 km. The tunnel will be fitted with a single track at the beginning, but later a second tunnel will be built for the second track. Continuous current will be picked up at 600 volts from a third rail.

SPAIN.—A company has been formed at Zaragoza for the building and working of a projected rural electric tramway from Zaragoza to Osera, to serve in its course some six villages and their local industries.

The title of the projected underground metropolitan railway in Madrid is changed, by a Royal Order, to Metropolitano Alfonso III, the company taking over the concession being authorised to vary its title accordingly.

Employment of Women Drivers.—The annual conference of the Amalgamated Association of Tramway Workers, held at Leicester last week, adopted a resolution insisting on the employment of discharged soldiers in lieu of women drivers.

Huddersfield.—YEAR'S WORKING.—At the T.C. meeting, last week, the annual financial statement of the tramway undertaking showed that the income had increased from £143,210 to £152,436, an advance of £9,226. The expenditure had increased from £79,892 to £90,749, a difference of £10,768. The passengers carried had increased on the previous year by 2 millions. The reserve fund stood at £44,562, but Mr. Sellers, moving the adoption of the minutes, said more than that would be required to put the system into a proper state when that could be done. The statement was approved.

Keighley.—The tramway strike, owing to a demand by the female conductors to be placed on the same footing as the men in the service, is unsettled. The tramway service was suspended on May 11th. The Corporation Tramways Committee received representatives of the workers on Tuesday, last week, but refused to consent to arbitration; the local Trades and Labour Council has passed a resolution protesting against the refusal. During the week the Tramways Committee took advantage of the opportunity to lay some new points on the track.

Lancashire.—TRAMWAY WAGES.—The Tramway Committees of Rochdale, Burnley, Bolton, and other towns, have been notified by the Association of Tramway and Vehicle Workers of its decision to withdraw its members in 21 days, unless an advance in wages of 10s. per week is given or the case referred to arbitration. For Bolton such an increase would entail an increase in expenses of £10,000 a year.

Leeds.—Substitution from the Army has been commenced on the Leeds tramway service, soldiers in khaki, unfit for general service, being now engaged as car drivers in the streets. After a fortnight's trial the men are sent back to their unit for discharge from the Army, so that they may take the place of drivers suitable for general service. There are at present 25 category "A" men on the Leeds tramways.

London.—The L.C.C. is recommended by the Highways Committee to suspend the halfpenny fare stages and the issue of ordinary return tickets on the Council's tramways; the general manager estimates an increase in revenue of £60,000 as a result of the suspension of the halfpenny fare stages, and £45,000 from the suspension of return tickets. The Committee considers that if the Council agrees to the recommendations, the duties of the conductors will be simplified, and an improvement in fare collection will result.

The Finance Committee, in its report on the question, points out that the chairman of the Finance Committee, in referring to the estimates for the current financial year, informed the Council that, although the financial result of the year 1916-17 would be more satisfactory than was anticipated 12 months ago, the estimates for the current year showed a probable deficiency in the revenue account of £89,402, and urged the necessity of steps being taken to increase the revenue of the undertaking, in order to prevent it becoming a burden upon the ratepayers.

Since the estimates were prepared additional liabilities have been undertaken, particularly in connection with increases of wages under decisions of Conciliation Boards.

The Committee considers it desirable to refer to the matter, in order that the Council may realise the importance of agreeing to the present suggestions for increasing the revenue of the undertaking; and adds that the present proposals are to be regarded as only an instalment on account of a comprehensive scheme for placing the undertaking on a sound financial basis.

The proposals have since been adopted by the Council.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—August 22nd. N.S.W. Government Railways and Tramways. Thirty-six induction motors (Specification No. 488). September 19th.—One 225-H.P. synchronous motor (Specification No. 489). Particulars from Electrical Engineer's Office, 61, Hunter Street, Sydney.

MELBOURNE.—July 25th. Victorian Railways. Step-down transformer and sub-station equipment for Sandringham-Black Rock electric tramway. Particulars from the Chief Storekeeper, Railway Offices, Spencer Street.

Dublin.—June 2nd. Corporation. One, two or three years' supply of coal for the electricity works (12 months' supply approximately 40,000 tons). Specification from Town Clerk.

Fleetwood.—May 26th. Council. 2,000 tons of rough slack coal for the electricity works. Mr. A. Cottam, Clerk to the Council.

Kingston-on-Thames.—Corporation. One 5-ton steam or electric wagon. Mr. R. H. Clucas, Borough Surveyor.

Manchester.—May 25th. Corporation Electricity Committee. Various stores for 12 months. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall.

Stoke-on-Trent.—Corporation electricity works. Coal and slack for a year. Borough Electrical Engineer.

CLOSED.

Government Contracts.—List of new contracts placed during April, 1917 :—

WAR OFFICE.

Electric cable.—G.E. Co., Ltd.; W. T. Glover & Co., Ltd.; C. Macintosh and Co., Ltd.; Siemens Bros. & Co., Ltd.
Electric cells.—I.R., G.P. & Telegraph Works Co., Ltd.; Siemens Bros. and Co., Ltd.
Stoneware conduits.—Albion Clay Co., Ltd.
Ebonite.—C. Macintosh & Co., Ltd.; Siemens Bros. & Co., Ltd.
Electric light fittings and accessories.—Cable Accessories Co., Ltd.; General Electric Co., Ltd.; H. J. Gray & Son; S. Heath & Sons, Ltd.; S. & F. Hodgetts & Co.; Jowett Bros., Ltd.; S. D. Page & Sons, Ltd.; G. Roe & Sons; T. Saveker; Simplex Conduits, Ltd.; Sun Electric Co., Ltd.; Leef, Sundt & Co.
Electric lamps.—B.T.H. Co., Ltd.; Cryselco, Ltd.; General Electric Co., Ltd.; Pope's Electric Lamp Co., Ltd.; Siemens Bros. & Co., Ltd.
X-Ray plant.—Austin Motor Co., Ltd.
Hand switches.—Edison Swan Electric Co., Ltd.; G.E. Co., Ltd.
Works services.—Electrical plant: Cavendish Electrical Co., Ltd.
Electric torches and lamps.—Edison Swan Electric Co., Ltd.; Efandem Co., Ltd.; G.E. Co., Ltd.; Westwood Electrical Co., Ltd.
Tin wire.—B.I. & Helsby Cables, Ltd.; P. Ormiston & Sons, Ltd.

INDIA OFFICE STORE DEPARTMENT.

Elements.—G.E. Co., Ltd.
Exchange.—Automatic Telegraph Manufacturing Co., Ltd.
Wire.—London Electric Wire Co. & Smiths, Ltd.

POST OFFICE.

Protective apparatus.—British L. M. Ericsson Mfg. Co., Ltd.
Repairing wire apparatus.—G. Plumpton, Ltd.
Telegraph ditto.—I.R., G.P. & Telegraph Works Co., Ltd.
Telephone ditto.—Gent & Co.; Peel-Conner Telephone Works, Ltd.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.
Air-line arms.—T. Gabriel, Sons & Burtons.
Galvanised cup arms.—Bullers, Ltd.
Arm bolts.—Guest, Keen & Nettlefolds, Ltd.
Battery boxes.—W. D. Tucker & Sons, Ltd.
Cast-iron brackets.—Bullers, Ltd.
Submarine cable.—Telegraph Construction & Maintenance Co., Ltd.
Telegraph cable.—B.I. & Helsby Cables, Ltd.; G.E. Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Union Cable Co., Ltd.
Dry cells.—Siemens Bros. & Co., Ltd.
Telephone cords.—Siemens Bros. & Co., Ltd.
Extensions and modification of telephone equipment, Edinburgh.—Western Electric Co., Ltd.
Galvanometers.—I.R., G.P. & Telegraph Works Co., Ltd.
Head-dresses.—R. Burley, Ltd.
Insulators.—Taylor, Tunnicliff & Co., Ltd.
Zinc rods.—Eyre Smelting Co., Ltd.
Telephone storage-battery repairs, Glasgow.—Tudor Accumulator Co., Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.; B.I. & Helsby Cables, Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. and Smiths, Ltd.).
H.D. copper wire.—T. Bolton & Sons, Ltd.; B.I. & Helsby Cables, Ltd.; Elliott's Metal Co., Ltd.; R. Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. & Smiths, Ltd.); J. Wilkes, Son & Mapplebeck, Ltd.
Tinned-copper wire.—B.I. & Helsby Cables, Ltd.
Enamelled and flame-proof wire.—C. Macintosh & Co., Ltd.
Galvanised-iron wire.—Dorman, Long & Co., Ltd.; R. Johnson & Nephew, Ltd.; Rylands Bros., Ltd.; Shropshire Iron Co., Ltd.; F. Smith and Co., Wire Manufacturers, Ltd.; Whitecross Co., Ltd.

Australia.—QUEENSLAND.—The P.W.D. has accepted the tender of the Brisbane Electric Co. for high-speed engines and electrical plant for the Goodna Hospital, at £4,055; and that of the Edison Swan Electric Co., Ltd., for a storage battery, at £1,281, SYDNEY.—Four electrically-driven induced-draught fans at Ryde pumping station, for the Metropolitan Board of Water Supply and Sewerage :—

Ferrier & Dickinson	(accepted)	£1,950
H. P. Gregory & Co.		1,480
Noyes Bros., Ltd.		1,730
Ditto	(alternative)	2,040
R. Wildridge & Co.		4,895

Office estimate, £1,360.

P.M.G.'s Department, N.S.W. Accepted tenders :—

100 miles enamelled-wire cable, £17 15s. per mile.—Western Electric Co. (Aust.), Ltd.

100 miles tinned-copper No. 18 wire, £11 17s. 6d. per mile. Noyes Bros. and Co., Ltd.

Victorian Railways Department :—

Storage-battery freight truck, with Edison battery, spares and accessories, £427.—Knox, Schlapp & Co.

Tenders.

Aylesbury.—T.C. Accepted tenders :—

Premier Gas Engine Co.—Gas plant for the electricity works.
General Electric Co.—Dynamos.

Leyton.—U.D.C. Accepted tenders :—

Electricity meters.—Electrical Apparatus Co., Ltd., and the Reason Mfg. Co., Ltd.

London.—ST. PANCRAS.—Tenders for 50,000 pairs of carbons for use in open arc lamps :—

		£	s.
General Electric Co., Ltd.	(accepted)	£505	0
Crompton & Co., Ltd.		562	10
British Central Electrical Co., Ltd.		630	0
Geipel & Co.		693	15
Wells Electrical Co.		768	15
Engineering & Arc Lamps, Ltd.		798	15

HAMMERSMITH.—The Electricity Committee has received the undermentioned tenders for induced-draught plant at the generating station :—

Musgrave & Co.	(accepted)	£1,564*
James Keith & Blackman, Ltd.		2,720
Matthews & Yates, Ltd.		2,260*
Davidson & Co., Ltd.		2,946
Underfeed Stoker Co.		3,271

* Not including the cost of electric motor for driving the second fan.

One steam-driven turbine with reducing gear for driving the fans, £650.—R. J. Hodges & Co.

STEPNEY.—Electricity Committee. Accepted tender :—

Four motors and starters, in connection with the new fans at the Limehouse generating station, £1,044.—Mawdsleys, Ltd.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, May 25th. At 8 p.m. At 30, Victoria Street, S.W. Dr. William Wilson, F.R.S., will exhibit and describe a Tellurion.

Royal Institution of Great Britain.—Saturdays, May 26th and June 2nd. At 3 p.m. At Albemarle Street, Piccadilly, W. Lectures (IV and V) on "The Electrical Properties of Gases," by Prof. Sir J. J. Thomson, Pres. R.S.

NOTES

Volunteer Notes.—COUNTY OF LONDON VOLUNTEERS ENGINEERS (FIELD COMPANIES).—Headquarters, Balderton Street, Oxford Street, W.

Orders for the Week. By Lieut.-Colonel C. B. Clay, V.D., Commanding :—

Monday, May 28th. See Special Orders.

Tuesday, May 29th.—Lecture, 6.30. Physical drill and bayonet fighting, 5.30 to 6.30.

Wednesday, May 30th.—Drill, No. 1 Company, Right Half Company, 6.15.

Thursday, May 31st.—Drill, No. 3 Company, Right Half Company. Ambulance Class by M.O., 6.30. Signalling Class.

Friday, June 1st.—Technical for No. 2 Company, Left Half Company, at Regency Street. Drill, No. 3 Company, Right Half Company. Recruits' Drill, at 6.30 to 7.30.

Saturday, June 2nd.—Commandant's Parade, 2.45. Uniform for drill.

Sunday, June 3rd.—Parade Clapham Common Station (Tube Railway), 9.45 a.m., for work at Bombing School. Uniform. Rations must be carried.

(By order), MACLEOD YEARSLEY, *Adjutant.*

Institution and Lecture Notes.—Physical Society of London.—At the meeting held on April 27th, a paper entitled "A Note on the Derivation of the General Equation for Wave Motion in an Elastic Medium" was read by Prof. J. A. Fleming, F.R.S. The paper explains a simple method of arriving at the general differential equation for wave motion in a manner which would appeal to students not very well versed in hydrodynamics or the theory of elasticity. A paper on "Cohesion," by Prof. Herbert Chatley, D.Sc., was taken as read. One of the objects of the paper was to re-state and add further evidence in favour of an electrical theory of cohesion.

Society of Engineers (Inc.).—A paper was read by Lord Headley, on May 7th, dealing with the "Goods Clearing House System" introduced by Mr. A. W. Gattie and Mr. A. G. Seaman some eight years ago. Electromagnetic sorting and distributing machinery is employed, with the view of doing away with the waste of time, space, and money inseparable from the clumsy methods of loading, unloading, shunting, &c., at the termini of all our great railway systems. The actual loss to this country due to the antiquated methods at the railway terminals has been estimated at over £1,000,000 a day. The system was described in our issue of July 8th, 1910.

Victorian Institute of Engineers.—In a presidential address, on March 22nd, Mr. H. R. Harper, electrical engineer to the Melbourne City Council, quoted figures illustrating the rapidity with which electricity is coming into use in factories throughout Victoria. In 1915, there were 1,915 factories using electricity, the actual H.P. used being 26,385. Assuming that the population of Melbourne in 1925 would be 925,000, the estimated consumption would average out at 260 units per capita; and assuming that 130 million units would be generated by the Railways Department for the operation of the suburban railways, the total consumption per capita for all purposes would be 400 units. In view of the necessity for larger plant, absolute bed-rock costs of fuel, and unlimited water for cooling purposes, it would be necessary to provide in the near future one, and later on perhaps two, large power houses for light, power, and tramway requirements in the metropolis. Before any scheme for a new power house for the Melbourne area could be decided upon, the question whether brown coal could be economically used would have to be given very careful consideration. The most serious handicap that brown coal in Victoria had been burdened with was the comparatively low price at which superior imported black coal had been available, but the greatly increased price in recent years of black coal gave the brown coal a great opportunity to compete with it. He estimated that, without any of the benefits derivable from by-products, electric power pro[illegible]ced at the Morwell field could be delivered in Melbourne in the form of 20.000-volt energy at about one-third of a penny for each unit, with a load factor of 40 per cent. For a 24 hours' daily supply, the cost for each high-tension unit would be about a farthing. These prices were based on a limited output of 50,000 KW. The cost of power from Altona would be equivalent to ·35d. a unit. It would be practicable, with the aid of 110,000-volt overhead transmission, to convey electricity considerable distances throughout the State. The production and distribution in bulk of electricity would seem a reasonable activity for the State Government to undertake, allowing the retail distribution of electricity to remain in the local hands, municipal or private.—*Australian S. and Mining Standard.*

Institution of Electrical Engineers.—The annual meeting of the NEWCASTLE-UPON-TYNE LOCAL SECTION was held on May 14th. The report of the Committee stated that the membership had increased from 240 to 250, and an unusually diversified programme of papers and discussions had been gone through during the year. The officers and Committee for the ensuing year were elected as follows :—Chairman, A. H. Marshall; vice-chairmen, A. P. Pyne, W. Cross; past chairmen, C. Vernier, P. V. Hunter, H. W. Clothier; Committee, power supply undertakings, E. Fawssett, J. W. Jackson, W. F. T. Pinkney; manufacturers and contractors, L. H. A. Carr, T. Carter, W. G. Gunn, J. H. Holmes, M. G. S. Swallow; Post Office, F. C. G. Baldwin; universities and technical colleges, F. O. Hunt, W. T. MacCall, Dr. W. M. Thornton; borough electrical engineers, C. Turnbull; consulting engineers, J. R. Beard, W. C. Mountain, G. Stoney, F.R.S.; North-Eastern Railway Co., C. E. Taylor; hon. treasurer, C. Vernier; hon. secretary, J. R. Andrews; assistant hon. secretary, R. W. Gregory; hon. auditors, H. S. Ellis, G. L. Porter; students' representatives, J. Rosen, A. W. Crompton. The report and the financial statement were formally adopted, and Mr. J. H. Holmes then gave an address on the early days of the telephone, phonograph, and electric light.

Illuminating Engineering Society.—The report of the Council for the session 1916-17 states that, in accordance with a suggestion made at a recent meeting, a Committee has been appointed to draw up a pamphlet explaining the nature and use of the "lumen." The Society has been actively engaged on work of public importance, having been invited to be represented on the London Safety First Council, and to co-operate with the Cinema Commission Inquiry, while Committees of the Society have been engaged in special investigations for Government Departments in connection with the war. A deputation also waited upon the Department for Scientific and Industrial Research, and requested it to form a Joint Committee on Illuminating Engineering; this was done, the following being the names of the members :—Mr. A. P. Trotter (chairman); Sir Maurice Fitzmaurice, Mr. J. S. Highfield (representing the Standing Committee on Engineering); Prof. H. Jackson, Prof. C. V. Boys (representing the Standing Committee on Glass and Optical Instruments); Dr. C. Carpenter (South Metropolitan Gas Co.); Mr. Leon Gaster (illuminating engineer); Mr. F. W. Goodenough (chairman of Council, Illuminating Engineering Society); Captain J. H. Parsons, F.R.C.S. (ophthalmic surgeon); Sir John Snell (electrical engineer). The formation of this Committee is regarded as an important recognition of the aims of the Society.

Protected Occupations.—The Ministry of Munitions of War has now issued a useful leaflet (MM 139), which forms a short guide to the Schedule of Protected Occupations (MM 130). Copies of the schedule, to which we referred some weeks ago, are in the hands of Trade Union secretaries and employers, and can be obtained from any bookseller for one penny. By means of a series of 15 paragraphs given in the form of question and answer any man may discover whether he is or is not protected and what he is to do under given circumstances.

Parliamentary.—ROYAL ASSENT.—The Royal Assent has been given to the West Kent Electric Power Act, 1917.

Protection from Lightning.—A correspondent, with the pseudonym "Erg," who has omitted his name and address, is informed that the measures he proposes to adopt ought to prove quite satisfactory and efficient.

The Huns and Cockerill's.—Reuter reports that almost all the machinery of the Cockerill establishment at Seraing has been removed by the Germans, and the management has consequently been obliged to close the works.

Fatalities.—An inquest was held at Dudley concerning the death of J. C. Beaumont (28), an electrician employed by Messrs. Bean & Son, who was killed in one of the transformer houses of the firm. Deceased had been employed by this firm 17 months. He was one of three electricians engaged in the night shift to attend to the repairs and maintenance of the plant, and one morning, shortly before finishing shift, he invited two friends, who were also employed at the factory, into the transformer house. He opened the cubicle, and almost instantly his friends noticed his right sleeve smoldering. One of them, who tried to pull the deceased clear, himself suffered shock and burns. Mr. J. L. Chalmers, the chief electrical engineer of the firm, said that the only purpose deceased would have in the transformer power house would be to put in the high-tension switch. It was against the regulations for anyone, except an authorised person, to enter the transformer house. From what he had seen of the man's injuries, he concluded that he must have opened the cubicle and touched two copper wires, and would have the full force of the 5,500 volts A.C. through him, so long as the current held him there. They had an automatic gear that caused the switches to trip out, and it would not be until the two switches at the Smethwick station (five miles away), and the two switches at Oldbury (three miles away), and the one at the works tripped out, that the man would drop to the floor. The whole of the regulations of the Home Office were complied with, and certain extra precautions taken, but it was impossible to wrap to the very ends the copper wire which deceased appeared to have taken hold of. Artificial respiration was tried for a considerable period. In addition to holding the wires, deceased was apparently leaning against the cubicle, which would account for the burns to the man's left leg. Verdict, "Accidental death."

An inquest has been held on the death of a labourer killed by being taken round a shaft when putting on a belt at the Blackpool Corporation electricity works.

BIRMINGHAM.—"Accidental death" was the verdict arrived at in the inquest on the death of D. R. Hinge (19), an electrician in the employ of Harpins & Co., who was repairing an electric light cable on a lift at 11A, New Street. Deceased was found on the top of the cage with his neck pinned between the cage and the lift wall. The foreman electrical engineer said that his assumption was that Hinge had been trying to work the switch from the top of the cage a thing that he should not have done.

Welsbach Appeal to the Privy Council Dismissed.—The *Times* for May 18th contains a report of the hearing before the Judicial Committee of the Privy Council of the appeal of plaintiffs in the case of the Welsbach Light Co. of Australasia, Ltd., *v.* the Commonwealth of Australia and the Attorney-General for Australia. The petition was for leave to appeal from a judgment of the High Court of Australia. Under the Trading with the Enemy Act the Attorney-General for Australia on August 5th, 1915, acting under the Proclamation of the Governor-General, declared that certain companies, including Falk, Stadelmann & Co., were, in his opinion, managed or controlled, directly or indirectly, by or under the influence, or carried on wholly or mainly for the benefit, of persons of enemy nationality or resident in an enemy country. On September 18th the Attorney-General made a similar declaration against the Welsbach Light Co. of Australasia. The petitioning company's affairs were thus brought to a standstill, and they instituted an action against the Commonwealth and the Attorney-General, alleging that the provisions of the Trading with the Enemy Act were *ultra vires* the Commonwealth Parliament, and, in any case, that the Proclamation, and the declaration under which they had suffered, were unlawful. They denied the allegations as to enemy influence or control.

The Commonwealth demurred to the action, and the demurrer was argued before the High Court of Australia, which, by a majority of six Judges against one, allowed the demurrer, and entered judgment for the Commonwealth.

The petitioners now applied for leave to appeal. They urged that the prerogative of declaring what persons were enemies belonged to His Majesty alone, and that it was beyond the powers of the Parliament or the Governor-General of Australia to declare or proclaim that a person or company was to be regarded as an enemy throughout Australia. Even if the Trading with the Enemy Acts of Australia were, in all respects, within the powers of the Parliament, they did not authorise or justify either the Proclamation or the Attorney-General's declaration. The petition was dismissed, without costs.

The Engineers' Strike.—Matters connected with the strike of engineers and other munition workers in different parts of the country came to a head at the week end, and as the result of conferences and interviews, in one of which Mr. Lloyd George personally took part, an understanding was arrived at which may eventually clear up the misunderstandings and grievances which have in part contributed to the trouble. Thousands of men returned to work during Monday and Tuesday, but others remained out pending the result of the proceedings at Bow Street on Wednesday concerning the strike leaders who were arrested in London, Manchester, Sheffield, &c. There has been talk of a strike of electricians, acting in sympathy with the engineers, and in some places matters went further than talk. At the time of writing we understand that as a result of a meeting of the men's representatives with the Minister of Munitions on Wednesday, the electrical strikers returned to work yesterday morning.

Telephone Operators for the Front.—Seven Liverpool telephone girls between the ages of 25 and 30 have been selected for telephone work in France. They are now receiving special instruction for the work they are destined for on the Army field telephone apparatus.—*Manchester Daily Dispatch.*

The Sperry Anti-Submarine Device.—It is reported from Washington that the United States Navy Consulting Board is testing an invention developed by Mr. E. A. Sperry to combat the submarine menace, and tests are expected to be completed in a few weeks. The device requires no extraneous machinery, and can be utilised against the enemy this summer; it is expected not only to render merchant ships immune from danger, but also to make them strong in offence, and to wipe out the U-boats altogether. Mr. Sperry is well known as the inventor of the Sperry gyroscopic compass and stabilisers and the Sperry searchlight arc lamp, and as a founder of various electrical companies. We wish him all success in his new venture.

Appointments Vacant.—Meter and electric light wiring inspectors (£2); shift engineer, for Eccles electricity works. See our advertisement pages to-day.

Pre-War Contracts.—The Committee appointed by the Board of Trade to consider and report on the position of British manufacturers and merchants after the war in respect of contracts entered into by them prior to the war with persons or companies in the United Kingdom or in Allied or neutral countries, the fulfilment of which has been prevented or impeded by the war, and as to the measures, if any, which are necessary or desirable in this respect, has begun its sittings, and is ready to receive evidence. Secretary, Mr. L. F. C. Darby, Board of Trade, 7, Whitehall Gardens, London, S.W. 1. Communications should be made through firms, their Chamber of Commerce or their Trade Association.

The I.E.E. Wiring Rules and the E.C.A.—The following letter was received too late for insertion in our "Correspondence" columns:

"The letter in your issue of May 18th, over the signature 'Wiring Rules,' is an instance of the insidious form of attack electric wiring contractors have been subject to for the past ten years or so. The suggestion is that the wiring contractors push a cheap class of wiring, whilst the supply authorities endeavour to maintain a higher standard.

"Your correspondent says:—'In a large town, several leading members of the E.C.A. are using slip-joint tubing, which the I.E.E. rules specifically forbid. On protest being made by a supply authority, the contractors stated that they paid little attention to the I.E.E. rules, and also declared that no one had the power to enforce them.'

"I contend that it is the wiring contractors who have continuously pushed for a better and more permanent class of wiring, but have been hindered from first to last by the attitude of the supply authorities. During the time this has been going on, contractors have been assailed by statements that their work is bad, and that the public should be protected by the granting of municipal wiring powers. It was expressly to combat these statements that the E.C.A. devised the 'Guarantee of Work' scheme by which it indemnifies the employer of any member of the E.C.A., subject to certain conditions, against workmanship below the I.E.E. standard. Unfortunately, the scheme was delayed by the interference of the Board of Trade, who pointed out that it benefited members of the E.C.A. in preference to the remainder of the trade, and was inconsistent with the articles of incorporation.

"The E.C.A. therefore promoted a company under the title of N.E.C.T.A., Ltd., expressly for the purpose of carrying out this indemnity, and your correspondent will be pleased to learn that the guarantee will come into force as soon as the necessary arrangements can be made, which are expected to be completed within the next few months.

"The E.C.A. is satisfied with the work of its members, and is prepared to back this opinion with its pocket. I think this should be a sufficient answer to your anonymous correspondent.

H. MARRYAT.

"London, E.C., *May 22nd*, 1917."

Electric Power Supply.—The Electric Power Supply Committee appointed by the Board of Trade, under the chairmanship of Mr. Huth Jackson, to consider what steps should be taken to ensure an adequate and economical supply of electric power for all classes of consumers in the United Kingdom, particularly industries which depend upon a cheap supply of such power for their development, has unanimously come to the following conclusions:—

1. That the success of British industry after the war will depend upon the adoption of the most efficient methods and machinery, so as to reduce manufacturing costs as much as possible.
2. That a highly important element in reducing costs will be the general extension of the use of electric power supplied at the lowest possible price, and it is by largely increasing the amount of power used in industry that the average output per head, and, as a consequence, the wages of the worker, can be raised.
3. That the supply of electricity in a large number of small areas by separate authorities is incompatible with a technically sound system.
4. That the interconnection of existing electric supply stations recommended by the Board of Trade in their letter of May 25th, 1916, cannot alone meet the requirements of the situation.
5. That a comprehensive system for the generation of electricity, and where necessary reorganising its supply, should be established as soon as possible.

It has been decided to invite representative associations throughout the country to give evidence before the Committee with regard to the best methods of giving effect to these conclusions.—*Daily Telegraph.*

An Industrial Bank Charter.—It is not so very long ago that there was a tendency in more or less influential public circles to throw cold water upon the efforts of those who desired after-the-war preparations to be made in good time. Those who knew from lengthy observation and experience how great was the leeway that we needed to make up in certain connections. saw only too plainly that the task before us would involve most minute and patient investigation of facts, conditions and situations, in order that appropriate remedial measures and enterprising policy might be adopted. Not many months after the war broke out such subjects pressed to the fore irresistibly, but, as the records show, we proceeded very slowly indeed in those dark days. and it was a long while before some of the necessary inquiries and investigations were properly begun. Of late we have been trying to make up for lost time. and. in addition to waging war on such an enormous scale, we are trying to settle all the great controversies of the past generation. This speeding-up process may help us win the war earlier than we should otherwise have done. and it may leave the way clear of some of the old political controversies which turned our fathers' grey, so that we may concentrate out minds and energy upon the problems of the new age. But it is not to be wondered at if some things attempted in a hurry, or advanced without receiving sufficient consideration from those concerned. are not in their early stages all that could be desired. Among industrial authorities there has for many years been a conviction that something must be done to assist financially in the development of our foreign trade. Lord Faringdon's Committee found no difficulty in accepting that view, and in elaborating a scheme. But when all seemed to be plain sailing for the corporation which had been formed. and had received its charter. hostility of a kind developed; apparently unexpectedly, in the Commons, and the Board of Trade vote. which carried with it the scheme in question, had to be adjourned. so that the scheme might be further enamined in the light of the critioisms that had been offered. Sir Albert Stanley's speech explained the objects of the British Trade Bank or Corporation clearly enough, but it was unfortunate that he should have had to deal with it on the Board of Trade vote, when his speech had to cover that great host of matters for which, as President. he has to act as spokesman. The whole of the discussion seemed to centre round this particular section of the Board's activities, and the criticisms may prove to be in a large measure inapplicable, but the whole matter seems to bear evidence of hurry. It would almost appear that some of the criticism offered could with fairness be attributed more to annoyance than to anything else. For the time being, the scheme is still awaiting Parliamentary sanction. The latest announcement is to the effect that the terms of the Charter are being considered by the Solicitor-General on questions of Law. Further Parliamentary discussion is deferred until after the holidays.

The National Alliance.—The Hon. F. Huth Jackson, P.C., presided on Tuesday at 64, Victoria Street, S.W., at a meeting of the General Committee of the National Alliance of Employers and Employed. Representatives of a number of Unions were present, together with leaders of industry. and the new constitution was adopted. after discussion. The chairman. after referring to the gravity of the prevailing unrest, emphasised the necessity for the Alliance to extend and strengthen its organisation as rapidly as possible. so that employers and employed might together assist the Government in the present difficult and involved situation. They should be able to deal with the questions affecting labour and employment before they reached the stage of acute controversy. and they must all co-operate to promote generally the welfare of the workers and the efficiency of British industries. Another of their objects would be the facilitating of the reinstatement of soldiers, sailors. and munition workers in employment at the end of the war. The Committee decided to urge the Government not to interfere in industrial disputes until every form of direct negotiation had been exhausted.

Electrical Trades Union.—At a meeting held at the White Horse Hotel, Birmingham. last week. it was decided to form a Birmingham Station Engineers' Branch of the Union. It was stated that the Union membership in the district had reached nearly 1,000, and was continually increasing. According to a Birmingham paper, Mr. J. Kinniburgh, the general organiser, said that the Union desired to include all grades of electrical workers. "One of the speakers declared that he was tired of running a power station for 8d. per hour while turnip-tops were costing 5d. per lb. and his war bonus amounted to only 1½d."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—The Brighton Corporation Tramways Committee has granted leave of absence, with an undertaking to increase his salary at the proper time, to Mr. W Marsh, the engineer and manager, who has been appointed to assist the Director of Labour at Admiralty Shipyards.

The Kilmarnock T.C. has granted an increase of £100 on the salary of the electrical engineer, Mr Benon.

Reading T.C. has increased the salary of Mr. Craven, general manager and engineer of the tramways, from £600 to £800 a year, by £100 from April 1st, and two subsequent yearly increments of £50 each; and that of Mr. J. McLennan Calder, chief assistant engineer, from £250 to £300 by two yearly advances of £25 each.

The Highways Committee of the London County Council recommends that Mr. P. L. Riviere, engineer on the staff of Messrs. Kennedy & Donkin, consulting engineers to the Council's tramway undertaking, be appointed electrical engineer in the Council's tramways department under the reorganisation scheme at a salary of £1,200 a year, rising to £1,500; there were 45 applications for the vacancy.

St. Pancras B.C. has altered the titled of Mr. T. H. Munford, mains foreman, to mains superintendent (outdoors). Mr. A. Walters, formerly first draughtsman, is to be styled in future mains superintendent (indoors).

The Heston and Isleworth U.D.C. Electricity Committee has agreed to lend the services of Mr. P. E. Rycroft, its electrical engineer, to the Controller of Coal Mines (Board of Trade), "probably only for a few months, and not exceeding the period of the war," to assist the Department on the technical side of the proposed redistribution scheme for coal, subject to payment of part of his salary.

General.—It is announced that the office of Sir George Askwith, Chief Industrial Commissioner, has been transferred from Old Palace Yard. The new address will be Ministry of Labour, Montagu House, Whitehall, S.W. 1.

At a meeting of the South African Institute of Electrical Engineers on April 19th, Mr. W. H. Perroll, the President, welcomed Lieut.-Col. J. H. Dobson, D.S.O., on his return from active service in German East Africa. It was announced that Mr. Bernard Price had joined the Government Industrial and Scientific Commission, and was in Cape Town.

The London Coke Committee have consented, upon the request of the Controller of Coal Mines, to their engineer and fuel expert, Mr. E. W. L. Nicol, Assoc.I.E.E., assisting and advising him in the matter of coke supplies and use, with a view to realising the greatest possible advantage through it in furthering the cause of coal economy.

Mr. R. E. Moynihan has been appointed works manager to the Electro Bleach and By-Products, Ltd., of Middlewich, Cheshire, and he has taken up his duties.

The *Telegraph and Telephone Age* states that the retirement of Mr. Joseph Furze from the management of the Commercial Cable Co., at Liverpool, a position which he had occupied since the formation of the company 33 years ago, was celebrated in Liverpool recently, when a goodly company, comprising members of the local telegraph and cable world, assembled to do him honour. Mr. J. Wilkinson presided, and among the guests were Col. H. A. Schrank (late Lancashire Fusiliers), Col. A. de Vere Alexander, D.S.O., Col. J. P. Sparling (both late of the Indian Army), and Capt. J. H. L. Richards, R.N. Mr. W. Steventon, assistant manager, presented to Mr. Furze a silver tea and coffee service on an engraved salver as a mark of esteem from the staff of the Commercial Cable Co. at Liverpool, while a walking-stick, subscribed for by officials of the Western Union Cable service was also presented to Mr. Furze. Mr W. Steventon, assistant superintendent, has been advanced to the position of superintendent in place of Mr. Furze.

According to the *Daily Telegraph*, the present chief of the Universities Department at the Board of Education, Mr. H. F. Heath, is to be the head of the new Science and Industrial Research Branch provided for in this year's Education Estimates. The salary is £1,500, and there will be an assistant at £1,200.

Roll of Honour.—We regret to learn of the death from wounds received in action, on May 13th, of Douglas Cutler Bonnella, son of Mr. A. J. Bonnella, of Messrs. D. H. Bonnella & Son, Ltd. He was educated at St. Paul's School, Hammersmith, and matriculated in 1913. On leaving school he joined the above-named firm, and remained there until he enlisted in the London Scottish at the age of 18.

Private E. V. Ball, Cheshire Regiment, killed in action on May 2nd, was employed at the Chester electricity works.

Lance-Corporal H. H. Nicholl, West Yorkshires, reported missing, was in the service of Messrs. Tate, electrical engineers, Bradford.

Private Richard A. Dooley, who has been killed in action, was employed at the British Westinghouse Works.

Sergeant G. H. Clark, West Yorkshire Regiment, late of the York Corporation electricity staff, has died of wounds received in action, aged 47 years.

The Military Medal, for bravery in conveying food to gunners under heavy shell fire, has been awarded to Driver C. Edmonds, R.F.A., formerly on the staff at the Torquay Corporation electricity works.

Sapper E. Clarke, R.E., formerly engaged in the electricity department of the Warrington Corporation, has died whilst on active service.

Gunner J. A. Padmore, R.H.A., who has died in a French hospital of wounds received in action, was for eight years at the Colchester Municipal electric light works.

Private W. F. Charkley, who has been killed, enlisted 18 months ago from the staff of the Hitchin electric light works.

Rifleman H. C. Carter, electrical engineer, for some years engaged with Messrs. Sandycroft, Ltd., Connah's Quay, is reported dead, after being missing since July, 1916.

Lieutenant T. R. Stancombe, of the Army Ordnance Department, who has been promoted to captain, is an Associate Member of the Institution of Electrical Engineers, and previous to joining the Forces he was a technical assistant in the sales department of the Bristol Corporation electricity department.

Mr. A. B. Kipping, late manager of the Gravesend and Northfleet Tramways Co., has received notification of the death in action of his son, Arthur Kipping, who had been missing since September 16th last.

Private T. A. Strachan (Northumberland Fusiliers), brother-in-law of Mr. A. Hugh Seabrook, was recently reported killed in action, but we understand that a postcard has since been received from him which is dated a week after the date upon which he was supposed to be killed.

Captain John Chamberlain.—The very large number of our readers to whom Capt. John Chamberlain was personally known will learn with deep regret that he has been killed in action at the age of 35 years. Captain Chamberlain was a son of the late Mr. Arthur Chamberlain, and a cousin of Mr. Austen Chamberlain, M.P., and of Mr. Neville Chamberlain. In the electrical industry his interests were both extensive and important, and they were also characterised with a spirit of enterprise and business energy. After leaving Rugby School, where he was educated, he joined the firm of Chamberlain & Hookham, Ltd., meter manufacfurers, &c., of Birmingham, and in this business he succeeded his father as managing director. He travelled extensively on behalf of the firm, and made many friends in all parts of the world. He was also interested in Tubes, Ltd., Credenda Conduits, Ltd., Thomas Smiths, Ltd., of Coventry, and in the Midland Electric Light & Power Co., which owns the Leamington Spa electricity works. He was a Magistrate of the City of Birmingham, but had not sought civic or political honours. When the war broke out he heard the call, and early in 1915 went with his regiment (South Wales Borderers) to the Front. He was through severe fighting and was badly wounded. He returned to the Front in February this year. Captain Chamberlain married a daughter of Prof. Poynting, of the Birmingham University, and he leaves four children.

Major G. C. Milnes, electrical engineer to the Lancaster Corporation, who has been on service with the King's Own Royal Lancaster Regiment since August, 1914, is again mentioned in dispatches by Sir Douglas Haig.

An American exchange records that Mr. Harold A. Logan, formerly manager of the Great North-Western Telegraph Co.'s office in Belleville, Ont., who relinquished his position to enter overseas service, has been wounded.

The *Times* records that Sec.-Lieut. Thomas Charles Turton, Liverpool Regiment, who was killed on May 8th, aged 23, was educated at Dunchurch Hall, Rugby, and at Uppingham, and afterwards at Faraday House Electrical Training College.

Obituary.—Mr. W. H. Munton.—The death occurred on May 16th of Mr. Walter H. Munton, who for 18 years had been electrical engineer to the Bristol Tramways & Carriage Co., Ltd.

Sir Alexander Binnie.—We regret to record the death of Sir Alexander Binnie, the well-known engineer, for many years chief engineer to the L.C.C., which occurred on Friday last at the age of 78 years.

Will.—The late Mr. Robertson Lawson, a director of the Aluminium Corporation, Ltd., and other companies, left £104,264 gross.

NEW COMPANIES REGISTERED.

British Magnetos, Ltd. (147,495).—Private company. Registered May 18th. Capital, £100 in £1 shares. To carry on the business of designers, manufacturers, exporters and importers of, and dealers in, plural and single-cylinder magnetos for motor-cars, cycles, aircraft, marine, and other engines, or other purposes, motors, carburettors, batteries, and ignition and other electrical appliances, &c. The subscribers (each with one share) are: E. H. Godbold, 8, Breams Buildings, E.C. 4, advertising contractor; J. W. Molony, 32, Winchester Avenue, Brondesbury, N.W. 6, advertisement writer and designer. The first directors are to be appointed by the subscribers or by the company. Registered office: 8, Breams Buildings, Chancery Lane, W.C.

C. S. B. Electric Bleaching Co., Ltd. (147,497).—Private company. Registered May 18th. Capital, £6,000 in £1 shares. To take over from W. R. Cooke and A. E. Coleman certain patents relating to improvements in electrolytic apparatus for producing liquor for bleaching and other purposes, &c. The subscribers (each with one share) are: H. Spray, Pinner House, Gregory Boulevard, Nottingham, lace bleacher and dresser; W. R. Cooke, 10, Colville Street, Nottingham, lace and hosiery bleacher. The first directors are: H. Spray and W. R. Cooke (both permanent). Registered office: Croydon Road Mills, Croydon Road, Radford, Nottingham.

Societe Anonyme des Ateliers de Constructions Mecaniques Escher Wyss & Cie. (1,570F) (also known as Aktiengesellschaft der Maschinenfabriken Escher Wyss & Cie). Particulars filed May 15th, 1917. Registered in Switzerland in 1912. Original capital, 6,500,000 francs in shares of 500 francs each. British address: 109, Victoria Street, S.W. F. M. Jeboult, solicitor, of 9, Walbrook, E.C. 4, is authorised to accept service. The directors are: Dr. H. Zoelly, J. Muller-Staub, D. Gauchtt, T. Kach, H. von Schulthess-Rechberg Bodmer, M. Zullig, Dr. F. Wegmann, K. Schafer, O. E. Usteri-Pestalozzi, and Morel Vischer (all of Swiss nationality), and C. von der Herberg and C. Zander (both of German nationality).

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Prometheus Co., Ltd.—E. T. Kerr, of 95, Colmore Row, Birmingham, ceased to act as receiver or manager on May 15th, 1917.

Leon Cornelis, Ltd.—Debenture for £1,000, dated May 8th, 1917, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: A. R. Robert, 265, Strand, W.C.

Electrical Contracts & Maintenance Co., Ltd.—Memorandum of satisfaction in full (*a*) on February 24th, 1916, of re-issue in 1913 of debenture dated 1910, securing £100, (*b*) on December 30th, 1916, of re-issues in 1912 of debentures dated 1910-11, securing £100, and (*c*) on December 30th, 1916, of debentures dated 1909 and 1911, securing £300 and £100, have been filed.

Electrical Distribution of Yorkshire, Ltd. (84,972).—Capital, £50,000 in £1 shares. Return dated March 13th, 1917. 45,634 shares taken up, £1 per share called up on 37,500 and 5s. per share on 8,134; £39,622 16s. paid. Mortgages and charges: £5,000.

English Electrical Co., Ltd. (112,639).—Capital, £5,000 in £1 shares. Return dated March 23rd, 1917. 526 shares taken up; £526 paid. Mortgages and charges: £10,000.

CITY NOTES.

British Westinghouse Electric and Manufacturing Co., Ltd.

An extraordinary general meeting of the shareholders was held on Monday at Hamilton House, Victoria Embankment, Mr. J. Annan Bryce, M.P., presiding. The Chairman proposed the following resolution:—

> That the directors of the company be and they are hereby authorised forthwith to increase the capital of the company from £1,150,000 to £1,395,000 by the creation (*a*) of 110,000 additional preference shares of £2 each, ranking for dividend and (when fully paid up and in the meantime subject to being fully paid up) in all other respects *pari passu* with the existing 500,000 reduced preference shares of £2 each, and (*b*) by the creation of 500,000 shares of 1s. each, to be called "deferred shares," and to be entitled to the payment of a non-cumulative dividend at the rate of 7½ per cent. per annum on the amounts paid or credited as paid up thereon next after and subject to the payment of the dividends at the rate of 15 and 30 per cent. respectively on the preference and ordinary shares respectively of the company, but before any further distribution of profits amongst the holders of such preference and ordinary shares and to rank for repayment of capital in a winding up next after such ordinary shares shall have been repaid the capital paid up thereon and before any further distribution of surplus assets but not to be entitled to any further rights whatsoever in respect either of dividend or profits, or of distribution of assets in a winding up, and that the directors be authorised forthwith to issue such new shares, subject to the consents of separate general meetings of the holders of the existing preference and ordinary shares of the company being obtained.

Proceeding to explain the objects of the proposals (see Elec. Rev., May 18th, p. 552, for the directors' explanatory circular), he said that the primary, and originally the sole, object of the negotiations was to have a transfer of the control from America to Great Britain. As the war went on, and it was discovered in how many directions the United Kingdom was dependent on foreign countries for the supply of articles which could perfectly well have been made at home, it was more and more felt that after the war Great Britain should become more self-sufficing in manufacturing. A natural corollary was a growing desire that British industry should as far as possible become independent of foreign capital and foreign control. As time went on this desire became more marked, and the directors became convinced that the business of the company might be prejudiced if the control remained in America. It was remarkable that the desire for the independence of British industry originally manifested itself strongly in the oversea dominions, especially in Australia, where, as they knew, Mr. Hughes very early in the war took drastic steps to put an end to foreign control of the metal industries. The lead given by Australia was followed by India, and the strong sentiment produced by their example eventually induced the Home Government to take action in the same direction. Before the war the company's business in the Overseas Dominions began to show marked signs of development, and to give them the full benefit of the extended field open through the diminution of foreign competition, which had been especially severe in Australasia, India, and South Africa, it had become of particular importance for them to be freed from foreign control. That they should be a purely British concern was, however, no less desirable from the point of view of their home and continental business. The directors believed that the transfer of control to this country would benefit the business in every direction, and for that reason alone they strongly recommended their acceptance of the proposals. As an illustration of the injurious way in which the continuance of foreign control was likely to affect their business, he might mention that when lately they desired to join the important Federation of British Industries, an organisation which had a membership of 400 firms, representing a capital of between four and five thousand millions of pounds, and of some 40 trade associations, they were refused admission on the ground of their being under foreign control, notwithstanding that they were on most friendly relations with many of its leading members. He had said that originally the sole object of the proposal was the transference of the control from America to Great Britain. But, incidentally, their American friends made it a condition of the option to purchase the control, that the holding company to be formed to buy the shares should acquire 110,000 preference shares of the company to be deposited, along with their holdings in the British company, in the hands of the trustees for the first lien bonds, as security for the payment of those bonds. From the point of view of their American friends, those 110,000 shares, representing at par £220,000, formed a collateral security, but from their point of view, the issue of the 110,000 shares to be acquired by the holding company had the advantage of furnishing them with £220,000 in cash. By the end of last year, when the option agreement was completed, it had begun to be apparent that additional capital was required. When he was at Manchester last week in connection with the King's visit to their works—which, he might say in passing, interested His Majesty greatly—he saw lying packed ready for shipment, but unable to get transport, about £150,000 worth of their products, and there were in the form of goods in process of manufacture similar locks up arising from delay in delivery of materials, not to speak of increased lock up due to the greatly increased cost of material. Copper, for instance, which bulked largely in all electrical work, had more than doubled in price since the war began. The effect of all those factors in lock up of capital was likely to increase until the war was over, and would thereafter tend to diminish, though only very gradually. But, as he said at the last general meeting, when the war was over they were certain to be confronted with an immensely increased demand for their products, which, by the excellence of their manufacture, had acquired a world-wide reputation. Even now they were able to undertake only a small part of the business open to them, and to overtake the volume of orders which would offer after the war large additions to their plant would be required. It was to provide this plant, and the additional working capital which would also be necessary, that in their negotiations for obtaining the capital of the holding company, they had arranged for the group which was forming that company to take up as and when required £500,000 in the form of debentures. Having given reasons why the directors now asked for an increase of capital after having a few years ago got it reduced, Mr. Bryce proceeded to explain the details of the proposals. He said that, as stated in the circular, their American friends held more than half of the preference and ordinary shares taken together in the British Westinghouse Co. Of the preference they held 236,747, out of 500,000; of the ordinary 54,421, out of 75,000; and of the two together 291,168, out of 575,000, or 50.58 per cent. Of the 4 per cent. debenture stock they held £675,000 out of £1,241,353, or 54.37 per cent. They were to sell their debenture stock at the price of 86 against 5 per cent. first lien bonds of the holding company, their preference shares at the price of 56s. against 5 per cent. first lien bonds of the holding company, and their ordinary shares against 50 per cent. of the authorised issue of ordinary shares of the holding company. The result would be that they would get about £1,250,000 in 5 per cent. first lien bonds and half the ordinary shares issued by the holding company. The bonds were to be redeemable in not later than ten years, and in security for them were to be deposited with trustees all the American holdings of British Westinghouse shares and debenture stock, and also the 110,000 preference shares of £2 each to be created by the British Westinghouse Co., and sold by it to the holding company. The income on all those securities would go to the holding company. The interest which the Americans would receive on the bonds of the holding company would be exactly equivalent in amount to the return which they at present got from their holdings in the British Westinghouse Co., on the basis of that company's paying 7½ per cent. on its preference shares. Therefore, the only hope their American friends had of getting a better return in the future than at present lay in any dividend they might get on their half of the holding company's ordinary shares. Before distributing a dividend on its ordinary shares the holding company would have to pay interest on its bonds and dividend on its preference shares, besides providing for its administration expenses, and as its income would consist of what it received from its holdings in the British Westinghouse Co. it would be able to pay a dividend on its ordinary shares only if the British Westinghouse Co. paid a larger dividend than 7½ per cent. As, however, the Americans would have only half the ordinary shares in the holding company they could in no case have so good a return as if they had not parted with their holding in the British Westinghouse Co. As to the values put upon their holdings by their American friends, let them take the preference shares of the company which they sold. The price he had mentioned, namely, 56s., was based on the market price at the time the option agreement was made, namely, 50s., and the premium of 6s. was added in view of their accepting payment in 10-year bonds, which might not prove an easily marketable security at par, and which, in any case, did not offer the possibility of an increase in value comparable with the possible, and even probable, increase in the value of the British Westinghouse preference share. The price fixed for the debenture stock was 86, as against a market price of about 68½ at the time the agreement was signed. The prices fixed showed a loss of nearly £600,000 to their American friends on their cash investment nearly 20 years ago, an investment on which they had no return until the last four years, and the loss was definitely fixed just as the investment promised to become profitable. They did not wish to part with their holding, and were under no necessity to do so, for during several years they had been making very large profits in their own business. Their consent to the proposals was given solely because they were broad minded enough to appreciate the motives which prompted their request, and the directors considered that their thanks were due to them for the generous way in which they had met them. Coming to the question of the new debentures, when the explanatory memorandum was issued some of the details as regarded these and some other matters had not been definitely settled, and therefore only an approximate figure of the total available new capital could be given. One of those details was the issue price of the debentures, which had since been fixed at 95, as a result of which, and of another small item, the total available new capital would be only £720,000, instead of about £750,000 as stated in the memorandum. The terms the directors considered reasonable under present conditions, and with the prospects of improved dividends they should prove better for shareholders than an equivalent issue of new preference shares. Proceeding to refer in conclusion to the parties providing the money, the Chairman said that, for the reasons given in the memorandum and for other reasons, it was not possible to form a combination of shareholders. They were advised, on consultation with their financial friends, that it would not be possible to find the money under present circumstances. One reason seemed to be conclusive. Under the option agreement it was a condition that the 110,000 new shares of the British Westinghouse had to be deposited with the trustees for the first lien bonds of the holding company. But an investment in the holding company was not likely to be attractive to the shareholder of the British Westinghouse Co., because the subscriber to the holding company was limited to 6 per cent. on his preference shares, and could not get anything from his ordinary shares unless the British Westinghouse Co. paid more than 7½ per cent., and, if it did, had to share any surplus with the Americans. Moreover, it was not merely a question of finding £220,000. There had to be an undertaking to redeem within 10 years the £1,250,000 first lien bonds, and also to provide additional capital to the extent of £500,000 for the British Westinghouse Co., that was to say something like £2,000,000 in all. There was no hope of doing all this, especially under present circumstances, unless with the assistance of some powerful group. In consideration for its undertaking these heavy obligations, the group stipulated that the holding company, for which it found all the money, should possess a three-fourths voting power in the British Westinghouse Co. To furnish this voting power, it was proposed that the British Westinghouse Co. should issue to the holding company in return for £25,000 in cash, 500,000 shares of 1s. each, which in combination with its other holdings of their securities would give it the requisite majority. Those shares were entitled to a dividend limited to 7½ per cent. only after payment of dividends of 15 and 30 per cent. on the preference and ordinary shares respectively. No commissions of any kind were payable in respect of any part of the transaction, and the directors considered that the terms as a whole were favourable, especially under present conditions. The group which was undertaking the obligations was the Metropolitan Carriage, Wagon & Finance Co., Ltd., of which Mr. Dudley Docker was chairman. It was entering into the transaction because it saw its way in connection with its own business to develop in many directions and make more profitable the business of the British Westinghouse Co. That it was prepared, after careful examination of their books and accounts, to take so large an interest in their business showed the confidence of the group in the position and prospects of the company, and furnished a practical guarantee to the company of getting any further capital it might require. The group, having made so large an investment, would have a strong interest in protecting it by finding any further funds which might be necessary. The consent of the Treasury had been asked and, considering the importance from a national point of view of the object to be attained, there was no reason to anticipate a refusal.

Mr. N. B. Dickson seconded the resolution.

In reply to shareholders, the Chairman said the negotiations began nearly a year ago, but they were not eventually carried through until the beginning of December, long before there was any idea of America coming into the war. Whether the directors would have thought it desirable to complete the negotiations if America had come into the war while they were in progress he could not say, but he should think it was probable they would have. Although they were delighted that the United States had come into the war, the directors still thought it was highly important that the concern should be a purely British company. He quite admitted that it meant handing themselves over to the new group "lock, stock, and barrel," but he was not sorry it was going to be done, as he believed the group would make the transaction a profitable one to the company as well as to themselves. They made it a condition that they were to get control, otherwise they would not put up the money. They were becoming responsible for raising £2,000,000, and it would have been impossible to get that money from the existing shareholders. He agreed it would have been nicer if the arrangement could have been carried out without the shareholders having to give up control, but it was necessary for the sake of the company to agree to the terms, and, in the end, he did not believe that anyone would be dissatisfied with the way in which the arrangement had been carried out.

The resolution was then carried with one dissentient.

Subsequently, separate meetings of the ordinary and preference shareholders were held at which the scheme was approved, one shareholder voting against the resolution in each instance.

Electric Construction Co., Ltd. The net profit for 1916, after providing £6,597 for debenture interest and £10,000 for depreciation, was £51,504 (against £43,241 for the previous year), plus £16,839 brought forward, less excess profits duty paid for the year ended March, 1915, leaving available for distribution £65,041. After paying the 7 per cent. preference dividend, 7½ per cent. for the year on the ordinary shares, and transferring £12,389 to the general reserve fund, making it £62,500, £31,442 is to be carried forward, subject to liabilities under the Finance and Munitions of War Acts for the two years. During the year the company was almost entirely engaged on special electrical work. Prices of materials and rates of wages continued on the up grade. The increased net profit is due once more to a larger turnover, which has been accomplished through the redoubled efforts of the staff and workmen. Annual meeting: May 31st.

Potteries Electric Traction Co., Ltd. Capital expended during 1916, £2,699; revenue, £150,181. Traffic and parcels receipts increased by £13,993 to £135,120. Working expenses increased by £12,278, although many repairs and practically all renewals had had to be postponed. The amount brought forward was £4,935. After deducting expenses chargeable to revenue (including £11,025 for debenture interest and £10,000 for renewals), £10,000 is put to reserve, 5 per cent. is paid on the preference, and 3½ per cent. on the ordinary shares, leaving £7,261 to carry forward. The reserve is now £46,128, and renewals account £45,738. In order to provide against the cost of carrying out the deferred repairs and renewals when conditions again become normal, a larger amount is carried to reserve and a larger sum carried forward. A fresh draft agreement providing for a postponement by the Stoke-on-Trent Corporation of the date of purchase of the tramways in the borough is now before the Council.

West London and Provincial Electric Supply Co., Ltd. Mr. H. Kahn presided at the annual meeting, on May 16th. He said that the gross revenue of the Chiswick Electricity Supply Corpn., which supplied Aberystwyth as well as Chiswick, had increased by £897 to £20,523, and the number of consumers by 31 to 2,809. The net revenue had increased by £471. The corporation had paid 5 per cent. dividend. The speaker referred to the increased cost of fuel and management, and said that the year had been one of considerable difficulty. They had managed to obtain additional power consumers, and they had further raised the charges in Chiswick by 10 per cent., and in Aberystwyth to the full charge allowed by the Statute. The new Diesel plant at Chiswick was working very satisfactorily and, in spite of the high cost of oil fuel, showed a considerable saving as compared with the ordinary steam-driven sets. A resolution was adopted paying 6 per cent., less tax, on the cumulative preference shares.

Callender's Cable and Construction Co., Ltd. For 1916, the balance at credit of profit and loss is £117,597, and £207,347 was brought forward, making £324,944. This is dealt with as follows:—Debenture interest, £13,500; pref. dividend, £10,000; depreciation of buildings, plant, machinery and office furniture, £17,237; dividend and bonus, and special bonus, aggregating 20 per cent. less income tax, £35,000; carry forward, £249,207. The war has seriously hampered the operations of the company, and regular business has continually decreased, owing to the restrictions and regulations of the Minister of Munitions, to increasing difficulties in manufacture, and to the more stringent curtailment of shipping facilities. The general home trade in electrical wires and cables, together with the export trade to branches and customers overseas, had therefore practically come to an end at the close of the year. On the other hand, the special work undertaken had largely increased, so that the workshops were well employed. The requirements of National Service had made great demands upon the staff and workmen, and it had been with the utmost difficulty that the conduct of its affairs at its offices and in its workshops had been maintained. Every effort had been made to release men for the Army, and an increasing number of women was being substituted, both at Erith and at Leigh, for the men hitherto employed. The constantly augmenting factory charges, the increase in the cost of labour and materials, and the difficulty of obtaining supplies had rendered the management of the company's business a task of considerable difficulty. Therefore the results must be deemed satisfactory. In order to meet the requirements of the Government for the company's usual run of production and for other materials, considerable extensions had been necessary in buildings, plant, and machinery, both at Erith and at Leigh, and further extensions were now being made. As usual, all plant and appliances had been maintained in thorough order. The cost of so doing had considerably increased over that in any previous year, largely due to the difficulties experienced in maintenance and the high prices of materials. The operations of the Anchor Cable Co., Ltd., had during the year become still more closely merged in those of this company. The workshops at Leigh had been fully employed, on behalf of the company, running day and night, on important contracts for cables. Twenty-four men from the company's service have given their lives for their country. Since the close of the last financial year Mr. A. W. Tait had, at the request of the directors, joined the board of the company. Annual meeting: May 31st.

German Companies. *The Concordia, Elektrizitats A.G., of Dusseldorf,* reports net profits amounting to £8,000 in 1916, as against £8,800 in the previous year. It is proposed to pay a dividend of 7½ per cent. on the share capital of £50,000, being the same rate as in 1915.

The Dr. Paul Meyer A.G., of Berlin, makers of electrical apparatus, realised net profits of £19,000 in 1916, as against £23,000 in the preceding year, on a share capital of £175,000. The dividend is at the rate of 7½ per cent., as in 1915.

The Faradit und Isolier-Rohr Werke Max Haas A.G., of Reichenhain, Chemnitz, reports net profits of £29,000 for 1916, as compared with £14,000 in the previous 12 months. The dividend proposed by this insulating tube company is 15 per cent., as against 12 per cent. in 1915.

The accounts of the *Kabelwerk Wilhelminenhof A.G., of Berlin,* show net profits of £13,700 for 1916, as compared with £12,200 in the previous year, on a share capital of £50,000. The method of disposing of the profits is not stated; in 1915 a dividend at the rate of 18 per cent. was paid.

The Elektrotechnische Fabrik Rheydt Max Schorch & Co., of Rheydt, reports that the plant was chiefly engaged on war work in 1916. After appropriating £11,000 for depreciation, as in 1915, the accounts exhibit net profits of £40,000, as against £78,000 in the previous year. It is intended to pay a dividend of 15 per cent. on the share capital of £131,000, as compared with 20 per cent. in 1915.

The Land und Seekabel Werke A.G., of Cologne-Nippes, earned gross profits amounting to £61,000 in 1916, as against £52,000 in the preceding year, the net profits being £37,000 and £38,000 in the two years respectively. The directors recommend the payment of a dividend at the rate of 12 per cent. on the paid share capital of £262,500, this comparing with 11 per cent. in 1915.

The Norddeutsche Seekabel Werke A.G., of Nordenham, which belongs to the group of the Felten & Guilleaume Co. and the A.E.G., reports a loss of £2,300 for 1916, as compared with net profits of £9,700 in 1915. By drawing, however, upon the dividend equalisation and redemption funds it is possible to pay a dividend at the rate of 4 per cent. on the share capital of £300,000, being the same rate as in 1915.

The gross profits of *Korting und Mathiesen A.G., of Leipsig,* arc lamp works, reached £54,000 in 1916, as contrasted with £30,000 in the previous year. After meeting general expenses and allocating £16,000 to depreciation, as against £4,500, the accounts indicate net profits of £21,000, as compared with £10,000 in 1915. A dividend of 8 per cent. has been declared, being 3 per cent. higher than in 1915.

The report of the *Elektrizitats Lieferungs Gesellschaft, of Berlin,* which owns, and is otherwise interested in, supply works, complains of the high prices of raw materials and the anxieties arising from the increasing scarcity of workmen. The net profits earned in 1916 were £163,000, as contrasted with £169,000 in the previous year, and the dividend is at the rate of 10 per cent. on the ordinary share capital of £1,500,000, being the same as in each of the two preceding years, and comparing with 12 per cent. in 1913.

The report of *Voight und Haeffner A.G., of Frankfort-on-Main,* states that the company was busily occupied in 1916 on munition work as well as in its own special departments, and the export trade with neutral countries even experienced an increase. As gross profits, the accounts indicate the sum of £169,000, as against £155,000, and net profits of £102,000 and £97,000 in the two years respectively, after having set aside £14,000 for depreciation, as compared with £15,000 in 1915. The dividend is at the rate of 12 per cent., as compared with 12 per cent. in 1915, 8 per cent. in 1914, and 12 per cent. in 1913.

The C. Lorenz A.G., Telephon und Telegraphen Werke, of Berlin, reports that the turnover in 1916 exceeded that in any preceding year, war contracts having formed the greater portion of the business. The works were extended, and double and triple shifts were introduced. The gross profits amounted to £149,000, as compared with £116,000 in 1915, and the sum of £57,000 has been applied to depreciation, as against £51,000, the plant having again been written down to one shilling. It is proposed to pay a dividend at the rate of 35 per cent., as in the previous year although the share capital participating is greater than in 1915.

The directors of the *Bergmann Elektrizitats Werke A.G., of Berlin,* report that the works were principally engaged on war orders in 1916, which frequently led to fundamental alterations in manufacturing, and partly to stoppages in the deliveries. Nevertheless, the value of the turnover was approximately the same as in 1915. The machinery and installation material departments and the cable factory were again fully occupied, and peace orders could only be satisfied to the extent to which substitute materials for copper, &c., were rendered available. The reduction in the profits is attributed to the considerable increase in wages and in the cost of materials, which was not equalised by any advance in sale prices. After the war, great problems would arise in the conversion from war work to peace work, including the replacement or repair of depreciated machinery, and these matters would necessitate a large expenditure, for which provision had already to be made. The machinery, which stood in the books at £201,000 in 1915, had been entirely written off, together with the additional machinery which was solely installed for war work, and was only suitable for this purpose The accounts show gross profits amounting to £958,000, as contrasted with £1,066,000 in 1915. After defraying general expenses, taxes, &c., the sum of £316,000 has been applied to depreciation, as against £313,000, leaving net profits of £459,000, as compared with £573,000. It is proposed to distribute 10 per cent. on the ordinary share capital of £2,387,000, as contrasted with 10 per cent. in 1915 and 5 per cent. each in 1914 and 1913. The amount of £132,000 has been placed to the war reserve fund, which includes the war profits tax (which is not yet collected by the Government), this comparing with £200,000 in 1915; and £30,000 has been devoted to benevolent purposes, as in 1915, the balance forward being £24,000, as against £19,000 in the previous year. It is added that the number of officials and workers totalled 12,000 at the end of 1916.

Shanghai Electric Construction Co., Ltd.—Sir A. Dent, presiding at the annual meeting in London last week, referred to the continued improvement in the affairs of the company, which had enabled them to pay a dividend of 10 per cent., as against 7 per cent. for the previous year. There were signs of a serious attempt at currency reform, which, it was hoped, would materialise to the advantage of the present depreciated coinage. The underground cable referred to last year was taken up and the copper shipped home and sold at £130 per ton, realising £2,300 The railless tram service had been slightly extended to Honan Road Bridge, and the route continued to be well patronised. If the Council sanction the new scheme they would gradually introduce the railless system on some of the narrow streets.

Colombo Electric Tramways & Lighting Co., Ltd.—Dividend, 10 per cent. (20s. per share), free of income-tax, for year; £15,000 to general reserve and renewal fund, from which £4,000 has been written off special renewal account, leaving £78,000; £8,805 forward.

A. Reyrolle & Co., Ltd.—The net profits for 1916, after providing for debenture interest and including £2,896 brought forward, were £16,579. A dividend of 12 per cent. is proposed on the ordinary shares, together with a bonus of 10 per cent. on both the preference and ordinary shares, transferring £5,000 to the reserve, and leaving £3,779 to be carried forward.—*Financier.*

Metropolitan Carriage, Wagon & Finance Co., Ltd.—According to the *Morning Post*, the directors propose to increase the capital of the company to £3,000,000 by the creation of a million ordinary shares of £1 each, and to capitalise £1,424,712, being part of the undisturbed profits and reserve funds, by a distribution to the ordinary shareholders at the rate of one new share for every share of £1 held.

Merthyr Electric Traction & Lighting Co., Ltd.—Revenue £27,179, compared with £26,235. Reserve, £1,000; dividend on preference shares, £1,500; 6 per cent. on ordinary shares, £2,400; carried forward, £507.

Penarth Electric Lighting Co., Ltd.—Revenue for 1916, £5,371; working expenses, £3,486. There is put to renewals fund, £750; dividend of 1 per cent. on the ordinary shares, £250; carried forward, £288.

Brisbane Electric Tramways Investment Co., Ltd.—The revenue account for 1916, consisting of the dividend received from the Brisbane Tramways Co., Ltd., amounted to £94,936. Available balance £101,792. A balance dividend of 4s. per share, free of income tax, on the ordinary shares, making 8 per cent., free of tax, for the year, is to be paid, and £23,567 carried forward.

Mirrlees, Bickerton & Day, Ltd.—The net profit, after providing for depreciation and directors' fees and excess profits duty, is £16,947, plus £2,038 brought forward. The directors recommend a dividend at the rate of 7½ per cent., free of tax, on the ordinary shares, transferring £5,000 to reserve fund, and carrying forward £1,266.

Chloride Electrical Storage Co., Ltd.—The directors propose to make up the ordinary share dividend for the past year to 10 per cent. A 100 per cent. scrip bonus was recently declared.—*Financial Times.*

Western Telegraph Co., Ltd.—The directors have declared the third quarterly interim dividend of 3s. per share, free of income-tax.

Castner-Kellner Alkali Co., Ltd.—Interim dividend for the six months ended March 31st, 9 per cent.

STOCKS AND SHARES.

Tuesday Evening.

Several of the clouds which have overhung the Stock Exchange markets for the past three or four weeks have either rolled away completely or else are sufficiently rent by blue patches to re-induce confidence and restore firmness to the House as a whole. The Russian news, of course, is the principal factor. Everybody now declares that he never entertained the least vestige of doubt as to Russia remaining staunch to the Allies, and this is true in a measure. Otherwise, prices would have fallen much more severely than they did. At the same time, the off-chance of German intrigue proving successful at Petrograd certainly helped to raise a bar against business.

The intimation that the United States would shortly put a division of men into the field came as another helpful consideration. The settlement of the engineers' strike had been regarded as a matter of days, but the 'bus strike looked more serious—at any rate, to Londoners unused to walking; and the removal of apprehension on the score of being able to get boot-leather to outlast the strike trouble was one of the reasons which dispelled dulness and depreciation. Money is plentiful, and peace rumours begin to circulate again.

Underground Electric income bonds recovered to 80½ after touching 78½. The shares of both classes, however, are unchanged, having been little affected by the strike. Metropolitan consolidated is a dull spot at 22¾, and Districts keep steady about 16. Stagnation is the ruling note in the Home Railway stocks; and when in any market there is nothing doing, the inevitable tendency is to let prices droop.

With a fresh recovery to nearly 1s. 2d. in the Brazilian exchange, the prices of all stocks and shares connected with the country are once more on the up grade. Brazilian Traction common have recovered to 48, and the preferred are a good market at 90. Rio Tramway 5 per cent. mortgage bonds, that is to say, the second issue, are a little better at 75¼, while the Firsts have been changing hands just lately on the basis of 87½. The Anglo-Argentine group, on the other hand, is a trifle easier, the first preference declining to 3 1-16, with business at 62s. 3d. at the end of last week. The 4 per cent. debenture stock has developed a mild activity at 73, and the 4½ per cent. second debenture is quoted 73½, and the 5 per cent. debenture holds its improvement at 69.

Of the Mexican issues, the 5 per cent. first mortgage bonds remain at 40 and the 6 per cent. seconds at 30, while no further changes occurred this week in the Mexican Light and Power descriptions. Kalgoorlie Electric Power preference rose nearly 1s. to 5s. 3d. Victoria Falls preference are fairly lively at 21s. 6d.

Domestic electric shares are extremely steady, and what little business there is centres on those of the London companies. County of London ordinary are a firm spot at 10½, and could probably be sold about this price. Cities have been done as high as £12 within the last few days. Some attention is also directed to the debenture stocks, City 5 per cent. debenture commanding 93. The company's 4½ per cent. second debenture has not been dealt in for the past six weeks, and is called 78 middle. The same price is quoted for County 4½ per cent. first debenture stock, the company's second debenture, also bearing interest at 4½ per cent., being about 76. A buyer paid 13s. for Edmundson's 6 per cent. cumulative preference the other day; and the last time that the 6 per cent. non-cumulative preference changed hands was at 10s. Business in the company's ordinary shares has died away for the time being; the nominal price is 3s. 9d. for the £3 shares.

Canadian electric bonds and shares have been influenced hardly at all by the declines that have taken place in many of the American industrials, attributed to the new financial conditions that arise out of the entry of the United States into the war. Canadian General Electrics remain at 114 for both common and preference, Shawinigan Water at 127½ and Kaministiquia at 122½.

The figures shown in the report of the General Electric Co. of New York are little short of astonishing. The company made a net profit of 18½ million dollars, as compared with 11¼ million dollars in the previous year, while the gross sales, at 134¾ million dollars, are nearly 50 million dollars more than they were in the corresponding twelvemonth. The company has paid 8 per cent. for the last 15 years. The directors have left this rate unchanged, notwithstanding the huge expansion in the profits. The company's surplus is now over 34 million dollars.

The Electric Construction Co. of this country publishes figures which look a bagatelle when compared with the gigantic totals of the New York concern. But it has done considerably better than it did in the year 1915-16, the net profit of £51,500 being £8,000 higher than it was in the previous year. The directors keep on the conservative side by retaining the dividend at 7½ per cent., but the carry-forward is nearly doubled at £31,400. It is stated in the report that the excellent results are due to the larger turnover. The price of the shares remains at 20s.

The Castner-Kellner interim dividend is also out since we last wrote, and is the same as before—namely, 17½ per cent. This is regarded in the market as satisfactory and the recent improvement to 3 5-16 is maintained. British Westinghouse preference improved to 2¾, on the result of the meeting on

Monday, when the shareholders assented to the scheme of reorganisation, of which we have already given the details. The expectation here is now general that by the directors' plan for bringing the control of the company into this country profits will be substantially increased through the extra opportunities which this will give the board of obtaining lucrative contracts, which, as we said before, could not have been handled under the ægis of an American controlled concern.

Callenders are a good market at 1⅝, showing a rise of 7s. 6d. on the week. On the other hand, British Insulated eased off to 12½. A buyer came in for Edison Swan 4 per cent debenture stock, upon which the price hardened to 70½.

Further particulars are now published of the issue of 5 per cent. extension debentures (1917) in the Metropolitan Electric Supply Co. All the debentures must be redeemed within 14 years by annual drawings. During the first seven years the redemption price will be 100, and in the second period it will be 102½. There is no market in the Stock Exchange for the bonds, but they are being offered outside at 95. It is said that the company sold them at 90; and, as we hinted a few weeks ago, there is a certain soreness in the London market at the debentures having been placed away from London in the first instance. From the investment point of view, they were certainly attractive at the latter figure. Even at 95, the yield is 5⅝ per cent. if the bonds run to 14 years' maturity; while if they are paid off in the first year, the return would work out to over 10½ per cent. on the money.

Marconis have again come in for attention, principally because of the activity that has developed in the shares of the Marine subsidiary. The latter rose to 2⅜, and the parent shares are within 1/16 of £3. Industrials generally are steady. Rubber shares show a trace of langour, although the price of the material is good at 3s. 1d. per lb.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.	Dividend 1915.	Dividend 1916.	Price May 22, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	9	6½	—	£6 18 6
Charing Cross Ordinary ..	5	5	8½	—	7 2 10
do. do. do. 4½ Pref..	4½	4½	8¼	—	6 18 6
Chelsea	4	3	2⅞	—	5 4 4
City of London	8	8	11¾	—	6 16 2
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10½	—	6 13 4
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	7	10	5¼	—	5 11 7
London Electric	8	8	1	—	Nil
do. do. 6 per cent. Pref.	6	4	8¾	—	5 6 8
Metropolitan	8	8	2¼	—	6 0 0
do. 4½ per cent. Pref.	4½	4½	8⅛	—	7 4 0
St. James' and Pall Mall ..	8	8	6¼	—	6 8 0
South London	5	5	2¾	—	7 5 6
South Metropolitan Pref. ..	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	5⅝	—	6 5 9
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	57	+ ½	6 3 9
do. Def.	83/6	1½	22½	—	6 13 4
Chile Telephone	8	8	6 15/16	—	5 15 4
Cuba Sub. Ord.	5	5	8	— ½	6 5 0
Eastern Extension	8	8	13½ xd	—	*5 18 6
Eastern Tel. Ord.	8	8	138	—	*5 16 0
Globe Tel. and T. Ord.	7	7	12½	+ ¼	*5 12 0
do. Pref. ..	6	6	10⅛	+ ⅛	5 18 5
Great Northern Tel.	22	22	38	—	5 15 9
Indo-European	13	13	49½	—	6 11 4
Marconi	10	10	2 15/16	+ 1/16	8 8 0
New York Tel. 4½	4½	4½	99	—	4 11 0
Oriental Telephone Ord. ..	10	10	2⅛	—	4 14 1
United R. Plate Tel.	8	8	6⅜	—	*6 0 9
West India and Pan.	6d.	6d.	1⅛	+ ⅛	2 4 5
Western Telegraph	8	8	14	—	*5 14 4
HOME RAILS.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	22¾	— ¼	4 8 0
do. District	Nil	Nil	16	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A" ..	Nil	Nil	5/-	—	Nil
do. do. Income	6	5	80½	+1½	*6 4 3
FOREIGN TRAMS, &c.	Dividend 1914.	Dividend 1915.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	3 1/16	— 1/16	8 19 6
do. 2nd Pref. ..	5½	5½	2⅝	—	—
do. 5 Deb. ..	5	5	69	—	7 5 0
Brazil Tractions	4	4	48	+1	Nil
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	60	—	8 6 8
do. do. Preferred	—	Nil	42½	—	Nil
do. do. Deferred	—	Nil	34½	—	Nil
do. do. Deb.	4½	4½	64		6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	40	—	Nil
do. 6 per cent. Bonds	—	Nil	30	—	Nil
Mexican Light Common ..	Nil	Nil	14½	—	Nil
do. Pref.	Nil	Nil	22½	—	Nil
do. 1st Bonds ..	Nil	Nil	37½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	14	15	2 15/16	—	5 2 0
British Aluminium Ord. ..	5	7	26/9	—	7 7 10
British Insulated Ord.	15	17½	12½	— ¼	7 0 0
British Westinghouse Pref. ..	7½	7½	2⅜	+ 1/16	6 6 4
Callenders	15	20	1⅝	—	7 6 10
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	3 5/16	—	6 13 0
Edison & Swan, £3 paid ..	Nil	—	⅞	—	Nil
do. do. fully paid ..	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	70½	+1	5 13 6
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9¾	—	6 3 1
do. Ord.	10	10	15	—	6 13 4
Henley	20	25	15½	—	8 1 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11⅞	—	*8 8 4
Telegraph Con	20	20	87	—	*6 9 10

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, May 23rd.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Oxalic	per lb.	1/6	..
a	Ammoniac Sal	per ton	£75	..
a	Ammonia. Muriate (large crystal)	"	£54	..
a	Bisulphide of Carbon	"	£23	..
a	Borax	"	£38	..
a	Copper Sulphate	"	£61 10	..
a	Potash, Chlorate	per lb.	2/6	..
a	" Perchlorate	"	2/-	..
a	Shellac	per cwt.	215/-	..
a	Sulphate of Magnesia	per ton	£16	..
a	Sulphur, Sublimed Flowers ..	"	£35	..
a	" Lump	"	£25	..
a	Soda, Chlorate	per lb.	1/-	..
a	" Crystals	per ton	120/-	..
a	Sodium Bichromate, casks ..	per lb.	..	..
	METALS, &c.			
c	Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c	" Tubes (solid drawn) ..	"	..	..
c	" Wire, basis	"	..	..
c	Copper Tubes (solid drawn) ..	"	1/8½ to 1/9	..
g	" Bars (best selected) ..	per ton	£165	..
g	" Sheet	"	£165	..
g	" Rod	"	£165	..
d	" (Electrolytic) Bars ..	"	£142	..
d	" " Sheets ..	"	£167	..
d	" " Wire Rods	"	£150	..
d	" " H.C. Wire	per lb.	1/5⅞	..
f	Ebonite Rod	"	3/-	..
f	" Sheet	"	2/6	..
n	German Silver Wire	"	2/3	..
h	Gutta-percha, fine	"	6/10	..
h	India-rubber, Para fine	"	3/1	½d. inc.
i	Iron Pig (Cleveland warrants) ..	per ton	Nom.	..
l	" Wire, galv. No. 8, P.O. qual.	"	£10	..
g	Lead, English Pig	"	..	..
g	Mercury	per bot.	Nom.	..
e	Mica (in original cases) small ..	per lb.	6d. to 3/-	..
e	" " " medium	"	3/6 to 6/-	..
e	" " " large ..	"	7/6 to 14/- & up.	..
d	Silicium Bronze Wire	per lb.	1/9½	..
r	Steel, Magnet, in bars	per ton	..	..
g	Tin, Block (English)	"	..	..
n	" Wire, Nos. 1 to 16	per lb.	3/6	..

Quotations supplied by—

a	G. Boor & Co.	g	James & Shakespeare.
c	Thos. Bolton & Sons, Ltd.	h	Edward Till & Co.
d	Frederick Smith & Co.	i	Bolling & Lowe.
e	F. Wiggins & Sons.	l	Richard Johnson & Nephew, Ltd.
f	India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.	n	P. Ormiston & Sons.
		r	W. F. Dennis & Co.

Central Station Employes.—According to the *Eastern Morning News*, Mr. Charles Doughty, appointed by the Industrial Commission, presided at the Guildhall, on May 16th, in arbitration proceedings between the Hull Corporation and employés of the electricity department. The latter had made an application to the Corporation for an increase of 12s. a week, in accordance with an award of the Committee on Production. Mr. H. A. Learoyd (town clerk) represented the Corporation, and Councillor Pybus (chairman of Hull Electricity Committee), Mr. Magoris (acting city electrical engineer), and Mr. T. G. Milner (city treasurer) attended. Mr. P. J. Tevenan (general secretary of the Municipal Employés' Association) and Mr. J. M. Gibson (district secretary) put the case for the men, who are in a certified occupation. It is stated that if the amount were awarded the cost would represent £2,000 a year. Mr. Doughty expressed appreciation at the way the case had been put on both sides. The award will be made in due course.

Willesden U.D.C. has revised the scale of wages to the technical staff as follows :—Senior charge engineer and meter tester, 40s. per week, rising by annual increments of 2s. 6d. to 50s. ; shift engineers 35s., rising to 47s. 6d. ; junior engineers 20s., rising to 30s. ; works foreman 50s., rising to 60s. ; plumber jointers 45s., rising to 52s. 6d. ; mains ganger 40s., rising to 47s. 6d. ; arc lamp mechanic 37s. 6d., rising to 45s. ; arc lamp trimmers 30s., rising to 37s. 6d. ; motor mechanics 37s. 6d., rising to 50s. ; installation inspectors 37s. 6d., rising to 47s. 6d.

Educational.—The Court of Governors of Sheffield University have sanctioned separate Faculties of Engineering and Metallurgy in place of the existing Faculty of Applied Science. The Vice-Chancellor (Dr. Ripper) announced that it had been possible to include among the members of the Faculty of Engineering two distinguished members of the profession—Mr. W. H. Ellis (Master Cutler) and Mr. S. Blake Walker.

The Metric System.—At the dinner of the Brighton Rotary Club last week, the president (Mr. A. F. Graves) told a story of his meeting two Polish gentlemen during a trip on the Continent, who caused him great astonishment by their perfect knowledge of English. In reply to his inquiry as to how they learnt to speak the language so well, they replied that, as they had only such a very simple system of weights and measures to learn, they had plenty of leisure in which to acquire other languages besides their own.

Compulsory use of the metric system was urged on Wednesday by the L.C.C. Education Committee.

SURGE BREAKDOWNS IN NETWORKS.

In a recent issue of the *Revue Générale de l'Electricité*, M. J. Sarolea, Technical Director of the Société Lyonnaise des Forces Motrices du Rhone, describes two important breakdowns which occurred on his network, and which he attributes to resonance set up by over-voltage surges. The first of these breakdowns occurred some months ago, when a dead earth was established on a 3 × 25 sq. mm. high-tension cable feeding a metallurgical works situated 985 yards from the end of a 3 × 150 sq. mm. feeder, 4,500 yards in length. The feeder was connected to the hydro-electric power house through an induction-type booster. Simultaneously with the occurrence of the dead earth, the leading-in turns on the station side of a modern static booster were short-circuited between themselves, put to earth, and finally cut through from the first to second or from the second to third turn in each of the three columns. Also, an alternator was put out of service by short circuit between turns at about one-quarter of the length of the windings from the leading-in point. Inspection of the cut-outs on the network showed that 42 of them had operated, whereas those in the power house, even on the bars, had remained inoperative.

The second breakdown considered occurred a few months later, when an earth developed on a branch of the network (3 × 15 sq. mm.) opposite the collar of a high-tension box, about 1,100 yards from the distributing post of a 3 × 300 sq. mm. feeder, 8,550 yards in length. Two adjacent alternators in the hydro-electric station were seriously damaged, and a third machine suffered short circuit between turns in one coil at about one-twelfth the distance from the lead-in; the insulation to earth of this coil remained perfect. The machine most seriously injured had a general short circuit near the terminals, and several adjacent coils were badly damaged. Projection of molten metal and displacement of the arcs by windage from the rotor were apparently responsible for the breakdown of the adjacent alternator. The third alternator, however, was some distance from the other two. Many cut-outs opened in the network, but the station cut-outs remained closed.

The series instrument transformer of the first alternator (which experienced general short circuit) practically exploded, with the expulsion of a number of arcs and a fusillade of pieces from the wreckage of the transformer and the framework. The 17 other alternators in service at the time delivered an enormous current to the short-circuited alternator, and it was the heating effect of this current and *not* its electromagnetic action on the winding that destroyed the instrument transformer in this case, and in others which have come under the author's notice. The copper is brought practically to melting point, with the result that the porcelain or other supporting insulation is shattered.

These two breakdowns are amongst the most serious encountered during 18 years of intensive operation, and one cannot fail to be struck by the following points of similarity in the two mishaps. A dead earth on the high-tension network at a point far from the station; a short circuit between phases and earth at the leading-in terminals of an alternator or step-up transformer on the station side; a short circuit between turns in a coil remote from the leading-in terminals of a second alternator, this coil remaining perfectly insulated from earth; and, finally, the indifference of the station voltage limiters, despite the operation of many limiters on the network.

A great many critical and analytical theses have been published during the past few years concerning pressure surges in generator and distributing circuits, and much valuable information and assistance has been derived from these theoretical investigations. It is noticeable, however, that the cause and circumstances of pressure surges have been expounded more accurately and more frequently than simple remedies have been suggested. For a long time too much importance was attached to surges set up by sudden interruption of short circuits. Petersen estimates that such surges rarely exceed 20,000 volts after total reflection of the surge wave on windings of high "characteristic resistance."[*] The author estimates that the general potential increase on his network due to interrupted short circuit could hardly exceed 10,000 volts. Such surges could cause numerous failures of insulation, but it is not necessary to bring in these surges to explain the damage to various parts of the equipment caused by the breakdowns described above.

When an accidental "earth" occurs on a distribution cable, the effect may be investigated by assuming that an E.M.F. equal and opposite to the instantaneous P.D. to earth is applied to each phase at the point of breakdown. Making certain justifiable assumptions, and proceeding by means which it is not necessary to reproduce in detail, it is an easy matter to arrive at an approximate estimate of the surges set up by connecting a source of known voltage and unrestricted power to a circuit open at its far end, and either homogeneous or composed of sections with different characteristics. In some cases the resultant pressure wave is very complex. On applying an E.M.F. E from a source of unlimited power to a cable which is connected to a second cable of high resistance as compared with the first, and open at its far end, the wave reflected from the beginning of the second cable is 2 E in amplitude, and from the end of the line is 4 E. If an earth or short circuit occurs at a point on the conductor at voltage E, the absolute value of the discharge wave cannot exceed 3 E. The problem is simplified if the two cables are of equal length, or if the length of the second is a multiple of that of the first. There is then resonance.

Under practical conditions neither surges nor beats conserve either their amplitude or their rectangular wave form. Damping reduces the amplitude (the more rapidly, the higher the frequency of the harmonics), and the speed of transmission of the waves depends on the degree of the harmonic. The conditions of resonance—when E is applied to one line connected to a second of high wave resistance—are fulfilled when the length of the second line is equal to, or three, five, or seven times, that of the first line. The maximum surge voltage is reduced in the ratio of the square root of the lengths. If the second line be short-circuited at the far end there is resonance when the length of the line is any whole multiple of the length of wave emanating from the source. This natural period of vibration, corresponding to a homogeneous line of length l_2 vibrating in quarter-wave, is found in any circuit comprising inductance L and capacity C in series, so long as $2\pi\sqrt{LC} = 4\,l_2/v = 4\,l_1/v$. From this follows a proposition of the highest practical importance. Any sustained wave of length $4\,l_1$ produced in a homogeneous line of length l_1 (whether by closing an interrupter connected to a source of unlimited power or by short-circuiting or earthing some point in the circuit), causes pressure resonance—theoretically unlimited, but restricted in practice by damping. Dangerous pressures may be reached, even if $2\pi\sqrt{LC}$ is only approximately equal to $4\,l_1/v$. In a modern central station network, there are always in series such inductances as cut-out coils, current transformer primaries, boosters, and transformers, and such capacities as those of generator cables, bus-bars, and so forth. The number of factors is so great, and conditions are so variable, that they cannot reasonably be made the basis of numerical calculation, but since $4\,l_1/v$ is obviously small (l being only a few miles in cable networks, and v being the velocity of wave propagation), LC may also be very small, so that resonance, or a dangerous approach thereto, is easily realised in practice.

The three frequencies, quite independent of each other, which it is necessary to take into consideration when studying abnormal pressures in large distributing systems, are:—(1) The generator frequency and its odd harmonics (generally of negligible amplitude in the higher frequencies). (2) The natural frequency of the circuit and the odd harmonics, which are generally damped out by transmission lines, and to a still greater extent by cables. (3) The frequency of the disturbance produced in the circuit, which appears as a series of waves propagated along the line, and reflected partially, or wholly, with interferences or complex superimpositions.

In the two particular breakdowns here considered a discharge wave was propagated through the system, following the earthing of a high-tension cable, and this set up numerous partial and complete reflections and a very complex distribution of pressure. None of the 800 transformers (some very old) on the system, nor any of the 360 km. of high-tension cable suffered any injury from the wave. Damage was confined to modern and thoroughly well-built apparatus in the station itself, doubtless owing to local circumstances making the stress on the insulation particularly severe in these cases. The initial "earth" on the network, at a distance of several kilometres from the station, was equivalent to the sudden application of a negative E.M.F.: $-(E) = -(K\,3{,}500/\sqrt{3})$ set up by a short wave of length nearly equal to that of the oscillating circuit. The latter included booster at station entrance bus-bar capacity, feeder trip-relay transformers, feeder board capacity, connector bars, generator bus-bars, series transformers, and capacity of generator cables. Abnormal pressure being developed on the bus-bars by resonance, the leading-in turns of apparatus connected directly thereto were stressed to a maximum, and, doubtless, the insulation turn to turn was somewhat defective at the points where breakdown occurred. The frequency corresponding to $4l_1/v$, where l_1 represents several kilometres of cable, is such that the pressure strain diminishes from the leading-in terminals towards the neutral point, hence breakdown occurred near the terminals of the apparatus on the bus-bar side.

The fresh "earth" thus developed amounted to applying an E.M.F. of $-(K\,3.500/\sqrt{3})$ to the station circuit at 100 ft. or so away from the bus-bars. This set up a very short, high-frequency wave, which was amplified by pseudo-resonance, on its way through the ammeter coils and the capacity of the bus-bars, and then reached the alternators. In the first case—short circuit at the booster terminals—the pressure ($-E$) was propagated as a rectangular wave, and the length of cable to each alternator vibrated in quarter-wave. In the case of short circuit at the alternator terminals, the pressure ($-E$) was reflected at the booster terminals, and returned thence with an amplitude ($-2E$), the resulting sustained oscillation vibrating with a length = 4 × distance from short-circuited alternator to boosters.

This time there was not a gradual and continuous pressure decrease from the booster terminals towards the neutral point. The alternators vibrated like Seibt coils or Oudin resonators. A number of pressure nodes and loops formed along the windings, and breakdown occurred from turn to turn at a point (far from the lead-in) where the insulation was comparatively poor.

In this case, as in all practical cases, the composition of the resonant circuit is complex and variable, but not arbitrary. Its capacity varies from a very small value to several microfarads, the corresponding inductance varying from some hundredths of a microhenry to several microhenries. Another most important, but indeterminate, factor, is the value of the resistance and self-induction of the alternators.

The author goes at length into the question of damping and evaluation of those constants of the circuit affecting the propagation of surges, but for the most part these investigations are qualitative rather than quantitative. There are enormous difficulties in the way of effecting exact numerical calculations: indeed, the basic data have to be assumed. Steinmetz has given simple formulæ for the resistance and reactance of conductors to high-frequency current, assuming an infinitely long conductor without return. The effective resistance is composed of a thermic resistance varying with the dimensions of the conductor, the frequency, the specific constants, and the permeability; and of a radiation resistance varying with the frequency, but independent of the dimensions and specific qualities of the conductor. A horizontal conductor parallel to the ground fulfils the assumed conditions only approximately, and, in the case of an alternator or transformer winding, the correction factor is far greater, as well as being uncertain. The simple resistance formulæ are still fairly well applicable, but the self-inductance is approximately multiplied by n, where n is the number of turns in series in the coil. Complex though the conditions are in a circuit including multiple-turn coils—partially embedded in laminated iron and subject to the influence of electrostatic and electromagnetic induction, Foucault currents, and hysteresis – it is yet possible to define limiting conditions, and to explain the turn-to-turn breakdown.

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[*] The characteristic or wave resistance of the line = $\sqrt{(\lambda/\gamma)} = \sqrt{\text{(linear self-inductance/capacity)}}$, and is about 600 ohms for aerial lines, 40 or 50 ohms for the author's subterranean cables, and 100 to 1,000 ohms for transformers and machines.

In practice, such breakdowns may occur in the body of apparatus away from the terminals, by the same action which causes loops and nodes of pressure in an Oudin resonator. A transformer, for instance, when subjected to a high-frequency E.M.F. may yield a distribution of pressure in no way proportional to the number of turns between the points concerned, and the stress on a central section of the winding may be three times as great as on the end sections.

The sudden closing of a switch on a network previously on open circuit produces charging waves, which are much less dangerous than those of discharge produced by earths or short circuit. The charging wave consists of a single train, generally heavily damped, whereas the wave of discharge in the case of an earth or short circuit is destroyed twice per cycle, and instantly re-established. The effect of the latter is much more serious, even with equal initial amplitude.

When considering methods of protection it must be remembered that, although cables and the various distributing apparatus may legitimately be expected to resist surge voltages occasioned by everyday conditions of manipulation and operation, it is going too far to expect (and is hardly possible to secure) immunity from damage under the abnormal conditions arising from dead short circuits, earths, incorrect connections, and so forth. Protection against such conditions must be provided by special apparatus, to the principles and design of which too little attention is paid, even in the most modern distribution systems. A great deal of attention has been given to protecting high-power transformers against switching-on surges; generally a "shock-resistance" is inserted momentarily in circuit just before the main switch is closed, and transformers have specially insulated shock-coils.

In alternators, as well, it is necessary to pay close attention to the insulation turn to-turn. The windings of alternators generally lack rigidity, and are subjected continually to vibration; to the powerful air currents set up by salient-pole rotors; and, worst of all, to violent and repeated electro-mechanical shock due to short circuits in the network and the rush of current caused by inaccurate synchronising. The final effect is to wear away the cotton insulation and produce weak (or bare) spots, easily susceptible to breakdown turn-to-turn. The risk is particularly great inside tubes through which the coils pass; due to defective cooling facilities, and particularly when overloads are frequent, the cotton covering of the wires loses tenacity, dries to a carbonised appearance, and becomes friable. In new machines or in old ones undergoing repair, every care should be taken to secure absolute rigidity in the coils, which, so far as possible, should be former-wound and impregnated with insulating compound. Another important advantage of the latter construction is that by excluding air from the coils, the destructive effect of ionisation is avoided: this effect is serious in non-impregnated coils where pressures of 8,000 to 10,000 volts or over are concerned.

Other precautionary measures consist in preventing over-voltages and steep-fronted waves from reaching alternators (which are always the worst insulated elements in distribution installations). Inductances of very low value should not be inserted in the feeders and near the generating station, for they are liable to cause resonance of surge waves due to earths or short circuits. In order to carry to earth as soon as possible any dangerous over-voltages which may be engendered, voltage limiters should be installed at frequent intervals. The author recommends that these be connected directly to earth through small fuses: the limiters may be protected against even a momentary excess of current by providing them with permanent, solid resistances—say of some tens of ohms, according to the characteristics of the network. As a protection against high-frequency pressures, Gino Campos suggests that conductors be electroplated with high-resistance metal, so as to increase the skin resistance and damping. He installs also along the line, coils with secondaries closed on ohmic resistances, inductances shunted on ohmic resistances, condensers in series with resistances, or a combination of these devices. Laboratory tests show surge attenuations of 65 to 99·5 per cent. for frequencies from 50 to 500 kilocycles.

In a recent patent, Steinmetz proposes to avoid local resonance in the windings of large transformers by building these from coils containing a different number of turns, and arranging the coils in various ways in series and parallel. The windings are not then homogeneous, and neighbouring coils have different natural periods of oscillation: hence waves are limited by interference and damping, whether they are brought into the windings or originate within the latter. Feldman and Herzog state that hysteresis and eddy-current losses in the sheathing of armoured cables are 40 times as great as in the conductor itself for high-frequency oscillations. The damping is therefore relatively high, but the energy available may be 600 times as great as in unarmoured cables. Petersen damps out oscillations by rapid damping, and prevents resonance between the inductances of cut-out coils, measuring transformers, wattmeters or ammeters, &c., and the capacity of bus-bars and alternators, by shunting the inductances with small graphite resistances.

The author has great faith in the possibilities of large-capacity condensers installed in the station on the bus-bars. The capacity must, however, be sufficiently large. Guilbert has recently stated that several hundred microfarads, installed at the alternator terminals, are required to prevent with certainty resonance of the fundamental harmonic. Such a capacity is inadmissible in practice, hence one is obliged to rest content with partial limitation of harmonic surges when using a protective capacity. The latter representing only a small fraction of the total capacity of the network, its connection to the bus-bars hardly modifies the resonance conditions for forced waves. The author concludes that, in his particular network, a capacity of 5 mfd. would protect windings against breakdown, turn-to-turn, caused by steep-front surges. Large capacities for industrial service would be costly, and would occupy much space, but it is worth while to attack the problem of their use.

Specifications for alternators should include a clause requiring special insulation turn-to-turn and turn-to-frame on the leading-in sections of the winding (as in modern transformers). Pressure surges in generating, receiving, or sub-stations, due to short circuits or "earths" on the line may, under present-day conditions, cause breakdowns which are very serious by reason of the interruption of service, as well as on account of the material damage caused directly. The study of such surges forms a special chapter in the technology of electrical distribution, and one which is yet scarcely opened.

THE TUNGAR RECTIFIER.

In the *General Electric Review* for March, Mr. R. E. Russell describes the hot-cathode argon gas-filled rectifier developed by the Research Laboratory of the General Electric Co. (U.S.A.).

The Kenotron rectifier, described in our issue of May 7th, 1915, is suitable for rectifying very high voltages, and has a drop in voltage of 100 to 500 volts between the anode and the cathode: the Tungar rectifier, on the other hand, has a drop of 5 to 10 volts, so that it can be used on ordinary supply circuits. Both devices depend upon the same principle—the emission of electrons from an incandescent filament. In the Kenotron tube the highest possible vacuum is maintained, so that the electrons themselves are the only current carriers, and the current is small: in the Tungar device, an inert gas at low pressure is ionised by the electrons, and the ionised gas acts as the principal current carrier, so that the drop is small and a current of several amperes can be transmitted. Fig. 1 shows the 2-ampere and 6-ampere bulbs, in which the cathode consists of a filament of fine tungsten wire coiled into a closely-wound spiral, and the anode is a piece of graphite of relatively large cross-section. The gas employed is argon, which must be kept absolutely free from impurities, which affect the voltage characteristics of the rectifier and produce disintegration of the cathode; to maintain this degree of purity special substances are introduced into the bulb in the course of manufacture, which react on the impurities. The purifying device is shown in the form of a wire ring on the anode: as soon as the tube is started the purifier is volatilised, and absorbs any foreign gases.

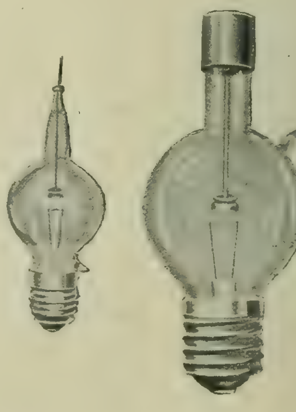


Fig. 1.—Two and Six-Ampere Tungar Rectifier Bulbs.

Fig. 2 shows the connections of a half-wave rectifier in their simplest form, the equipment consisting of the bulb B, cathode filament F, anode A, transformer T for exciting the filament, rheostat R, and the load, in this case a storage battery.

At present the commercial patterns of the rectifier are all of the half-wave type: the 2-ampere set on 115 volts A.C. will charge three lead cells at 2 amperes, six cells at 1 ampere, and eight cells at 0·75 ampere; the 6-ampere set charges three or six cells at 6 amperes, and another 6-ampere set charges three to 30 cells at 1 to 6 amperes. Only small sizes, taking less than 500 watts, are being sold, but work is progressing on full-wave rectifiers of larger capacity. Two half-wave rectifiers can, of course, be connected up so as to rectify both waves, if desired. Fig. 3 shows the 2-ampere rectifier with cover removed, the parts including the bulb and receptacle, compensator and reactance, fuse and receptacle; the compensator is used instead of a rheostat for regulation, and reduces the primary voltage to that required to deliver the desired direct-current voltage. The filament transformer and a reactance are combined with the compensator.

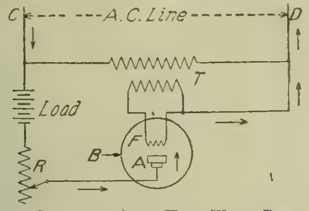


Fig. 2.—Connections of Half-Wave Rectifier.

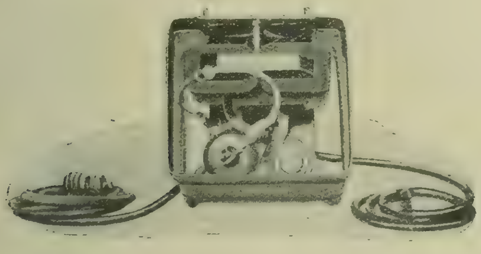


Fig. 3.—Two-ampere Rectifier with Cover Removed.

The 75-volt set is more elaborately designed, and is provided with a regulating handwheel and an ammeter; its efficiency is 75 per cent. when delivering its full load of 450 watts. It was designed primarily for charging 10 three-cell automobile starting and lighting batteries in series, and has experienced a large demand for this purpose. The smaller 6-ampere set was similarly designed to charge three to six cells in the private garage, and the 2-ampere size to charge small three-cell batteries for lighting and ignition. Other applications have also been found for the rectifier, some of which depend on the fact that, while the mercury vapour rectifier requires a current of at least one or two amperes to maintain the arc, the Tungar is kept excited by the heated filament. Moreover, it is self-starting, and can be employed in connection with apparatus which is only occasionally energised, without necessitating attendance. The life of the bulb is expected to average at least 600 to 800 hours under normal conditions, and many of the standard bulbs have run as long as 1,500 to 2,000 hours.

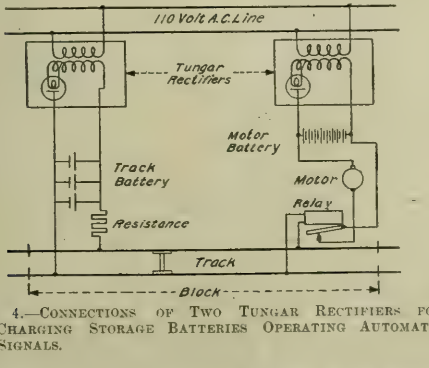


Fig. 4.—Connections of Two Tungar Rectifiers for Charging Storage Batteries Operating Automatic Signals.

An interesting application of the device is to charging D.C. automatic signal batteries on railway systems (see fig. 4). The track battery consists of three lead cells connected in parallel and through a resistance to each rail of track. The rectifier charges the battery continuously at about 0·75 ampere. In this rectifier a transformer with separate windings is used in place of the compensator, to prevent connection between the A.C. line and the battery, both of which are earthed. The motor battery used to operate the semaphore signals on the block consists of five to eight cells; the rectifier is connected in much the same way as the track battery rectifier, and gives 0·13 to 0·2 ampere at 10 to 18 volts, the output being designed to be just sufficient to keep the battery in a certain state of charge, by supplying sufficient current to equal the average discharge plus the losses in the battery. The practicability of this system is being investigated on an important railway system. Other uses of the rectifier are for charging small storage batteries for ringing bells and fire alarms, operating private branch telephone exchanges, &c., but the possibility of applying it to the charging of electric vehicle batteries, requiring 30 amperes at 110 volts, seems rather remote. It is stated that the first cost and cost of installation of the device are low, and that in the first three months nearly 1,000 were sold.

HIGH-TENSION OVERHEAD TRANSMISSION LINES.

By G. V. TWISS, A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

(*Concluded from page 558.*)

A line insulator, whether of the pin or suspension type, may be made up of one or more shells of porcelain with metal parts, usually malleable cast iron or mild steel, and in performing its normal function must encounter considerable variations of temperature. Expansion and contraction stresses may therefore occur even in one of the component materials owing to its uneven heating and cooling, and are bound to occur in the different component materials owing to their different coefficients of expansion. The problem is, therefore, to shape and proportion the various parts of the insulator so that these stresses are kept as low as possible and, in conjunction with the stresses set up by outside loads, well within those that the materials can continuously withstand without deterioration.

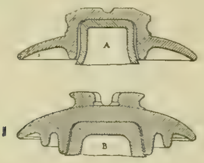
Metal parts do not generally fit in close contact with porcelain parts, nor do porcelain parts fit in close contact with other porcelain parts; there is always a layer of cement, generally neat Portland cement. Any stresses set up by the expansion and contraction of the parts will therefore be transmitted through such cement layers. Cement has, however, a low modulus of elasticity and a strength under compression very much less than either iron or porcelain, so that it will act to some extent as a cushion. From this point of view, the cement layers should be made reasonably thick. On the other hand, however, neat Portland cement unless very sound, *i.e.*, thoroughly burned and skilfully gauged, is liable to a slight expansion of its bulk, which may take several years to develop. From this point of view the cement layers should be kept thin.

Between two parts, such as two shells of porcelain, which have the same coefficient of expansion, the desirable thin layer of cement can be used without corresponding disadvantage. When, however, there are solid and bulky metal parts, the expansion stresses will be appreciable, and the cement layers must be of greater thickness so as to give the cushioning effect. In some cases, however, it is possible to keep such stresses low, thus avoiding the necessity of the thickest layers, as, for instance, by cementing a sheet metal thimble instead of a solid pin into a pin insulator. The stress may also be reduced by doing the work of cementing at a higher temperature, thus reducing the range of expansion, and by the employment of other expedients. In any case, however, the cement should be chosen with care and gauged with skill, and the parts should be shaped so that whatever stresses may occur will not be localised.

Pin Insulators.—A pin insulator may be heated to a considerable temperature by the sun shining directly upon it—probably more on one side than on the other—during which time the parts tend to expand; and it may then be subjected to a sudden downpour of rain, which suddenly cools the top shed, causing it to contract. With small pin insulators, nothing is likely to happen under these conditions. In large pin insulators, such as those for 50 kilovolts, designed with the top shell shaped as A in fig. 15, considerable stresses may be set up at the corners, thus causing the side to split and fall off. This has been a source of trouble in America.

It is, however, possible to design the top shed in the form of a continuous disk, with the head formed on the upper side and a flange on the underneath side for fixing to the other shells (see B in fig. 15). The flange is given a slight slope and the cement space is kept thin, and as porcelain is a poor conductor of heat, this arrangement of head and flange largely obviates this trouble. It might be thought that this arrangement would weaken the insulator mechanically, but comparative tests which have been made show that the insulators so designed have a strength at least equal to that of earlier designs with the heads as shown in A, and have ample strength for any load which can (or ought to) come on them in practice.

As already set out, the characteristics of the design of a pin insulator limit its use to positions where the working loads are comparatively small, of the order of, say, 500 lb. To obtain very great mechanical strength in a pin insulator precludes the shaping of the parts so as to suit best the electrical requirements and obtain freedom from stresses due to sudden extreme variations of temperature.



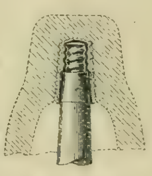


Fig. 15.—Large Pin Insulators. Fig. 16.—Thimble.

As the strength of the means of attachment, and also of the spindle, limit the stresses which can come upon a pin insulator, it would appear unnecessary to insist upon a strength in the pin insulator very much in excess of that of its spindle or of the means of attachment of the conductor, especially since, as shown above, the insistence on excessive mechanical strength merely obtains something of little or no value, at the sacrifice of something of real value.

Many different methods have been employed for fixing pin insulators to spindles, including such devices as the Cordeaux screw, hemp fixing, cementing, or cementing-in a separable metal thimble into which the spindle is screwed. The desirable fixing is a detachable one, which permits of the insulators and spindles being transported and handled separately and of insulators being replaced. The Cordeaux screw and metal thimble both possess this advantage.

The Cordeaux screw fixing has been extensively used in this country, presumably because of its detachability, and also, perhaps, because it is inexpensive. The Cordeaux fixing, however, is certainly not good from an electrical point of view, owing to the presence of sharp edges and small air spaces between the metal and porcelain, and it is one of those liberties which may be, and therefore is, taken with insulators for comparatively small voltages, though it certainly ought not to be taken at the higher voltages. From a mechanical point of view the Cordeaux fixing is much weaker than any other.

Hemp fixing was presumably the outcome of the necessity for a method of fixing to certain foreign porcelain, a characteristic of which is its brittleness. With English porcelain—or American for that matter—which is tougher and more resilient, the use of hemp is not at all necessary. In any case, however, to make a good job of hemp fixing, the hemp should be wound on the spindle under tension on a lathe and screwed in on a lathe; and as such facilities are generally not available on the site, it has to be done at the maker's works. On the other hand, however, this increases the cost of carriage and the liability to breakage in transit, the extra expense of which does not appear to be justified.

The fixing of metal pins by cementing them direct into insulators makes a very sound job, but as the pins are of solid metal a good cushion of cement is necessary.

The following test has been applied to insulators of English porcelain fitted with metal-work cemented in, and it shows that when such fixing is properly done, no trouble occurs through expansion and contraction:—

The insulator fitted with a thimble is immersed for five minutes in a freezing mixture at — 7 deg. C., and is then plunged into water at 85 deg. C. for five minutes. This test may be performed repeatedly without damage to the insulator or reduction of its electrical strength.

To ensure that the metal-work is correctly centralised and that proper materials are used, it is desirable that the cementing should be done at the maker's works, where these facilities exist. The same argument, however, as for hemp applies here, namely, that the cost of carriage and liability to breakage in transit cause extra expense. If, however, a separable metal thimble is cemented into an insulator, the advantages of proper centralisation, materials, &c., are obtained, but the extra expense and risk of breakage in transit are obviated. Moreover, if the thimble is made in stamped sheet metal as opposed to a casting, the expansion stresses are kept low, and smaller clearances of cement can therefore be used.

A thimble of this nature is shown in fig. 16. In this design of thimble the joint is made on a cone seat (patented), the screw in the upper half of the thimble being chiefly for the purpose of bringing the cone seats of the thimble and spindle into close contact. The cone-seated joint develops the full strength of the full section of the spindle, and the small taper of the cone, requiring at least a half turn to release properly, prevents looseness. This would appear to be one of the best methods of attaching an insulator to a pin.

Suspension Insulators.—In suspension insulators porcelain and metal are in very close relationship, and the insulators are also required to work under heavy loads, so that it is necessary to give very careful attention to the details of the design.

Metal-hooded insulators are sometimes considered to be in tension, and as porcelain is notoriously weak in tension the design is considered to be inferior to interlinked insulators in which the porcelain is in compression. The following test is therefore interesting:—

Insulators A and B, fig. 17, are identical as regards section of material, shaping, shear area of cement, &c., but the pin in A is inserted deeper than that in B.

A gives an average strength of four tons, and the porcelain is crushed without the cement being sheared.

B gives an average strength of two tons, and the spindle pulls out, shearing the cement.

It would appear that A transmits a large component of stress to the hood through the porcelain in compression, and the shape of the break as marked on the diagram and the stratified character of the porcelain at the break substantiate this.

Combined electrical and mechanical tests show that some designs fail electrically long before they appear to break mechanically, whilst others develop very nearly the full mechanical strength before electrical failure takes place. The former always appeared to be those where the shaping of parts indicated the possibility of severe and localised expansion stresses, and the latter where such stresses were likely to be the least and not localised. This shows that the design which gives the highest mechanical test is not necessarily the best design from the point of view of inside stresses.

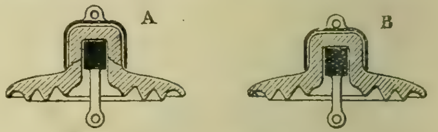


Fig. 17.—Metal-hooded Insulators.

A metal-hooded insulator may be designed for an ultimate strength of 10 tons or more. The same remarks that were made on this head under pin insulators, however, hold good here, as insistence upon unnecessarily high mechanical strengths precludes the easy shaping of parts which is so desirable for considerations of electrical soundness and freedom from expansion and contraction stresses.

Transmission line conductors rarely have a breaking strength much in excess of 2½ to 3 tons, and for such cases there would appear to be no object in requiring the suspension insulator to stand much more than this. For a load of three tons or so the insulator can embody the most desirable characteristics from every point of view, but for loads very much beyond this something has to be sacrificed.

Testing of Insulators.

1. *Routine Tests.*—These may be briefly summarised as follows:—

Electrical routine tests at normal frequency (50 to 100 cycles). A predetermined voltage* is applied to each shell before assembly, and again to each assembled insulator for a period of five minutes, water generally being used as electrodes.

A predetermined mechanical load is applied to the insulator for a certain period of time, usually 10 seconds. The routine mechanical test is not as a rule applied to pin insulators, but with suspension insulators it is applied before the routine electrical test on the assembled insulator. Mechanical tests if taken to very high values may cause damage by starting internal cracks, and should be limited to about 25 per cent. more than the maximum working load.

2. *Design Tests.*—An electrical design test at normal frequency (50 to 100 cycles).

For flash-over: the insulator is fitted with metal-work and is attached to a cross-arm as in practice, a gradually increasing voltage being then applied:—

(*a*) with the surface dry,

(*b*) with the surface wet by a precipitation of water at an angle of 45 deg. to the vertical and at the rate of 1 in. in five minutes.

For puncture: the insulator with metal fittings as similar as possible to those used in practice, is immersed in oil and a gradually increasing voltage (at the rate of 10 kilovolts per second) is applied until puncture occurs.

The voltage on the high-tension side of the transformer used to be measured by means of a needle spark-gap. Needle points are, however, subject to variation due to brush discharge, &c. The sphere gap is not subject to such variation when the spheres are of sufficient diameter in respect to the width of the gap to prevent corona preceding the spark. With a width of gap up to three times the diameter of the spheres there is very little corona, but for the most accurate work the width of the gap should not be greater than the diameter of the spheres. The sphere-gap readings are, of course, subject to correction for barometric pressure and temperature. A resistance which may consist of a porcelain tube filled with water should be placed in series with the gap to limit the flow of current at arc-over to one ampere or less, otherwise oscillations are set up, causing discrepancies in the readings, and the sphere gap may also be damaged through pitting.

---

* This voltage should be in the neighbourhood of the flash-over voltage; in fact, one English firm regulates the voltage so that the insulators flash over at the rate of as nearly as possible once per second. This makes the routine test very searching.

The resistance of the water used for spray tests is important, and very different results are obtained with different qualities of water. Water with a resistance approximating to that of actual rain, *i.e.*, distilled water, should therefore be used when especially accurate figures are required.

When insulators are submitted to design tests, the formation of corona on parts should be carefully observed, as much can be learnt in that way in regard to overstressing.

Lightning surge-oscillation and switching or arcing surge-effects would appear to be best simulated by high-frequency oscillations as given by a Tesla circuit. High-frequency oscillators of this type have been made abroad, which, when taken off an ordinary supply at, say, 60 cycles per second give 120 trains of oscillations per second at a wave frequency of about 300,000 cycles per second. There are, of course, comparatively long periods of rest between each series of wave trains. The voltage is controlled on a control spark gap and measured on a sphere gap.

Insulators submitted to high-frequency oscillations should withstand the potential being increased until flash-over occurs without puncture.

The insulator fitted with metal-work as in practice is submitted to a gradually increasing mechanical load until the ultimate mechanical strength is reached. As previously mentioned, internal damage sufficient to cause electrical breakdown may occur in an insulator under mechanical test before visible mechanical failure occurs. This points can be detected by applying an electrical test to the insulator in conjunction with the mechanical test. This test would seem to be important, as an apparently high mechanical test is of no value if damage has occurred which causes electrical failure at a very much lower value. The best insulator from the mechanical point of view will be the one which will withstand, before electrical failure takes place, a load as high as possible in respect to the ultimate load.

3. *Deterioration Test.*—It is important to recognise that even a test by high-frequency oscillations is not necessarily an infallible test of either the soundness of the material or the design. For instance, an insulator might be quite sound at the works and withstand high-frequency tests, but, under working conditions of changing temperature, stresses will occur which, if the insulator be not properly designed, may set up small cracks and thereby eventually cause failure. Moreover, an insulator slightly porous from under-firing might withstand these tests when in a new and dry condition, but under working conditions such an insulator might gradually absorb moisture by breathing action set up by the changing temperature. It is probable that the so-called "fatigue" of insulators under high pressures has been due to these causes.

In regard to expansion and contraction stresses causing deterioration, the mechanical-electrical test previously referred to would, to some extent, detect this tendency, as an insulator in which these stresses are likely to be most severe would fail at a lower load. A more exact way, however, would be to perform this test with the insulator heated up to the maximum temperature likely to occur in practice.

In regard to the detection of slight porosity, probably the best way of discovering this is by the use of a "Megger" giving, say, 1,000 volts.

A test, presumably for the purpose of detecting porosity, and one frequently met with in specifications, requires that insulators be broken into small pieces and weighed after being kept in a warm, dry place for 24 hours, then soaked in water for 24 hours, the surfaces dried, and again weighed, when no increase in weight must occur. The difficulty with this test is that it is impossible to remove all the moisture from the slightly rough surface of the broken pieces. A more searching way to discover porosity in broken pieces of insulators is to leave them to soak in a solution of aniline dye and alcohol, and then to break the pieces transversely to the surface, when any absorption will at once be visible.

However well designed an insulator may be, it will not make up for defective materials; and an indifferently designed insulator of good material will probably give better service than a well-designed insulator of bad material. The importance of sound material cannot be over-estimated, and fortunately in English hard porcelain we possess a sound material which, in combination with good design, makes an insulator having exceptionally desirable characteristics.

It is quite easy to save 20 per cent. or more on the design of an insulator and still give the same flash-over tests. That such saving is not worth while will be granted when it is remembered that insulators only account for about 1 or 2 per cent. of the cost of a power supply system, and that the power supply may be shut down by the failure of an insulator.

Attaching Conductors to Insulators.

The means of attachment of conductors to insulators should be such that:—

(*a*) Crystallisation of the conductor must not be set up.

(*b*) The conductor should be held to the required load without bruising or injury to its surface.

(*c*) The attachment should be capable of being erected with ease.

Strain-insulator clamps have flexibility to an eminent degree owing to all the motion being taken by the link attachment of the insulator, and they are therefire ideal from the point of view of the prevention of crystallisation. A strain clamp necessarily requires a grip sufficient to develop the ultimate strength of the conductor before slipping. The best grip can be obtained by means of roughened gripping surfaces, but these injure the conductor, and it is preferable that the gripping surface of the clamp should be smooth and rounded, which requires a greater length of surface than when roughened. In some forms of clamps this grip is obtained by gripping jaws consisting of two grooved plates bolted together. This, whilst providing an excellent grip, free from risk of damaging the conductor, is not the easiest to erect owing to the necessity of handling separate plates, bolts, and nuts whilst erecting.

For ease of erection, clamps providing the grip by means of hook bolts have been used, these bolts not having to be separated from the clamp during erection. Perhaps a better way, however, is to use plates bolted together as above mentioned, but with the bolt holes arranged so that the gripping jaws can be opened to receive the conductor without removing the bolts. A clamp on this principle is shown in fig. 7 (p. 556). The eye at the end of the clamp enables a block and tackle to be attached to the clamp instead of to the cross-arm, thus facilitating the clamping-in of the conductor.

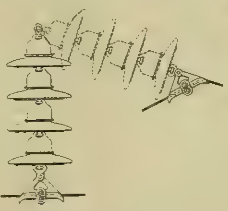


Fig. 18.

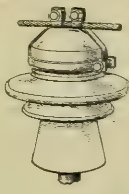


Fig. 19.—Stirrup Clip.

Suspension clamps have also a considerable degree of flexibility by virtue of being suspended from a link. In the event of a conductor breaking, the suspension clamp swings out into the line of the sag, thus reducing the stress, so that there is no necessity for the suspension clamp to grip the conductor to its breaking-point. In any case, the intermediate pole upon which the suspension insulator is fixed is not designed to carry the stringing tension of the conductor. A light grip which will permit the conductor to slip at a load of 500 to 1,000 lb. is sufficient, and such a grip can be easily obtained in a manner which will not damage the surface of the cable.

The suspension-insulator clamp should have the ends formed with ample radius, so that when the insulator swings into the line of the span, in the event of a conductor breaking, the conductor will not be further damaged by kinking. The clamp should also be formed so that when this condition occurs the end of the clamp or the conductor will not strike and shatter the porcelain of the last unit of the insulator chain (see fig. 18).

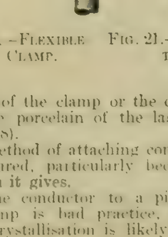


Fig. 20.—Flexible Clamp.

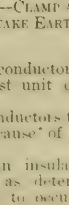


Fig. 21.—Clamp arranged to take Earth Wire.

The binder method of attaching conductors to pin insulators is largely favoured, particularly because of the amount of flexibility which it gives.

To attach the conductor to a pin insulator by a rigid mechanical clamp is bad practice, as deterioration of the conductor by crystallisation is likely to occur. To obtain a mechanical grip without rigidity the "stirrup clip" (patent No. 6,286/12) shown on fig. 19 was designed. The thin metal and particular shaping of this clamp give a degree of flexibility sufficient to obviate crystallisation, and it has given satisfactory service.

A new type of clamp* to obtain the advantages of a mechanical attachment and yet be flexible is that shown in fig. 20. This type of clamp has complete freedom of motion, and all wearing of the conductor by rubbing on the point of support is obviated.

Owing to the fact that a pin insulator is only capable of carrying loads of the order of the transverse load, there is no point in making the attachment grip to a greater load.

In no case does the means of attachment develop a grip anything like the strength of the conductor, but it lets the conductor slip at a load more of the order of a transverse load due to wind on the conductors. This is as it should be, otherwise the insulator pin or cross-arm would be damaged. The U.S.A. binders, however, seem to give too light a grip.

The flexible clamp shown in fig. 20 has mechanical characteristics in both the line and longitudinal direction of the same order as a good binder, and has a flexibility greater than any binder.

In regard to ease of erection, a binder is probably always more difficult and requires greater skill to erect than a mechanical clamp, but of all mechanical clamps the flexible clamp shown in fig. 20 is by far the easiest to erect, being merely dropped into the insulator head and turned at right angles, the conductor then being dropped into the slot and the one nut tightened up. This type of clamp is, of course, only suitable for use with the latest type of insulators (designed to withstand surges), the heads of which insulators are, as previously explained, formed on the upper side of a disk to avoid internal stresses. Fig. 21 shows a clamp on similar principles arranged to take earth wires.

Conclusion.

The matter, data, and illustrations that have been referred to in the foregoing are almost exclusively concerned with transmission lines which have been engineered from this country, and the material for which has been designed and manufactured in this country. The author's thanks are given to Messrs. Bullers, Ltd., for facilities afforded in connection with the preparation of the paper.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

[illegible] "Electric starters for internal-combustion engines." M. S. Conner. May 7th.

6,467. "High-tension magneto machines for ignition systems of internal-combustion engines." J. B. Bensami & G. N. Fell. May 7th.

6,508. "High-frequency alternating-current dynamos." Crompton & Co. and N. Pensabene. May 8th.

6,525. "Electrical connections for switches, plugs, lampholders, connectors, &c." R. Reynolds. May 8th.

6,528. "X-ray exploration couches." A. I. Dean. May 8th.

6,530. "Electric cable containing several conductors." Pirelli & Co. May 8th. (Italy, June 28th, 1916.)

6,531. "Electric switches." Electrical Improvements, Ltd., & R. W. Gregory. May 8th.

6,532. "Stabilising self-excited direct-current dynamos." J. R. Beard, Electrical Improvements, Ltd., & H. B. Poynder. May 8th.

6,536. "Apparatus for manufacture of electric lamps." General Electric Co. & British Thomson-Houston Co. May 8th.

6,542. "Electrical signalling systems." F. G. Bell, W. C. Davey and Sterling Telephone & Electric Co. May 8th.

6,584. "Electro-magnetically-operated brake, &c., mechanisms." R. S. Lewis and Ransomes & Rapier. May 9th.

6,586. "Fusible cutouts." British Thomson-Houston Co. & E. B. Wedmore. May 8th.

6,600. "Forming filaments." British Thomson-Houston Co. (General Electric Co., U.S.A.) May 9th.

6,603. "Spring device for attaching shades to electric lampholders." T. Cracknell. May 9th.

6,610. "Electrical arrangements for facilitating starting of internal-combustion engines." J. W. T. Cadett & C. Percy. May 9th.

6,631. "Momentary-contact electric switches for cancelling mining visual signals." G. Saint. May 10th.

6,642. "Sparking plugs." T. Crosbee & Sons, T. S. Rogers & R. H. Weeks. May 10th.

6,659. "Mechanical and electrical relays." A. Barr, Barr & Stroud, and W. Stroud. May 10th.

6,699/6,700. "Lead-covered cables." British Insulated & Helsby Cables, Ltd. May 11th.

6,725. "Protection of electric distribution systems." J. R. Beard, Electrical Improvements, Ltd., & P. V. Hunter. May 11th.

6,732. "Electric furnaces." J. R. Quain. May 11th.

6,746. "Electric batteries." W. A. S. Hellyar. May 11th.

6,752. "Magneto-electric machines." T. H. Chambers & F. Stuck. May 11th.

6,787. "Secret switch or cut-out." G. J. Mosley. May 12th.

6,794. "Employment of thermionic devices for magnification." Marconi's Wireless Telegraph Co. May 12th.

6,802. "Systems of phase modification." British Thomson-Houston Co. (General Electric Co., U.S.A.). May 12th.

6,805. "Electrical measuring instruments." P. O. Dorey, R. H. Rogers and S. Smith & Sons. May 12th.

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

4,035. Apparatus for and Method of Treating Articles Electrolytically. C. J. Lea & D. L. Honeyman. March 18th, 1916. (105,582.)

5,341. Insulators for Supporting Electricity Conductors for Appliances. British Insulated & Helsby Cables, Ltd., and J. W. Astley. April 12th, 1916. (105,586.)

5,501. Field or Portable Telephones. H. Burge. April 14th, 1916. (105,592.)

5,567. Means for Concentrating or Intensifying the Light of Electric Filament Lamps. A. G. France. April 15th, 1916. (Cognate application 5,568/16.) (105,600.)

5,579. Special Service System for Machine Telephone Switching Exchanges. Western Electric Co., F. R. McBerty & L. Polinkowsky. April 15th, 1916. (105,601.)

5,945. Shields or Guards for Electric Lanterns, Electric Torches, or similar Hand Lamps. N. J. Austin & G. E. Taylor. April 25th, 1916. (105,631.)

6,039. Dynamo-electric Generators for Aircraft. G. E. Mortley. April 27th, 1916. (105,634.)

7,736. Electrical Signalling Systems. Sterling Telephone & Electric Co., F. G. Bell & W. C. Davey. May 31st, 1916. (Cognate application, 12,456/16.) (105,659.)

7,942. Systems of Turbo-electric Ship Propulsion. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 5th, 1916. (105,660.)

8,165. Electric Systems of Ship Propulsion. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 9th, 1916. (105,664.)

8,303. High-speed Telegraphy. T. B. Dixon. July 19th, 1915. (Divided application on 2,524/16.) (100,942.)

9,036. Electric Welding Systems. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 27th, 1916. (105,676.)

10,162. Electric Photographic Printing or Copying Frames. J. Halden and Co. & J. B. Halden. July 19th, 1916. (105,685.)

12,382. Magnetic Chucks. H. Humphreys. September 1st, 1916. (105,701.)

14,546. Inductances for Duplex Telephone Circuits. Western Electric Co. October 13th, 1915. (101,805.)

14,886. Dynamo-electric Machines. A. H. Midgley and C. A. Vandervell and Co. October 19th, 1916. (105,714.)

15,123. Combined Electric Plug and Switch. D. M. Edwards. November 21st, 1916. (105,717.)

15,269. Batteries for Electric Pocket Lamps. Hollandsche Elementenfabriek "Juliana." October 5th, 1916. (105,721.)

17,281. Quick Make-and-break Switch for Electric Circuits. E. A. Leopard and Johnson & Phillips. December 1st, 1916. (105,726.)

Sleet on Transmission Lines.—In a climate like that of the northern United States the danger from sleet on transmission lines is a serious one. On the earlier systems, before suspension insulators came into use, the only danger from sleet which had to be seriously considered was the actual mechanical failure of the cables, insulators, or some part of the supporting structure. A heavy coating of ice, combined with strong wind, may actually bring down a line either by parting the wires or by collapse of the supports. Fortunately, in a well-designed line this dangerous combination is one very rarely formed, so that failure of service from this cause has been rather rare. With the coming of the suspension insulator, however, the conditions were materially changed. In using such insulators there is a certain lengthwise flexibility controlled only by the anchoring of the spans at more or less frequent intervals. If all spans were loaded equally, no trouble would result, because, whatever the spacing of the wires might be unloaded, a somewhat analogous spacing would result when all were borne down by a load of ice. If, however, one of the wires is much more heavily coated than the others, or, being initially like them, retains its coating after its neighbour has been freed from it, the vertical clearance between spans may be very considerably decreased. The loaded span comes down, while the wire below it, freed from ice, and, perhaps, pulled up by loads still retained on neighbouring spans, rises, so that there may be considerable danger of contact or sufficient approximation of the circuits to start an arc. The variations in sag of spans due to this unequal loading on suspension insulator lines may be of surprisingly large amount, and it is particularly likely to cause trouble on double-circuit tower lines where the wires are spaced one above the other. On horizontal single-circuit lines it is very unlikely to result in trouble, since the swaying of the loaded lines is extremely unlikely to be sufficient to bring them into even approximate contact.

Some valuable experiments were carried out on a line, built with 7-ft. clearance, to determine how great the sag due to loading might be. This was done by actually loading the cable through one entire span, and measuring the effect in sag of the cable and deflection of the insulators from one strain insulator to the next, over a distance of seven spans. In a 640-ft. span the increase of sag, due to a loading equivalent to a ½ in. coating of ice, proved to be 15 ft., the effect of the load being chiefly to pull over the suspension insulator strings so as actually to shorten the distance between supports, and thus to drop the catenary to a corresponding amount, which agreed very closely with the theoretical result, in thus shortening the span with the same length of conductor.

The obvious course in most cases would seem to be the installation of suspension insulator lines with the conductors staggered enough to limit the danger from unequal sag.—*Electrical World.*

Coal Economy.—Mr. Brace states that he hopes in a few days to communicate with the Metropolitan Borough Councils with a view to securing such economy in the use of coal in connection with street lighting as may be possible during the summer.—*Times.*

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* Patent applied for.

THE

ELECTRICAL REVIEW.

Vol. LXXX. JUNE 1, 1917. No. 2,062.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: June 1, 1917. No. 2,062.

	Page
Electric Power Supply ...	589
"Business Must Go On." ...	590
The Manufacture of Controller Drums, by R. K. Shield (*illus.*)	590
Team Work in Line Construction, by "Tramp Royal" ...	592
Electrical Equipment at a Great Western Goods Station (*illus.*)	593
Electrical Communication in the Field (*illus.*) ...	595
Legal ...	597
Electric 'Bus Charging at York (*illus.*) ...	598
Electrical Heating and Cooking ...	598
War Items ...	599
Reviews ...	600
Telephone Wires in Streets ...	602
Business Notes ...	603
Notes ...	605
City Notes ...	608
Stocks and Shares ...	610
Static Sub-Stations ...	611
The Faraday Society ...	612
Wayleaves ...	613
Economies in Lighting in Relation to Fuel Saving ...	614
Foreign and Colonial Tariffs on Electrical Goods ...	615
New Patents Applied for, 1917 ...	616
Abstracts of Published Specifications ...	616
Contractors' Column ...	Advertisement page xx

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Published every FRIDAY, Price 4d.

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Telephone Nos.: City 997; Central 4425 (Editorial only).

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Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

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SYDNEY: The Mining & Engineering Review, 273, George Street. Gordon and Gotch, Pitt Street.
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WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

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ELECTRIC POWER SUPPLY.

LAST week we published the report of the Departmental Committee which was appointed by the Board of Trade, in March last, to consider what steps should be taken to ensure an adequate and economical supply of electric power to all classes of consumers, especially to industries which depend upon cheap power. The conclusions unanimously arrived at by the Committee, so far from containing any novel features, may be described, if not as obvious truisms, at any rate as facts with which readers of the ELECTRICAL REVIEW must necessarily be familiar, for the principles laid down by the Committee have been repeatedly insisted upon in articles which have appeared in our pages. It is singular that it should have taken the Government of a civilised country so many years, to say nothing of the greatest war in history, to discover that the policy which it had adopted of chopping up the country into innumerable isolated areas, each provided with its own little generating station under the control of a committee of laymen more interested in local party politics than in the efficient conduct of a highly technical undertaking, was almost the worst that could have been devised.

Government interference from the first has been the bane of electricity supply, both in the Provinces and in the Metropolis, where a similar policy of dissection was aggravated by the institution of competition in each area—a system which appears to touch the limit of fatuity. We sincerely trust that history on this occasion will *not* repeat itself; that for once the intervention of a Government Department may not have a detrimental effect upon the development of the industry. We are encouraged in this hope by the fact that the Committee was unanimous in recording its recognition of the necessities of the future, and the utter inadequacy of the system followed in the past; this fortunate circumstance is due, no doubt, to the powerful influence exerted by the three or four electrical members of this Committee of twelve. Thanks to their guidance, the Committee has been enabled to formulate a true statement of the position, and though the facts were common knowledge amongst electrical men, it should not be forgotten that the general public, and still more the Government, needed enlightenment. The report will, therefore, serve a useful purpose in this respect, at any rate, and the time spent in producing it has not been altogether wasted. We trust that the Committee's proposals to obtain the advice of representative associations throughout the country will be followed up without delay, and that a constructive policy on the lines of common-sense designed not to pander to the political aims of local authorities, nor to fill the pockets of speculators, but to serve the interests of the community as a whole, may speedily be evolved. Whether the demand of the I.M.E.A.—at the instigation of Committeemen—for the more direct representation of municipal undertakings on the Committee would tend to this result is a matter of opinion; what is required is not the verdict, by a majority, of representatives of sectional interests, but that of a Committee of impartial experts, capable of appreciating the merits of the question, and free to arrive at an unfettered decision based thereon. The municipal undertakings will have ample opportunity of stating their case before the Committee through the medium of the I.M.E.A. The parochial system of supply may be said to be upon its trial, and it is not usual to give counsel for the defence a seat upon the bench of magistrates. However, the inclusion on the Committee of Mr. C. H. Merz may perhaps be regarded as an infraction of the principle in favour of company interests, although, as the leading exponent in this country of electricity supply on the large scale, his right to be there is incontestable, and probably it would be well to offer a seat to an equally prominent municipal electrical engineer, such as Mr. S. L. Pearce, whose experience would abundantly justify his nomination apart from his representative function. At present the Committee appears to us to comprise too large a proportion of non-technical men, and though so far it has arrived at obviously correct conclusions, its constitution would be greatly improved by an increase in the number of electrical engineers amongst its members. The names of Mr. C. P. Sparks and his elected successor in the presidential chair of the I.E.E. at once commend themselves, and to these we might add others—men who are already intimately acquainted with the situation, and are capable of dealing with the real problem of ways and means, without further loss of valuable time.

"Business Must Go On."

It is somewhat amusing to observe that, on the entry of the United States into the war, the Society for Electrical Development has adopted practically the same "slogan" as we did in this country at the outbreak of war. In spite of the prophetic foresight of Lord Kitchener, few of us at that time imagined that the war would last for years and would, in fact, become the "usual business" of a vast proportion of our industries. The Society has initiated a campaign with the purpose of keeping business moving, holding that "everything depends upon the individuals holding up their links in the chain of mercantile business."

It is, to our mind, unlikely that the industrial upheaval which has taken place in this country will be felt to anything approaching the same degree in the United States, whose internal resources in both raw materials and plant are inexhaustible, and whose works are already largely engaged on the manufacture of munitions, while her needs are far less urgent than were ours in the first years of war; nevertheless, the Americans do not do things by halves, and we are confident that they will, with their customary energy, provide us with agreeable surprises at no distant date.

As regards "Business as usual," however, this will be confined almost entirely to internal trade, for sea transport will be restricted to the utmost, except in the case of munitions of war and food for the Allies. We trust that we shall not be regarded as unfriendly to our latest brothers in arms if we frankly express our relief that for the American campaign to capture South American trade—a species of industrial warfare upon ourselves—there is now substituted a campaign of co-operation and support, and that thus, after the war, we shall be able to enter the competition for the world's trade, if not on equal terms, at any rate without the heavy handicap with which we were threatened.

THE MANUFACTURE OF CONTROLLER DRUMS.

By R. K. SHIELD.

Compared with the number of firms making motors and switchgear, there are very few engaged in the manufacture of controllers: yet it may be hoped that some account of certain processes of manufacture will be of general interest. In outside appearance most of the drum controllers used for cars, cranes, and general industrial applications resemble one another very closely, but an almost infinite variety of electrical connections is set up by modifications in the drum. Consider, for example, the ordinary variations in a standard size of crane controller. They include :—

(*a*) Plain series control.
(*b*) Ditto with shunt brake.
(*c*) Shunt control.
(*d*) Slow motion steps, as required for foundry work.
(*e*) Rheostatic lowering.
(*f*) Limit switches.

In addition to the above, every maker finds that special applications require, perhaps, a dozen other modifications in every size of his standard line. The cross-section of a controller is not affected by these changes, and if the height of the case is originally made to suit the greatest number of fingers usually required, the only detail affected is the drum, which will vary according to the system of electrical connections to be established. It is thus evident that the standardisation of drums must be of a very flexible nature, and although the problem is not easy, it is, nevertheless, possible to arrange the design in an orderly method, which facilitates, improves, and cheapens manufacture.

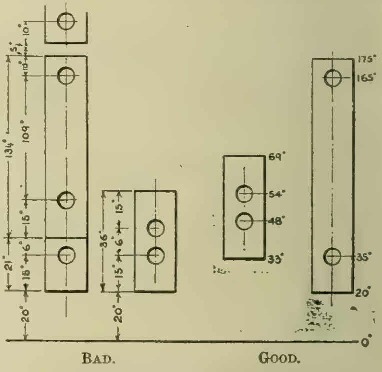


Fig. 1.—Style in Dimensioning.

In the first place, when getting out a line of controllers, the connection diagrams should be drawn for as many probable varieties as can be foreseen, so that, by mutual accommodation and adaptation, the number of different lengths of contacts and drum castings is reduced to a minimum. If this is not done in a very thorough and painstaking way, the cost of manufacture suffers an initial and permanent handicap.

The making of the drum development drawing from the diagram is a fairly simple matter, but the best method of dimensioning the contact strips is, perhaps, worthy of notice. On the left-hand side of fig. 1 is shown a common, but bad, method, which has persisted from the regular system of dimensioning a drawing in inches. A better method is shown on the right-hand side. This has the advantage that it is more straightforward to mark off the drums in the works when the angular position of the holes is given from zero, that is, the "off" position.

Another point which requires attention in making the drum development drawing, is to arrange that the fixing screw-holes on a series of drums coincide in as many cases as possible. Further, the positions of the holes in the various contact strips should be arranged with a view to the possibility of drilling every piece in the same universal jig, as described later. Practically every length of contact of a given width, thickness and diameter, whether for D.C. or A.C. controllers, can be arranged for drilling in the same jig.

The usual drum construction is now to clamp cast-iron segments on a mica-insulated square shaft. In designing the castings, the provision of adequate creeping distance along the shaft requires attention, as does also the form of the casting to eliminate cores as much as possible.

The shaft is usually of square, bright mild steel, insulated with micanite wrapped and moulded under heat and pressure. There is a system of moulding the insulation in the shape of a tube on a standard former, after which it is shellacked and pressed in place on the shaft. In the opinion of the writer, there is no advantage in this method, except for those makers who are not equipped for carrying out the whole operation themselves.

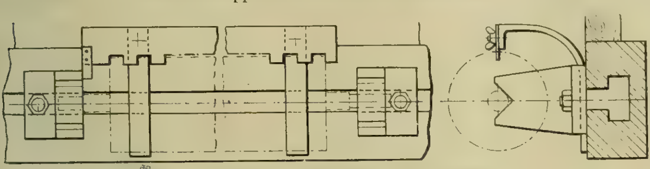


FIG. 2.—ASSEMBLY BENCH FOR DRUM RINGS.

If the drum castings are of good quality, it is unnecessary to machine the square which fits on the shaft. The drilling of the clamping screw-holes need only be mentioned to state that co-operation between the drawing office and tool room will enable the same jig to be used for many castings of different lengths.

In the case of standard controllers, the rings are set in the correct longitudinal position at a special bench fitted with centres sliding on a cast-iron bed and facilities for holding spacing templates, as shown in fig. 2. After the castings are assembled on the shaft, they should be stoved to slightly soften the shellac, which acts as a bond to the mica, after which the clamping screws should be driven home very tight. The next operation is to turn the periphery of the drum, after which it is marked off for the contact screws, or drilled in a jig.

To mark off the contact screw holes, where no drill jig is available, a protractor is mounted on the shaft which is set in vee blocks on a surface plate. The zero method of dimensioning shown on the right of fig. 1 makes the marking of the centre lines of the holes a very simple process, which requires no addition or subtraction of dimensions by the workman.

A good design of drill jig is shown in fig. 3, from which it will be noticed that a hardened bush is provided for every hole to be drilled in the drum. The first cost of such a jig is high compared with some kind of indexing arrangement, but it has the merit of being quick, accurate, and foolproof throughout a long life, during which it returns its first cost over and over again.

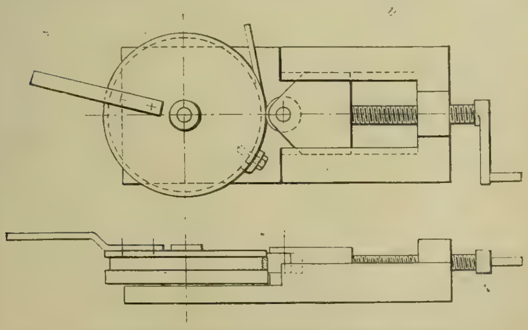


FIG. 4. HAND BENDING TOOL FOR LONG CONTACT STRIPS.

It was remarked in connection with the drum development drawing that the contact screw holes should be made to coincide in as many types of drums, of the same diameter, as possible. The object in view was to arrange for the same drill jig to be used on several types, and when this is done the jig contains a greater number of holes than are used on any one drum. On each drawing instructions should be given to leave holes marked, for example, 7, 8, 15, 20, 81, 83 on the jig, undrilled for that particular drum. The driller will fill the surplus holes up with a wood peg before starting to drill.

The contact screw holes will usually be machine-tapped, either in a special vertical spindle machine or with a tapping attachment on an ordinary drilling machine.

The contact strips are invariably made from hard-drawn copper strip cut off to exact length, which is first found by trial and then recorded on the drawing. The bending of short lengths—say, up to about 3 in.—can be done satisfactorily in a hand or power press; but for greater lengths this method is not sufficiently precise, although it will serve, but the bend has then often to be corrected by the assembler. It is better practice—that is to say, more economical in the long run—to use a hand bending roll, as illustrated in fig. 4. The diameter of the bending roll is smaller than the nominal inside diameter of the strip, as, found by trial and by practice, the pressure roll can be screwed up to such a degree that every strip is correct to diameter, in spite of variations in the hardness of the material.

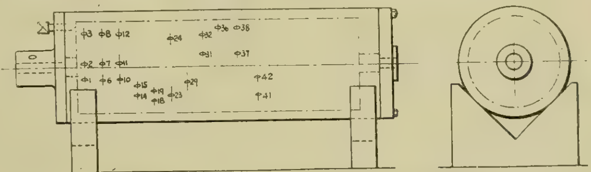


FIG. 3.—DRILL JIG FOR CONTACT SCREW HOLES.

A good type of drilling jig for the strips, which are, of course, drilled after bending, is shown on fig. 5, from which it will be seen that the strips are located against a stop at one end by slotted wedges driven across the holes to be drilled, which are generally two in number, and never exceed three.

The advantage of standardising the contact strips can now be appreciated from the design of the jig. The points to be kept in view are that the first hole must always be the same distance from the stop end, and that the other holes shall be limited in number and position, so that they do not clash in the jig. If these conditions are observed, there will be very few strips of a given section and bend which cannot be drilled in one or, at the most, two jigs.

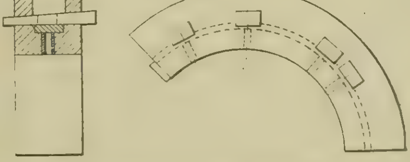


FIG. 5. DRILL JIG FOR CONTACT STRIPS.

Where renewable tips are provided for the long strips, the ends which butt together must be a good fit, and as the tips must be interchangeable, these ends are best milled to a correct length, measured in degrees, from the nearest screw hole. It is scarcely necessary to sketch a jig for this simple operation, but it may be remarked that a little forethought will enable a jig to be designed which, with very little modification in each case, can be used for all widths, lengths, diameters, and end lengths of contact strips.

After drilling, the contact strips are countersunk, and then screwed in place, for which operation a quick-acting "Archimedian" screw-driver is a time saver.

The last machining operation is turning a light "skimming" from the surface of the contacts, which is done at a high speed with a vee-point tool.

After rounding the contact strips at the front and back ends, the drum is ready for mounting in the controller case, and if the various steps which have been briefly described have been carried out in a proper fashion, there is no need for any subsequent adjustment.

TEAM WORK IN LINE CONSTRUCTION.

By "TRAMP ROYAL."

Let your imagination take you to the car-shed built in the "Mission" style of architecture on the Pacific Slope, and, assuming it has not turned 7 a.m., we shall be in time to see the construction train "pull out" for the day's work. It is the conversion of a steam interurban line to electric, so the track is already in existence. On the train, consisting of a locomotive, a flat-car, and a caboose, we have the construction gang and the apparatus for boring holes.

Having settled ourselves in a vacant corner on the train, we travel to the commencement of the new overhead route, where, in the easy-going way of Californians, the gang dismounts. The hole-borer is adjusted, and each man takes his allotted place. It is only a matter of about 10 minutes, and we are steaming on to the next pole position. All day the work goes on, no hurry, no dawdling, and with just a half-hour's break for lunch, which is taken on a bank under a canopy of cloudless blue sky, what time gophers pop up for a nibble of spare fragments of food. At 5 p.m. we are back in the car shed.

Next morning, we find a change in the train make-up. A flat-car, fitted with a winch and derrick, is sandwiched back and front by a car-load of wooden poles, all ready drilled for bracket arms. At each hole, bored the previous day, the jib picks up a pole, and drops it into the hole, allowing it to lean from the track. It is quick and easy work, as there is no dismounting from the train. A man on the load of poles fixes the grab band around a pole, a man at the winch "sets up," a man on a guy pulls the jib round; the pole is lowered, another man pulls a cord releasing the grab, and the train journeys on to the next hole.

The locomotive and caboose comprise our train for the next day, and the aligning of the poles proceeds. The work is not carried out with the nicety of English pole lines, but it "gets there" all the same, and it matches the surrounding brown country, with its listless eucalyptus and pepper trees. There is no shouting and no wasted effort of a man picking up a spike and finding someone else pushing where he intended assisting. It's the clown at the circus who earns his daily bread by dodging around the carpet and helping nowhere. Outside the circus the clown is not appreciated. Each man has his place in the team, and, under the vigilant eye of the "boss," the pole springs upright, and is held by the three spikesmen while earth is rapidly thrown in and tamped. A man who cannot toe the line is very soon told to go, or, in the vernacular, "to beat it."

The next operation is slower, and takes about two days for the stretch described. A crude tower is fitted on to the flat car, and the bracket arms are put into the poles. These arms consist of a length of pipe, one end of which goes through the pole. The hanger wire, with necessary globe insulators, spans from an eye-bolt in the pole to a bracket at the end of the pipe arm. The fixing of a stay to the arm completes the work on the pole.

The paying-out of the trolley wire is a very interesting operation. The locomotive is dispensed with, and we travel on a flat-car specially fitted with motors and a controller. The further equipment of the car consists of a drum of trolley wire turning on a shaft, and fitted with a hand brake, a tower to carry a man, and supporting a trolley wheel electrically connected to the car controller. The wire is run over the trolley, its end anchored and made alive. Then we all go sailing merrily along. At each bracket arm, the man aloft roughly ties the trolley wire to the span wire for temporary support. The "boss" is at the controller, two men manipulate the brakes, and the remainder of the gang sit by awaiting eventualities, or they take a turn to relieve the other men. It feels good to sit in the sun and be rid of the oil-burning loco's fumes.

The work of the next few days is slower, as it consists of fixing the necessary mechanical ears, guys, "messengers," and "stubs." The "stubs" are pieces of pole about 5 or 6 ft. high, to which are attached the "messengers," or guy wires, at bends or anchoring points.

This work completed, all is ready for "Public Service."

In describing the above I have only taken a day's run, but in, say, a 20 or 30-mile run the whole of one operation would be completed, if possible, before dismantling the erection gear. I should have liked to give figures as to distances, actual time, &c., and also sketches of the gear used; but, unfortunately, my notes are war-bound in California, and it is some 15 years since the described erection took place. I have had to draw upon my memory for the details, but I trust the *raison d'être* of this article has been secured, viz., to show the advantage of team work.

Economy of Gas-Coke as Fuel.—In connection with the appeal issued by the Ministry of Munitions for coke to be used in place of coal, the following result will be of interest:—The Deptford Borough Council during March last year introduced the London Coke Committee's apparatus for burning gas-coke in the steam boilers at the public baths, and now report the following result of a year's working with coke exclusively as fuel. The cost of coal for 12 months from March, 1915, to March, 1916, at the current price of coal, would have been £1,792 12s. 5d. The cost of gas-coke from March, 1916, to March, 1917, has been £1,444 7d. Amount saved, £348 11s. 10d. The saving, which is equivalent to 19·4 per cent., would have been greater but for the large increase in the heating and electric lighting of the buildings owing to the very cold and dark winter, and the increase in the number of warm baths used, estimated at over 9 per cent. The financial saving, despite the adverse circumstances, has exceeded the estimate made by the local gas company who supplied the coke-burning apparatus, which was fitted to the boiler furnaces by the baths staff at a total cost of about one-tenth of the saving effected during the first year.

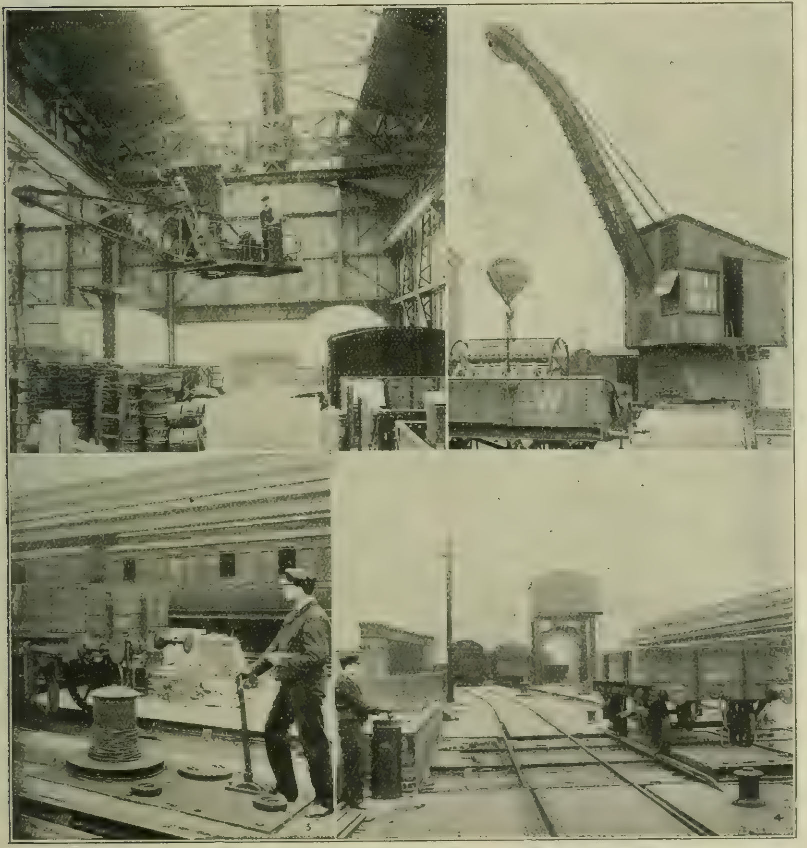
From the national standpoint, the saving effected by the patriotic action of the Council in using gas-coke in lieu of raw coal is in the by-products recovered by first treating the coal in gas retorts. The by-products recovered from an equivalent quantity of coal so treated include 1,440 gallons of benzol, 9,600 gallons of coal-tar, and 10 tons of sulphate of ammonia (fertiliser).—*Mechanical World.*

A Simple Electric Vehicle.—We have received some particulars of an interesting innovation in electric vehicle construction, which, according to the makers, "will bring down the weight of electrics one-third to one-half of the present figures, and reduce the cost nearly in proportion." Although we are unable to gauge the accuracy of the claim, the makers, the Dey Electric Corporation of New York, have the support of Dr. C. P. Steinmetz in their contentions, and propose to place on the market a light two-seater at a cost of under $1,000. In general outline it resembles a petrol-driven car, but the resemblance ceases here, for the chassis is severely simple, due to the use of a special form of rear axle which incorporates the motor and gearing, and therefore does away with a great part of the usual mechanical driving gear carried on the chassis. The field and armature of the motor revolve in opposite directions, each driving a wheel through gearing, and the motor itself becoming the differential. The use of the Dey axle simplifies and lightens the construction of the chassis and incidentally decreases the weight of battery required or increases the possible mileage. It is said, for instance, that the complete rear axle weighs only 200 lb., and the whole car, including body and battery only 1,400 lb. The Dey car can be supplied to take a battery which will give a maximum of 105 miles run, and is fitted with a control having regenerative and electric braking features.

ELECTRICAL EQUIPMENT AT A GREAT WESTERN GOODS STATION.

The following description of the electrical labour-saving equipment at the Moor Street, Birmingham, goods station of the Great Western Railway Co. appeared in a recent issue of the *Great Western Railway Magazine*, to which we are indebted for the following particulars and illustrations.

The design of the equipment was dictated by the peculiar situation of the several goods sheds, the depôt consisting of a high-level goods yard built on a ferro-concrete structure, which also houses underneath a low-level goods station. On the low level are two sheds (A and B) separated by a street, and at different levels, due to the contour of the ground.



Overhead Travelling Crane in Goods Shed.

6-Ton Fixed Jib Crane Outside Goods Shed.

Wagon Being Hauled by Electric Capstan.

25-Ton Bridge Traverser.

High-Level Equipment.

The modern tendency in goods handling of bringing the loading and unloading machinery to the wagons, instead of bringing wagons to fixed cranes, was followed wherever possible, and with this object a variety of modern electrically-operated appliances was installed, the electrical energy for which is obtained from the Corporation supply.

Dealing first with the high-level accommodation, the covered goods shed in the yard comprises under one roof two long sidings, a platform beside one of these sidings and a cart road between the platform and the other siding. The platform and the siding beside it are served for a length of 400 ft. by an overhead travelling crane made by Messrs. Royce, Ltd. The travelling bridge, with a span of 28 ft. 4½ in., moves at an average speed of 250 ft. per min., and carries a traversing carriage with an underhung revolving jib below it, the jib having a radius of 16 ft. The carriage with its jib traverses the shed at a speed of 70 ft. per min., while the jib revolves at a speed of 2 R.P.M., and the hoisting gear raises and lowers a load of one ton at an average speed of 33 ft. per min. This crane can take the load to or from any wagon in the siding from or to any cart in the cart road. Two covered openings in the shed platform are provided, through which goods in special crates can be transferred to the low-level sheds A or B. The electrical equipment was made by the British Westinghouse Co.

Outside the high-level shed is fixed a jib crane capable of raising and lowering a load of 6 tons. The gear can raise and lower its full load at a speed of 20 ft. per min., and slue it at a speed of 2 R.P.M., the jib radius being 15 ft. An automatic electric brake is fitted to the hoisting gear, while provision is made for lowering either by a separate hand-lever brake, or by the use of the motor itself as an electrical brake. The crane, made by Messrs. Stothert and Pitt, is fitted with E.C.C. motors and Allen-West controllers and resistances.

For marshalling the goods wagons, which are raised to, or lowered from, the low-level shed B by a 20-ton lift, the north-east end of the yard is provided with a 25-ton bridge traverser. It is designed to transfer wagons between three parallel lines of rails, the wagon being hauled on to or off from the traverser by an electric capstan. The traverser was made by Messrs. Ransomes & Rapier. Thirteen Clyde capstans and a large number of reels are disposed in the yard to haul wagons, either singly or in trains, to and from 20 and 30-ton wagon lifts, the 6-ton crane, the long siding beside the covered platform, and two turntables at the Moor Street end of the yard. The rope used on a Clyde capstan is never handled by the capstan man except to unwind it from the barrel and haul it to the wagon, which can be done by the hook. This allows steel ropes to be used instead of hemp ropes, which must be used where the rope slips on the barrel, and the capstan man hauls in the slack. The consequent saving in the annual cost of ropes, and in the labour of handling hemp ropes when wet, is remarkable. All these capstans have been made by Messrs. Stothert and Pitt, and the switchgear by Messrs. Morris & Lister, squirrel-cage E.C.C. motors being used.

In the low-level sheds A and B there are 14 similar capstans, four in shed A, to serve the 30-ton lift and traverser and the sidings, and 10 slower-speed capstans in shed B, where the number of sidings is greater. All the necessary reels for guiding the capstan ropes are provided. The electric equipment for the capstans in shed B was provided by Messrs. Crompton & Co.

Shed A contains only two long sidings, for which power appliances are needed. Between the sidings, which run for a distance of 285 ft., are two platforms, one beside each siding, and a broad cart road between the platforms. A cross platform connects the two long platforms, and a "walking" jib crane has been provided, which runs on a one-rail, U-shaped track extending down each platform, and round the cross platform. The crane hoists and lowers its full load of 30 cwt. at a speed of 40 ft. per min., and slues the jib at a speed of 2½ R.P.M.; it has a travelling speed of 250 ft. per min. on the straight, and the jib radius of 18 ft. allows of anything within reach on either platform being transferred to a cart backed against the platform, or *vice versâ*. The crane and top guide, with its three conductor wires, were made and erected by Messrs. Babcock & Wilcox, the motors by Messrs. Harding Churton, and the controllers by Messrs. Allen West.

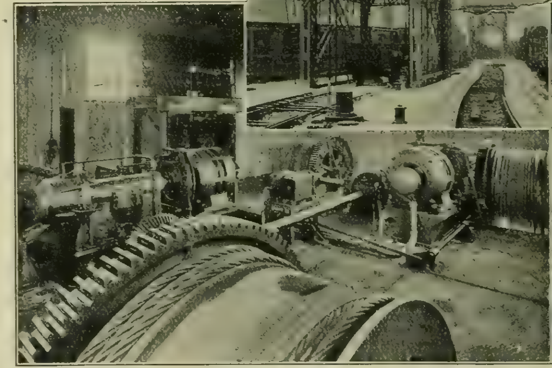
A 30-ton lift is provided in each shed to transfer wagons between the high-level yard and the shed. The cage can take a wagon 25 ft. over buffers and weighing 30 tons. Such a wagon has been raised and lowered at an average speed of 128 ft. per min. The lifts were made by Messrs. S. H. Heywood and Co., three-phase motors being provided by the Lancashire Dynamo Co., and semi-automatic switchgear by Electric Control, Ltd.

The switchgear is worked by means of a master controller in the cage. Its handle is interlocked with disappearing rail stops on the cage rails. The controller handle cannot be moved until the rail stops have been raised, after the wagon is in position, to prevent its movement either way in the cage. Other safety devices consist of automatic gear to hold the cage should any of the ropes break or stretch unduly; limit switches are also provided to prevent overtravel of the cage either at the top or bottom, which act first on the control gear, and, should this fail, a second switch shuts off the main supply.

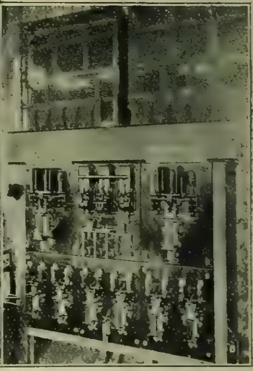
In shed A wagons are transferred from the lift to the sidings, or from the sidings to the lift, by a 30-ton wagon traverser. The sidings on either side of the cart road are 100 ft. apart, and only these two sidings are served. The traverser is driven by an induction motor of the one-speed Sandycroft cascade type, arranged to creep while exerting full-load torque; this feature has proved most useful in aligning the traverser rails with the siding or lift cage rails.

The traverser, made by Messrs. S. H. Heywood & Co., can travel the whole width of the shed with a 30-ton load at an average speed of 285 ft. per min. A capstan with head fixed to the gearing, and using a slipping rope, is provided for hauling wagons on to and off from the lift cage, and is worked by a Sandycroft squirrel-cage motor, with special high-resistance motor windings to give great starting torque for moderate current expenditure. It can give a pull of 750 lb. at 300 R.P.M. and a maximum pull of 2,000 lb.

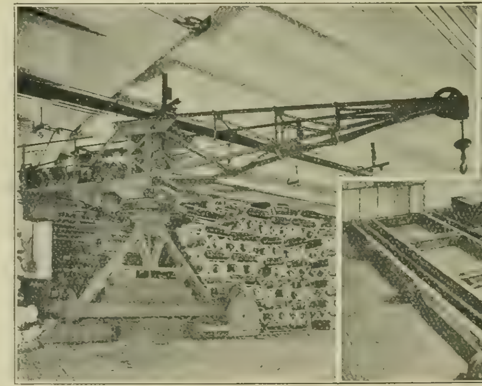
30-Ton Lift Between the High-level Yard and Low-level Shed B.



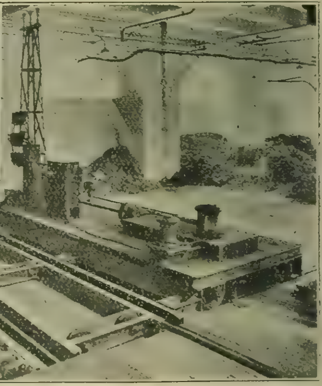
Hoisting and Lowering Gear in Motor House on 30-Ton Lift seen above.



Switch Gear in Motor House.



"Walking" Jib Crane in Shed A.

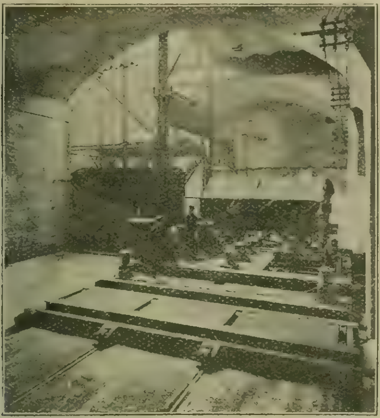


30-Ton Wagon Traverser in Shed A.

Shed B is served by a similar lift, and the average speed of raising and lowering a 30-ton load is 137 ft. per min.

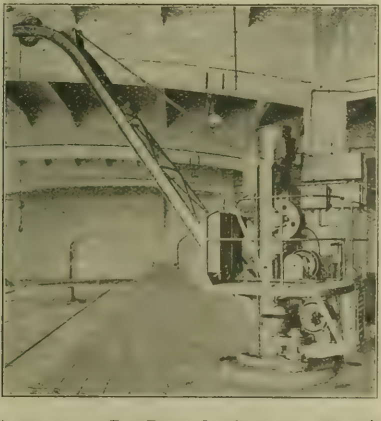
Shed B is further provided with a 20-ton lift at the corner opposite to the 30-ton one. This was built by Sir William Arrol & Co., with B.T.H. electrical equipment. The height of the lift is 33 ft. 4 in., and the average speed when raising and lowering 20 tons is 145 ft. per min.

Shed B is provided with eight parallel lines of sidings, some of which are only a few feet apart. A 30-ton wagon traverser runs the whole width of the shed for 256 ft. The perishable market traffic dealt with in the early morning in this shed requires the most rapid handling possible. This accounts for the high speed of the large lifts, and it was essential that the traverser should not only have a correspondingly high speed but be able to stop very accurately at any of the sidings. This is accomplished by the use of Hele-Shaw oil-pressure transmission gear. By turning a hand-wheel the traverser can be stopped or started in either direction, and the rapid acceleration and high maximum speed obtained (the average speed with a 20-ton load for the journey of 220 ft. being 350 ft. per min.) are combined with the slowest possible creeping speeds and rapid reversing for securing rail alignment.



30-Ton Wagon Traverser in Shed B.

There being two lifts to serve at opposite sides of the shed, two traversing carriages, each to take a wagon, are necessary. Each of these carriages has been made detachable from the central locomotive, automatic couplings being provided to quicken the process of attaching and detaching.



One of the 1-Ton Fixed Jib Cranes in Shed B.

The locomotive part of the traverser is able to haul both traversing carriages, one empty and the other loaded, at an average speed of over 300 ft. per min. for the whole journey. The traverser was made by Messrs. Stothert & Pitt, a Crompton motor and B.T.H. controllers being used. The Hele-Shaw transmission gear was made by Messrs. Compayne, Ltd.

The sidings, lifts, and traversers are worked by 10 Clyde capstans of the same type as described for the high-level yard.

The central loading platform in Shed B is provided with two 1-ton fixed jib cranes, either of which can deliver goods from wagons in the siding beside the platform to the cart roads on the other side of the platform, or *vice-versa*. These cranes, made by Messrs. Stothert & Pitt, lift loads of 1 ton at an average speed of 30 ft. per min., and slue at a speed of two R.P.M. They are equipped with E.C.C. motors and Allen West controllers. The load can be lowered by a hand brake or by using the motor as a brake, and the sluing motion is stopped by a pedal brake.

External Appearance of Transmission Gear on 30-Ton Traverser in Shed B.

The whole of the electrical machinery at Moor Street was made to the drawings and specifications of Mr. Roger T. Smith, the electrical engineer to the Great Western Railway.

ELECTRICAL COMMUNICATION IN THE FIELD.

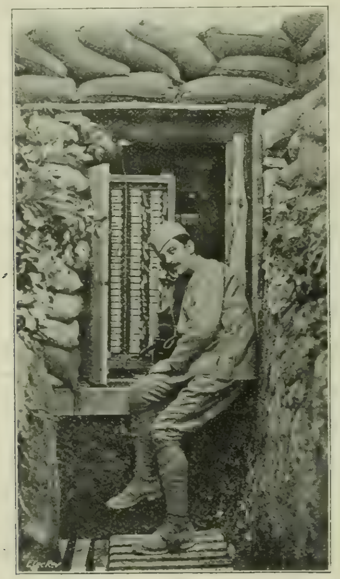
While we hear but little of the uses of electricity in connection with the war, it must not be supposed that they are either few or unimportant. On the contrary, without the aid of electricity it would be impossible for either side to conduct operations on a scale even remotely approaching the vast dimensions of the conflict now in progress, for by no other means would it be feasible for the directing authorities to maintain continuous communication with their naval and military forces in every part of the war area, and to gain information instantaneously, and to a great extent secretly, from their scouts and observers both on the surface of the earth and even in the upper air above the enemy's territory. The latter in particular is an achievement which a century ago would have been regarded as a miraculous performance, and a little earlier still

French] Official photo.

Fig. 1. A French Artillery Observation Post.

would inevitably have doomed the inventor to a fiery end. But these essential functions of the electric current are fulfilled so quietly, unobtrusively, and efficiently, and have become so commonplace, that no one takes much notice of them; moreover, the men who are responsible for the maintenance of such communications are so modest that they neither seek nor desire publicity.

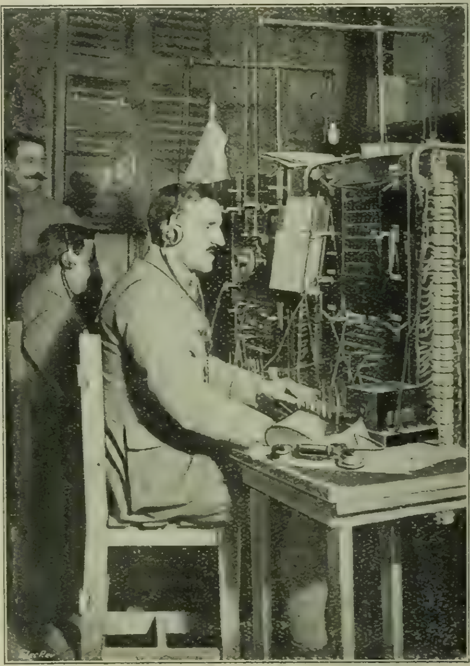
The telephone and telegraph wires and waves are the nervous system of the land forces, a system whose ramifications extend from the headquarters of Government to all the military commands, beyond them to the sub-divisions of the units, and even to the foremost trenches and observation posts; the apparatus employed comprises corresponding classes, from the complex permanent telephone exchange in town to the more primitive, but still elaborate, local exchanges "at the back of the Front," the comparatively simple switchboards housed in dug-outs in or near the trenches, and, at the ends of the uttermost threads or feelers of the system, to the portable telephone and telegraph sets with which communication is maintained from the immediate vicinity of the enemy's trenches. We illustrate herewith some examples of the signalling stations used by our French Allies on the Somme, showing successive stages on the upward march from the utmost simplicity to a comparatively high degree of complexity.



French [Official photo.

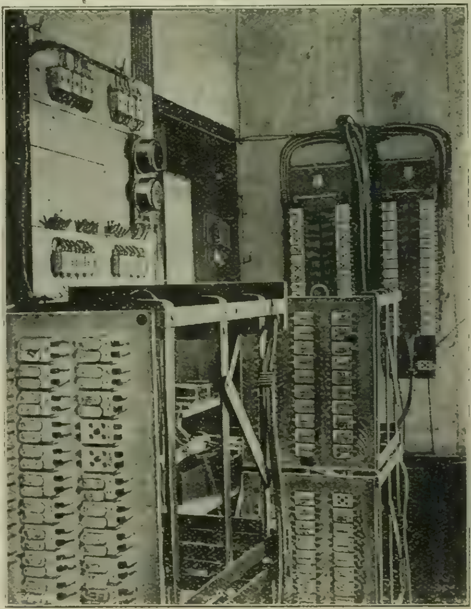
Fig. 2.—A Telephone Station in the Trenches.

Fig. 1 shows an artillery observer "spotting" in an advanced position, with his telephone signaller close at hand. Fig. 2 represents a telephone station in the trenches, in charge of a single operator. Fig. 3 is a view in the telephone office in the French lines on the Somme; here, it will be seen, a much higher level of elaboration is required, and the apparatus begins to assume the appearance of a branch exchange. Fig. 4 shows a still closer approximation to the equipment of a permanent exchange serving a large number of lines, the station, in fact, attaining to the dignity of a "central" office, and being fitted with frames to carry the cables and apparatus.



French [Official photo.

Fig. 3.—Telephone Office in the French Lines.



French] [Official photo.

Fig. 4.—Part of the Interior of a Central Army Telephone Office.

In the case of wireless telegraphy, the system, of course, is wholly different; there are no switchboards or distributing apparatus, the place of which is taken by the ether of space. The stations are necessarily more cumbrous than the light portable telephone apparatus, but yet are readily movable from place to place. Fig. 5 shows one of the simplest outfits in operation at an outpost, the antenna being simply a horizontal wire stretched between two trestles, and the earth or "counterpoise" a sheet of metallic gauze unrolled upon the ground. A more pretentious apparatus, requiring two motor vehicles for transport, is illustrated in fig. 6, which shows the staff erecting a light telescopic antenna pole, extending to a height far beyond the limits of the view. The installation can be erected ready for work within a few minutes of its arrival on the scene.

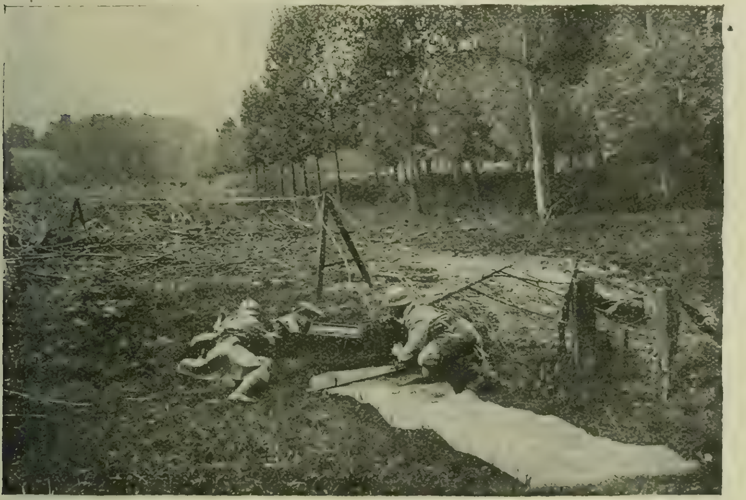

French] [Official photo.

Fig. 5.—An Outpost Operating a Portable Wireless Station.

We are indebted for these views to Giles's Photo Agency, and for the loan of the block for fig. 5 to the *Wireless World*.

LEGAL.

Coupling for Electric Machinery.

Before the Patents Court concluded its work for the Whitsun recess, Messrs. Croft Bros., of the Thornbury Works, Bradford, applied for licence to use the German patent 11,898 of 1908, in the name of Franz Tacke, for an elastic coupling for joining up dynamos with electrical apparatus, &c.

Mr. Armstrong, of Messrs. W. P. Thompson and Co., Liverpool, explained that Messrs. Croft Bros. made many kinds of couplings, and they had lately had special inquiries for this elastic type.

Mr. Justice, who opposed the application, said the patent was assigned to one Habermann in 1909, and a licence, sole and exclusive, was granted to the Power Plant Co., Ltd., of West Drayton, Middlesex, who had been manufacturing the coupling under it and supplying the market. They were able to meet all the demands, and to supply Messrs. Crofts into the bargain. The agreement by which they manufactured was not, he admitted, on the register. It was a document prepared and executed in Germany. He was prepared to show it to the Controller, together with the books of the company, disclosing the firms for whom they manufactured.

The **Controller** said this was a difficulty which would have to be dealt with. It was a misfortune that they did not get all these documents affecting the title of a patent on the register. He and his colleague, Sir Cornelius Dalton, had felt a great amount of hesitancy, because there might be British manufacturers in this country. There was nothing to force a man to place his name on the register, and therefore there was nothing to show who was the owner of the patent. When new legislation came along, they would endeavour to have the register placed on a proper basis. He sympathised with Messrs. Crofts. The document effecting the transfer of the patent, or showing the interest of somebody else in the matter, was something of which they might possibly know nothing at all till the application came on.

Addressing Mr. Justice, the **Controller** added: If this were a court of law, I should make you pay the costs of the day, supposing you convinced me that I ought not to deal with this patent.

Mr. Justice: I think cross-examination would show that the applicant was not altogether in the dark. We have been dealing with the entire British and Colonial demand, and supplying ever since the title was granted. Last year we supplied £1,100 worth. The Power Plant Co. is a purely British concern. Not only has it paid a 5 per cent. royalty, but it has paid the income-tax on the royalty. The Power Plant Co. has built up the goodwill, and the applicants now want to collar our business.

The **Controller**, after examining the documents, said he was afraid this was one of the rare cases where the agreement was fatal to the application. There had been cases where they felt that it was in the public interest to extend the range of manufacture, but here was a firm working under exclusive licence covered by document, which had gone to great expense to build up the English and Colonial trade, and were coping with the demand. The Court were not disposed to interfere with this arrangement, definitely come to before the war. The agreement had been loyally acted on by the grantees to the best of their ability. It was unfortunate that the agreement was not on the register, but the Court having seen the Power Plant Co.'s books, would not interfere with the course of their business now.

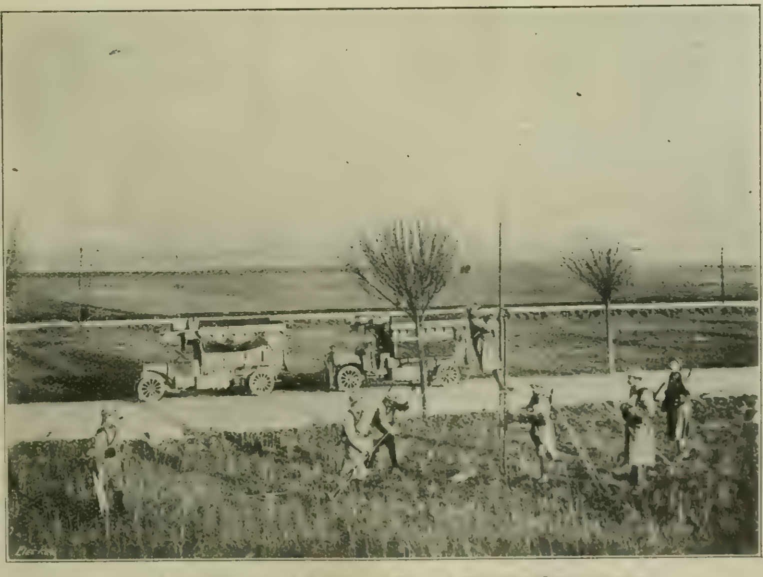


Fig. 6.—Erecting the Mast of a Mobile Wireless Installation.

The Right to Disconnect.

At Brentford Police Court, recently, the Twickenham and Teddington Electric Lighting Co., of Broad Sanctuary, Westminster, were sued for unlawfully making default in the supply of energy to Stephen T. Whaley, of Spencer Road, Twickenham.

Mr. Terry prosecuted, and urged that there was a *bona fide* dispute between the parties as to the amount of current consumed for the December quarter, yet the defendants cut off the supply. Under the Act of 1909, Sec. 18, they had no power to do this, and in refusing to continue the supply they had brought themselves within the penalty clause.

Complainant stated that there was an arrangement with the company to supply current at 1½d. per unit. For the September quarter, 1915, the consumption was 90 units, and for the next quarter 110, but in the meanwhile a radiator had been installed. For the summer quarter of 1916, 20 units were paid for, and the next quarter 25, and then for the Christmas quarter the meter registered 408 units. He contended that he could not have used so much, as not more than three rooms were in use, and the radiator was only on for about half an hour each evening. The defendants, in reply to correspondence, put in a check meter without his consent, and told him his meter did not register enough. He declined to settle the account, and the company cut off the current.

Mr. Farrer, the manager of the company, stated that they gave the complainant every consideration. It became necessary in 1916 to change the meter, and then came the complaint from Mr. Whaley that it had greatly over-registered the current used. Witness sent a man to inquire, and found there was a radiator which would use about 2 units per hour. They told complainant they were satisfied with the meter, but he could have it tested at a small fee of 5s., which would be returned if it was incorrect. He declined, and witness had a check meter fixed, which showed that the older one registered 5 per cent. slow, and recorded less current than was used. As complainant refused to pay the charges the current was cut off, and the company relied on the fact that the register of the meter was conclusive unless proved to be inaccurate. The winter was severe, coal was scarce, and people used their radiators more than in other years, which accounted for the increased amount of current consumed. Complainant could have had the test made. The right to disconnect was under the Act of 1882, Clause 21.

Mr. Terry said the later Act overrode that.

Mr. Farrer: Even then there is no *bona fide* dispute; either party can have a test made. We did not want one, and the complainant refused. We were quite satisfied with the meter.

The Court held that the complainant should have exercised his power to have a test made, as he was the dissatisfied person. There could be no *bona fide* dispute unless both were dissatisfied. The summons was dismissed, with costs.

ELECTRIC 'BUS CHARGING AT YORK.

In connection with the operation of the Edison accumulator 'buses by the York Corporation, to which reference has been made in our pages, the British Thomson-Houston Co. supplied some interesting charging sets, consisting of motor-boosters with foolproof control gear.

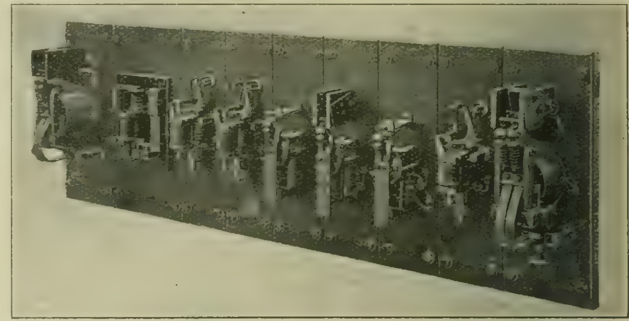
This charging switchgear, which is designed for operation by unskilled persons consists of an automatic starter and battery switch having no-volt and overload features, the whole of the switchgear being installed in shelters placed at the outlying terminus, to which these 'buses run, so that the cells can be charged when necessary at the end of the journey.

'Bus Charging Station, York.

The operation of this gear, which is controlled from outside the building, and the function performed by the switchgear, are as follows :—

On closing a small snap switch, the motor booster set is started up, but before this can be done, a field reostat controlling the generator field must be brought back into the weak field position; this rheostat is interlocked with the other gear, so that it is impossible to start up the set except under these conditions. The closing of the switch puts into operation the control gear of the motor, which consists of special B.T.H. series-contactor switches, which close in the correct sequence, bringing the motor up to full speed. The generator voltage may then be raised by means of the field rheostat, until a point is reached at which the voltage is just above the voltage of the battery being charged, when the automatic battery switch closes the circuit to the accumulators, the charging current being further regulated by raising the generator voltage by means of the field rheostat.

The automatic battery switch is arranged to open in the case of reverse currents, due to the booster set shutting down from any cause whatever.



Charging Switchgear for Electric 'Buses.

Overload relays are also included, giving efficient protection against earth on either pole of the generator circuit, and against overload on the motor circuit itself. When any relay trips it disconnects the faulty circuit, and at the same time shuts down the motor booster set. If such should occur during the charging of the cells, these relays can be electrically re-set by reclosing the small snap switch used for starting. A similar snap switch is provided for disconnecting the starting gear when the charging of the cells has been completed.

The whole of the control operations outlined above are made outside the shelter in which the switchgear is enclosed, the control panel consisting of a small junction box, conveniently placed, containing the stopping and starting switches, field rheostat handwheel, and necessary terminals for connecting up the charging plugs and cables from the vehicle to the charging switchgear, these plugs and receptacles being designed to comply with the requirements of the Electrical Vehicle Committee.

ELECTRICAL HEATING AND COOKING.

A paper on the above subject was recently read to the members of the Birmingham and District Electric Club by Mr. C. Scott. The writer said that for the past four years electrical heating and cooking had been serious competitors for older methods to meet, and there was no doubt that the invention of the nickel-chrome resistance alloy had been of the utmost importance in aiding the development of the apparatus. Previous to this discovery there was no common metal which could be safely run at a bright red temperature for any length of time when exposed to the air; consequently, the most popular electric heater, the electric fire, could not have existed without nickel-chrome wire. To be successful the heater must have the appearance of a red-hot fire to appeal to the eye, a fairly free air circulation to warm the air in the room, and sufficient heat radiation to warm any person standing near it by radiant heat alone. The lamp radiator was being gradually ousted by the electric fire, because, however good it was for warming anything placed directly in front of it, it seemed to take a long time to warm a room. The convector had also largely been displaced by the electric fire, because no warmth was felt until the whole of the air in a room was warmed perceptibly, and this was rather a slow process.

To be a commercial success the electric heater must be reliable, inexpensive to maintain, and low in first cost. The terminals should be heavy, and placed in a convenient position; the amount of wire used in the element should be as large as possible, and an earthing terminal should be provided. As on most electric heaters the switches were near the ground, a tumbler switch was more convenient than the rotary type, and although the tumbler was more often operated by the foot than the hand, a good switch would stand this treatment quite well.

The coal fire was the cheapest form of heating, while gas and electricity were about equal, but there were many advantages which electricity had, the value of which was hard to express in money. A great advantage of the electric fire was its portability; this enabled two or three fires to do duty for a house, whereas the gas fire must be fixed because of its weight, pipework, and flue. A rating giving the best results was 1.5 watts per cu. ft.; this would give a temperature rise of 12 deg. in one hour, and half this consumption would maintain the temperature.

The chief points to be considered in electric cooking were reliability, low first cost, and low running costs. Reliability was largely a matter of design. For good and economical cooking the heat should be evenly distributed in the oven, yet the elements should be arranged so that the cook could make any portion of the oven hotter than the rest. The terminals should be heavy, and the elements should be easily replaced, and cheap to renew. Connections in the oven casing should preferably be of strip, and all screw connections should have locknuts. The position of the heating elements was important; bottom heating only did not give good browning on the top of pastry. Top and bottom heat was better, and when used in an oven which was broad in proportion to its height, was quite good; but when the oven was of ordinary shape, that was with a ratio of height to width of 3 : 2, the best results were undoubtedly obtained by the use of side elements. The whole of the interior of the oven should be vitreous-enamelled, including the shelf and shelf racks. The loading of the elements should be enough to raise the oven to a cooking temperature in 25 to 30 minutes, and a temperature of 350 deg. should be maintained by one-third heat. The temperature of the elements had an important effect on cooking. It was necessary to get direct radiation on to pastry and meat to ensure a good colour, and this could only be obtained by running the elements at a temperature giving the correct proportion of radiant and convected heat to suit the oven. Too much radiant heat would brown the outside without cooking the inside, while too low a temperature on the elements would tend to give tough pastry of poor colour. At present the rotary switch was most favoured by designers, but the writer had used tumbler switches with first-class results, and had had a switch of this type rated at 10 amp., breaking 25 amp. at 230 volts 20 to 30 times daily for three months. Of course, none but the best switches would stand this test. It was advisable to fit a fuse on every circuit, otherwise a faulty element would render the whole cooker useless. The screwed plug type of fuse seemed ideal for domestic purposes, its only defect being the cost of replacements. The top plates should be machined with a fairly coarse cut, and on no account should they be ground. There was no fear of mica disintegrating if the right mica was used, and the element assembled on the top plate under pressure. The writer had had three hot-plates run at a cherry red for over 4,000 hours, and at the end of that time the mica, 5 mils. thick, withstood 1,200 volts applied for 30 seconds. There was no doubt that electricity at 1d., or even 1½d., a unit compared favourably with gas for all oven work, and when current could be purchased at 1d. a unit or under a complete cooking outfit would not cost more to run than the corresponding gas cooker. In addition, there was the unchallenged superiority of the results obtained in an electric oven due to:—

1. The absence of the products of combustion.
2. The temperature being under better control.
3. The retention of the meat juices.

It was a fact that the usual shrinkage in a gas or coal oven was not less than 25 per cent., while in an electric oven this could easily be reduced to 12½ per cent. Considering the oven alone, when full heat was on there was not much difference between the costs for gas and electricity. Full heat was only used for running up to cooking temperature, which was only for a small portion of the time the oven was in use. While cooking was actually going on the electric oven was costing 50 per cent. less than the gas cooker. Obviously, then, although the figures given are based on a ½d. per unit tariff, electricity for roasting was equal to gas at 2s. 3d. per 1,000 cu. ft. when the charge per unit was 1d.

WAR ITEMS.

Exports to China.—The "London Gazette" for May 29th contains further names of persons and bodies of persons in China and Siam to whom exports may be consigned.

After-the-War Trade Policy.—The following have been appointed members of Lord Balfour of Burleigh's Committee on Commercial and Industrial Policy in place of others who are now members of the Government:—Sir Charles Henry, Bt., M.P., Mr. J. A. Roxburgh, Sir William Pearce, M.P., Sir William Priestley, M.P., Sir Archibald Williamson, Bt., M.P.

Sulphuric Acid.—The Minister of Munitions has issued a new Order relating to the manufacture, supply, and price of sulphuric acid as and from June 11th. It will be found in full in the *London Gazette* for May 29th.

Trading with the Enemy.—The "London Gazette" for May 25th contains further lists of persons or bodies of persons in the following countries with whom trading is prohibited:—Argentina, Brazil, Chile, Netherlands, Peru, Spain, Sweden, &c.

Coal Shortage in Denmark.—The "Times" states that many Danish factories have been compelled to cease work owing to lack of coal, and thousands of workmen are out of employment. The theatres are open for only a few hours a week, lighting in the streets is completely stopped, and railway traffic, already cut down to 42 per cent., will be still further restricted.

Enemy Works Destroyed.—According to the "Weser Zeitung," there has been a destructive fire at the Wolfram lamp factory at Lechhausen (Bavaria). The main building and a number of adjoining stores were destroyed.—*Times*.

Part of the Kahlbaum chemical works at Adlershof, near Berlin, has been destroyed, and a number of persons were injured by an explosion there last week.—*Times*.

New Lighting Order.—With a view to checking the consumption of gas and electricity for certain forms of unnecessary lighting, the Home Secretary, after consultation with the Coal Controller, has made an Order prohibiting altogether the use of sky signs and other illuminated advertisements, and lights outside or at the entrances to shops or theatres, kinemas, and other places of amusement, excepting such as may have been approved by the police as necessary for the safety of the public. The prohibition applies at all hours, before or after dark. The Order also prohibits the retention of the interior lighting of shop windows after the shops are closed for the serving of customers.

Industrial Problems After the War.—The "Times" states that the Government propose to make novel use of the Reform Bill in their scheme, now well advanced, for the reconstruction of industry after the war, and especially for the transition of factories from war work to civil work. "It is proposed to insert in the Bill a clause enabling local registration officers, in compiling lists of voters, to ascertain the nature of the employment of each voter before the war. These returns will be tabulated in each district. At the same time a branch of the Ministry of Munitions has collected statistics from 22,000 firms in the engineering and allied industries of their prospective labour requirements. In this way there will be available lists of the men required by firms to carry out their peace contracts and of the labour reservoir on which they can draw. The Reconstruction Committee are preparing lists of public contracts interrupted by the war, as well as of those which will have to be put in hand immediately peace is declared. These will be pooled among firms according to their capacity."

America and British Colonial Trade.—From the "Journal of Electricity" (San Francisco), May 1st, we quote the following extract:—

"The Electrical Review, of London, recites the fact that strong resentment on the part of British firms in Australia is being aroused by the extraordinary preference given to foreign manufacturers when material for construction is wanted. The procedure is said to exhibit such a bias in favour of American manufacturers that all others are practically excluded from consideration. While ever-increasing commercial and engineering relations with our Pacific neighbours is exceedingly desirable, still no true American would want this trade for an instant unless devoid of bias, and winning its entrance on service and quality alone."

We appreciate the sentiment expressed by our contemporary. We are confident that the mobilising of American resources with a view to hastening the defeat of the Hun will promote an increasing friendliness with our trans-Atlantic cousins for after-the-war trade co-operation.

Women in Engineering.—We referred some weeks ago to a very impressive and effective exhibition of official photographs and samples of women's work that was organised by the Labour Supply Department of the Ministry of Munitions, and was held at the Royal Colonial Institute, in London. It will be remembeerd that the collection illustrated the various types of work upon which women are employed in engineering and other industries on munitions of war. On Wednesday last the second of the series of exhibitions was opened, and it shows a still greater variety. This time Bristol is the centre, and the Lord Mayor of that city performed the opening ceremony. The exhibition will remain open until June 5th from 10 a.m. to 6 p.m. It is being held at the Royal Colonial Institute, Whiteladies Road, Bristol, and we are sure that a visit to it will well repay those connected with engineering and munition labour questions who may be within fairly easy reach. Most of our readers are already well versed in regard to the excellent adaptability that the women of the nation have shown in connection with such activities, but even to such the variety of the collection will, we feel sure, convey some new information worth possessing at the present time regarding the responsible work for which they have proved their capacity.

"**Be a Potatriot.**"—Under this heading, the "Electrical Age" (U.S.A.) urges its readers to take their share in the increased production of foodstuffs. Potato sowing plans by private householders are being proceeded with energetically in the States, and we gather that central stations there are also taking up the gardening idea. "There is much unoccupied land adjacent to company buildings where amateur farmers have easy access, and where crops are readily protected from theft. Certainly a well-tended garden looks better than a cinder-covered yard, and the improvement costs the company nothing. Indeed, it is of distinct benefit, as putting the central station in its rightful place as a leader in a project in which the community is asked to join." Oh where, and oh where is our own Electrical Development Committee gone? What untold possibilities might otherwise lie awaiting us in the form of central-station crops. Pity we are all so short-handed—or short-sighted. Tomatoes in the boiler-house, even chestnuts in the staff room—perhaps.

Exemption Applications.—At Aldershot, on May 22nd, the Aldershot Traction Co. defended a military appeal against conditional exemption held by the superintending engineer, Mr. E. A. Fager, who is 42, and in Class B1. The Tribunal decided that Mr. Fager was in a reserved occupation, and the exemption was confirmed.

Mr. H. B. Atkinson, electrical engineer, Morecambe, aged 29, has had his temporary exemption extended by the Morecambe Tribunal till August 31st. He had from 800 to 900 customers on the books. He was told he must confine himself to doing electrical work.

At Rochdale, temporary exemption to July 31st was given to Mr. J. Fozard for S. Standring (37, C 2), electrician, and to the Tramways Committee for W. T. McCaul (41, C 3) and J. Hird (37, Class A), motormen.

An application by the Military Representative against the decision of the Heywood Tribunal, granting conditional exemption to June 15th in the case of an employé in the Corporation electricity department, was successfully made at the Salford Appeals Tribunal. The certificate was altered to final exemption to the date named. Judge Mellor, who presided, said a trade card had been produced, but the Appeals Tribunal, acting on instructions, had decided not to recognise such cards. They could be easily obtained, and the Tribunal were not going to be parties to the scandal of sending men of 40 to the Colours and exempting Class A men of 26. If the card would over-ride their decision, that was a matter the parties must fight out for themselves.

At Faversham, an appeal was made by the Military against exemption held by Mr. Colin Walton (31), who has, amongst other duties, charge of the electrical plant at the sewage works. The appeal was disallowed, and the exemption confirmed.

Renewed exemption was applied for, at Nuneaton, by Mr. G. H. Patrick (28, in Class C 3), electric light and power contractor, and he was exempted under a munitions substitution order.

P. MacAlpine (37), fitter and electrician, with the East Surrey Traction Co., has been given three months' temporary exemption by the Reigate Tribunal.

On the appeal of the Dorking Electric Supply Co., final exemption until June 30th has been given to J. Rawlinson (34), electrician.

Berwickshire Appeal Court has refused exemption to Mr. J. G. Graham (36), electric light fitter, of Newton Don.

On the recommendation of the Advisory Committee, Rochdale Tribunal has given temporary exemption until July 31st to W. T. McCaul (41, in Class C 3) and J. Hud (37, Class A), motormen on the Corporation tramways; and to S. Standring (37, Class C 2), electrician, appealed for by Mr. J. Fozard.

At Hastings, the Tramway Co. appealed for a brake and trolley examiner and a switchman, and it was agreed that the cases should be referred for substitution.

Herts. Tribunal has refused an appeal for exemption to S. C. Salmon (36), of Barnet, clerk to an Electric Supply Co., and he is to join up on June 15th.

A military appeal has been allowed against exemption held by R. H. Lerwell, charge engineer at the works of the Ilfracombe Electric Light Co.

Bradford-on-Avon Tribunal have granted three months' exemption to Mr. Malcolm Stirling (40, in Class C 2), electrical engineer at the Wilts. County Asylum, Winsley.

At Melton Mowbray, Mr. J. F. Montague, of Cold Overton Hall, appealed for T. E. Smith, electrician, responsible for the supply of current and the upkeep of about 400 lights. The Tribunal granted conditional exemption.

Australia and Electrical Contracts.—At a meeting of the Adelaide Chamber of Manufactures, held toward the end of March, consideration was given to a letter from the Secretary of State for the Colonies regarding the handicaps under which the British electrical industry is at present labouring owing to the war, and a resolution was carried recommending that all contracts be suspended until British manufacturers are again in a position to tender for oversea work.

REVIEWS.

Electric Switch and Controlling Gear. By C. C. Garrard, Ph.D., M.I.E.E. London: The *Electrician* Printing and Publishing Co., Ltd. Price 15s. net.

This is a specialised work dealing with appliances and devices for the control and regulation of pressure and current, a subject in which the author has a very extensive experience. To produce a satisfactory book on such a subject is undoubtedly a difficult matter, since so many of the points which must be dealt with are of a controversial nature, and anything approaching finality is far from being reached in regard to the subject generally.

The book is divided into eight chapters, the first being devoted to a study of the materials used in the construction of switches and switchboards, and to considerations in regard to specifications and manufacturing methods. The next section deals with appliances for breaking electrical circuits, and includes a consideration of high and low-tension switches and fuses. Particular stress is laid on the fact, recently the subject of much attention on the part of operating engineers, that the real difficulty in designing a switch is not to arrange for it to carry (or break) the normal current, but to arrange for it to break the much larger currents which occur under fault conditions. As is well known, high-tension switches are often weak in this respect, and in some cases special means have been taken to keep down the current flowing under short-circuit conditions.

Chapter III is chiefly concerned with devices for cutting out faulty cables and machines, and the section dealing with the application of time elements to overload relays is of particular interest. Reverse power relays and the more recent systems of balanced protection are also adequately considered.

Field regulators, both hand and automatically-operated, are next dealt with; in this section it is noticed that the carrying capacity of a wire (the material, temperature rise, and environment being fixed) is said to vary as $d^{1.5}$. As a matter of fact, in the case of fusing currents of wires (a very similar problem) the index 1.5 is not correct; it would be interesting to know if there are corresponding variations, as seems probable, in the case under notice.

The section dealing with motor starters seems rather unbalanced; there are few schemes of connection for shunt motor-starters, and difficulties with no-volt releases, particularly with variable-speed motors, are certainly worth discussion; the problem of the "inching" starter is also of considerable interest. Starters for induction motors are dealt with in a much more satisfactory manner.

Switchboards, for high and low-tension circuits, are fully considered from the point of view of diagrammatic arrangement, and also from the standpoint of mechanical and electrical construction. Particular attention is paid to the switchgear for appliances which have come into use in recent years, as self-synchronising rotary converters and phase advancers. In regard to the former, one very interesting arrangement does not seem to be mentioned: that in which the same auxiliary machine is used both as the starting motor and, subsequently, as the synchronous booster. In this section there is also included an interesting account of current and pressure transformers for use with instruments and relays.

In the concluding chapter, the protection of circuits against damage from pressure rises, both internal and external in origin, is considered; in particular, the numerous ways in which internal causes may produce pressure rises, a difficult subject, are clearly explained.

Several appendices dealing with the regulations concerning switchgear issued by various controlling authorities are included, perhaps the most useful being that concerned with extracts from the United States National Electrical Code.

Dr Garrard can certainly be congratulated on his book, which must have entailed very great labour in collection and compilation. The half-tone diagrams have been well reproduced, and the line diagrams clearly and simply drawn. It seems, however, a mistake to have taken a clockwise direction for the rotation of the vectors in vector diagrams, especially since the fact is not explicitly indicated in each diagram. In addition to serving as a text-book to engineers and students generally, it can be recommended with every confidence as a reference book to central-station and transmission engineers and to those engaged in the manufacture of high-tension switchgear and machinery.

The Principles of Electrical Engineering and their Application. By Gisbert Kapp, M.I.C.E. London: E. Arnold. Price 15s. net.

The electrical student of the present time appears to be a most fortunate individual; he has the choice of numerous works of reference, both general and specialised, and the book now before us presents the subject under discussion in still another light.

Some works are highly mathematical treatises, while others give but a vague and popular presentation of the matter set forth. Prof. Kapp's effort, however, steers a mid-way course;

it is by no means a book to be lightly treated, but, at the same time, there is no reason for the prospective reader, who is assumed to have had an education involving at least a nodding acquaintance with higher mathematics, to be dismayed; although the theory is mathematically treated, all steps are carefully set out, so that there should be no difficulty in following the reasonings. As the volume in question, being the first of two, deals with principles only, it must not be expected that the contents may be digested save at the expense of time; but one's mind attains a sense of satisfaction after it has been perused, and there is a feeling that the time so spent has been time well spent—it being a book of undoubted interest even to the general engineer. For the student at technical school or college it should be looked upon as a text-book setting forth the principles of electrical knowledge so that their application becomes almost nature to him, while for those whose opportunities have not been so favourable, it is a mine of untold wealth. It should also enable the captains of industry to readily appreciate technical points brought before their notice, and so assist them in their judgments.

The matter is disposed of in logical sequence, opening with a chapter on conductors, Ohm's law forming the basis of the arguments. The measurement of resistance includes accounts of various bridges, and here one is immediately struck with the diagrams and descriptive matter which enable the minor details necessary to render success complete to be appreciated. Generally the possibilities of the potentiometer are but slightly known, but the chapter devoted to potentiometric measurements should assist those who consider its use to be very limited, to value its wider applications. The graphical methods for combining resistances and the design of resistance steps are features of the section dealing with applications of Ohm's law, and other principles illustrated are dealt with in a most explicit manner.

The author proceeds to discuss the distribution of continuous currents, several general examples being worked in detail; their similarity to the determination of bending moments was explained, illustrating how results may be easily determined by graphical methods. The subject of boosters is included in this chapter, and Dr. Kapp's modesty in this connection is most marked. Consideration of circuits for electric tramways introduces the Board of Trade rules, while the pages devoted to the three-wire system prove to be of more than passing interest.

In a work of this nature one does not usually expect small but practical details to be discussed at such length as the author devotes to the testing of insulation resistance, and the reading under this heading should be of immense value to the general engineer, who, at some time or other, has to deal with such tests.

The next subject to take our attention is that of elementary electrostatics, which leads up to the consideration of capacities, to which much space is devoted. A chapter on applied electrostatics follows, and the principles set out in the previous pages enable one to appreciate the more practical questions now involved; to one interested in the study of cables from a general view-point these portions of the work should be of great value. A section allotted to magnets follows, the mathematical and physical conceptions being concisely treated, so that when one comes to the subject of electromagnetism the grounding given makes it possible to readily understand the arguments then presented, and there is no doubt that a careful student of the mathematical reasonings will find much capable of being turned to good use when the consideration of designs is necessary.

Chapter XI is devoted to elementary electrodynamics, and here again, we find the same logical and clear manner of handling a subject as is shown in the previous pages, the mathematical side being given fully though simply; the relation between the various units employed is next investigated, useful tables being given after original discussion.

There are few so competent as Dr. Kapp to deal with the subjects next treated, viz., electromagnetic measurements and the testing of the magnetic qualities of iron. At first the more usual forms of instruments are briefly enumerated; the principles of the galvanometer are dealt with thoroughly, so that one proceeds to those paragraphs relative to iron testing with an intimate knowledge of the capabilities of the apparatus used. The reader is also enabled to form a concrete idea of the importance of hysteresis, and the pages touching upon this should be of great concern to the designer, embryo or otherwise. Before passing on to the second of the two chapters, the author's bridge method of finding inductance is mentioned amongst others, and is dealt with in a characteristic way. After a section referring to the objects of testing iron, we are introduced to the subject of permeameters, and here again Dr. Kapp's versatility becomes apparent, and one cannot but admire his simple mechanical devices for overcoming the difficulties appearing in the experimental work of others. The testing of thin sheets next claims attention, and once more interest is keenly held, especially by the final dissertation in which the original work of the author asserts itself. One who has attempted the testing of sheet iron by some of the various methods will appreciate the ease and simplicity of the test in question, and the working out of results cannot fail to please a professed student. The final chapter is devoted to the theory of alternating currents, and forms one of the clearest accounts anent this subject that we have seen; vectorial representation is carefully explained, and practical details are alluded to in such a manner that it is with genuine regret that one comes to the end. A good general index and an index to formulæ complete this section of the work.

The general impression gained is one of thoroughness, combined with a facility of expression which arouses a keenness and sustained interest, and there is no doubt that a reader of this work is sure to look forward to the companion volume on "Applications" from the same author, which is promised for the future. Mistakes are few and far between, and the paper and type well chosen, so that the two together form a work which will last and be a handy means of general reference.

Atoms. By Prof. Jean Perrin. London: Constable & Co., Ltd. Price 6s. net. (Translated from the fourth revised edition.)

We are in some little danger in these days of taking a somewhat lop-sided view of the atomic theory in general, and of the structure of the atom in particular, owing to the great amount of attention directed of late years to the various phases of radioactivity. We are apt to forget the great amount of work formerly devoted to these subjects—work which, for accuracy and brilliancy, compares quite favourably with anything recently done. The little book under review comes as a timely corrective; for in its 200 odd pages it sets out in brilliant style the case of the atom from our first rudimentary conceptions of it as the ultimate irreducible particle right down to our latest pictures of it as a whirling system of electrons. That is to say, the discoveries of the last 20 years, important and epoch-making as they are, are nevertheless apt to bulk too large because of our nearness to them, and this book endeavours to give them the kind of perspective they will eventually assume in the eyes of our descendants.

The author commences the book with a long chapter on chemistry in relation to the atomic theory, in which he deals thoroughly with such things as Avogadro's hypothesis, atomic coefficients, gramme molecules, molecular structure, valency, stereochemistry, solution, &c. The chapter includes a couple of interesting paragraphs dealing with the upper limit of molecular size. The author states that he has satisfied himself that a solution of fluorescein containing one part in a thousand, illuminated at right angles to the microscope by a parallel beam of very intense light, still shows a uniform green fluorescence in volumes of the order of a cubic micron; from which it follows that the mass of the bulky fluorescein molecule, which is 350 times as heavy as the hydrogen atom, is certainly less than the one-thousandth part of the mass of a cubic micron of water. The sum total of the researches on thin films shows that the different atoms are certainly less than a hundred-thousandth (perhaps a millionth) of a millimetre in diameter, and that the masses even of the heaviest (such as a gold atom) are certainly less than a hundred-thousandth (perhaps a hundred-millionth) of a trillionth of a gramme.

Chapter II is on molecular agitation, and deals with molecular speeds, molecular rotations and vibrations, molecular free paths, &c.

The next three chapters are perhaps the most important and most noticeable in the book, and will repay careful study. They deal in great detail with the Brownian movement. From the time when the English botanist Brown in the year 1827, just after the introduction of the first achromatic objectives, examined a collection of small particles suspended in water, and noticed that each of them, instead of sinking steadily, was jumping about in a lively and haphazard way, up to the time of the latest and most refined researches, the author takes us. Like most really great events, the original discovery attracted little attention. The motion of the particles was thought to be due to currents, vibration, temperature variations, and so on. But most careful experimentation has discredited any such theories. It was soon discovered that the smaller the grains the more active the agitation, while their nature exerts little influence. In the same fluid two grains are agitated to the same degree if they are of the same size, whatever the substance of which they are composed, or whatever their density. The Brownian movement never ceases. It is seen in the liquid inclusions that have remained shut up in quartz for thousands of years. We have therefore to come to the conclusion that it is concerned with actual molecular motions.

The author details the considerable researches he has carried out on the Brownian movements. He describes the preparation of the emulsions used, the methods of determining the density and volume of the granular material, and the methods of observing an emulsion and of counting the grains. He sought to discover the law according to which the concentration of the grains decreases. He found that the grains obeyed a law like the atmosphere under gravity. Thereafter an investigation was carried out to discover if the rarefaction law led to those values of molecular magnitudes that we look for. After most exhaustive research the author found that he deduced the very numbers that had been obtained from the widely different point of view of the kinetic theory.

Einstein's theory is then given, dealing with the translational and rotational Brownian movement, and the author describes, with the aid of diagrams, the long and involved research he carried out to test it.

Chapter VI is on light and quanta, and considers black bodies, the composition of the light emitted by such bodies, how the radiation emitted by a black body enables us to determine the molecular magnitudes, rotational velocity in a molecule, and so on, while the last two chapters deal with the atom of electricity and the genesis and destruction of atoms.

The book is a valuable epitome of the greater part of our knowledge of the atom as such knowledge stands to day.

TELEPHONE WIRES IN STREETS.

[FROM OUR LEGAL CONTRIBUTOR.]

From time to time complaints are to be found in the newspapers as to the inadequacy and inefficiency of the telephone service. It is easy to rail at any public department: but before deciding whether there is any good ground for complaint it is necessary to consider the powers with which the particular department is invested, and the limitations which the Government has placed upon the exercise of those powers.

Those who are responsible for the telephone service are in this difficulty—each new subscriber involves additional capital outlay. He adds, indeed, another complication to an already complicated system. Into that, however, it is not proposed to enter. We merely desire to draw attention to one of the difficulties which beset the Postmaster-General when he is asked to extend his system for the benefit of a new subscriber. He may have to lay a new overhead wire. Can he do this? Sec. 12 of the Telegraph Act, 1863, provides that: The company (that is to say, the Postmaster-General) shall not place a telegraph over, along, or across a street or public road, or a post in or upon a street or public road, except with the consent of the body having the control of such street or public road, and where a public road passes through, or by the side of, any park or pleasure grounds, and where a public road crosses, by means of a bridge or viaduct, or abuts on any ornamental water belonging to any park or pleasure ground, and where a public road crosses or abuts on a private drive through any park or pleasure grounds, or to any mansion, the company (*i.e.*, the P.M.G.) shall not, without, or otherwise than in accordance with, the consent of the owner, lessee or occupier of such park, pleasure grounds, or mansion, place any work above ground on such public road.

Sec. 13 of the same Act provides that:—

"Where any landowner or other person is liable for the repair of any street or public road (notwithstanding that the same is dedicated to the public), the company shall not place any work under, in, upon, over, along, or across such street or public road, except with the consent of such landowner or other person, in addition to the consent of the body having the control of such street or public road, where under this Act such last-mentioned consent is required: provided that where the company place a telegraph across or over any street or public road, they shall not place it so low as to stop, hinder, or interfere with the passage for any purpose whatsoever along the street or public road."

"The term 'street' means a public way situate within a city, town, or village, or between lands continuously built upon either side, and repaired at the public expense, or at the expense of any turnpike or other public trust, or *ratione tenuræ*, including the footpaths of such way and any bridge forming part thereof.

"The term 'public road' means a public highway for carriages, being repaired at the public expense or at the expense of any turnpike or other public trust or *ratione tenuræ*, and not being a street, including the footpaths of such public highway, and any bridge forming part thereof, and also any land by the side and forming part of such a public highway, but not including a railway or canal."

The question then arises as to what is a "city, town, or college," and it seems to be a matter of fact upon which divergent views may be held. "Town" in modern Acts of Parliament is not restricted to its legal meaning, but is expanded popularly, and means the space which, for the time being, is covered by, or occupied as accessory to, houses collected together in a mass, and in sufficient number to be ordinarily designated as a town, and includes unbuilt on lands that may lie within the ambit of such collected mass of houses (Elliott *v.* S. Devon Railway (1842), 17 L.J., Ex. 262). In the case just cited it was held that the word "town" meant the space on which the inhabitants have permanently collected their dwellings so near to each other that they may be reasonably said to be contiguous. It includes all open spaces surrounded by a continuous line of houses: and, *semble*, all open spaces occupied as mere accessories to the congregated dwelling houses although not so surrounded. In a later case (The Queen *v.* Cottle and Others (1851), 20 L.J.M.C., 162), a judge who told a jury that a town was to be taken in its popular sense of a collection of houses, and that they were to consider whether the spot was so surrounded by houses that the inhabitants might fairly be said to dwell together, the fact of the houses being separated by gardens not preventing them from lying together, was held to have given a proper direction.

In one case it was for the Court to decide whether Teddington was a town. In the London and South-Western Railway *v.* Blackmore (1870), 39 L.J.N.S., Ch. 712, the question was whether two plots of land situate near the High Street, Teddington, were in a town. At that time Teddington contained two churches, two chapels, two post offices, 450 inhabited houses and 2,250 inhabitants, within a radius of 30 chains of the plots in question. The Lord Chancellor said:—"With regard to this particular place where the land is situate, which has been offered for sale by auction, it appears to me, I confess, that there is no pretence for saying that that particular land is situate in a town. . . . There is on one side of it a small row of houses, built by some building society or freehold land society . . . with that exception, and the exception of the house of the plaintiff in this suit, who has built a house on the property which adjoins the railway property, there is really nothing which can be said to be occupied by persons in such a manner as to constitute continuous residence or anything like it in any reasonable sense that would induce their Lordships to say that the land is 'situate within a town.'"

"In my opinion," said Hawkins, J., in Deards *v.* Goldsmith and Wife (1879), 40 L.T., 328, "a town grows with the buildings, and wherever it can be said that the latter have advanced to such an extent as that that which was formerly without is now within the 'town,' the exemption will apply to such newly-added part of the town."

The borough or urban sanitary boundary is not conclusive, as it might run through fields (see per Cairns, L.J., in Carrington *v.* Wycombe (1868), 37, L.J., Ch. 213, at p. 217).

Even assuming there is no difficulty with any private owner of property, the Postmaster-General may find it difficult to know with whom he is to negotiate. Thus it might be thought that the local authority obviously had some say in the matter. But this is not always the case. For instance, in the recent case of the Postmaster-General *v.* Hendon Urban District Council, the Postmaster-General applied to an Urban District Council for their consent to his placing telegraphic lines in, upon, over, along or across urban streets or public roads in their district. The Council objected that they were not a body having control over the roads within the meaning of Sec. 13 of the Telegraph Act, 1863. It was held, following Redhill Gas Co. *v.* The Reigate Rural District Council (1911), 75, J.P. 358, that the District Council had not the control over the roads, within the meaning of the section, and were not, therefore, entitled to give consent.

This case leaves the question to whom the Postmaster-General was to apply entirely open. He was probably put to considerable expense in order to ascertain who he was *not* to apply to. If the Legislature thinks it right to put these burdens upon him, it is small wonder that the telephone system is expensive.

Japanese Exports.—Japanese exports to the United States have doubled since the beginning of the war.—*Times.*

BUSINESS NOTES.

Book Notices.—"*Journal* of the Institution of Electrical Engineers." Vol. LV. No. 266. May, 1917. This issue contains the following papers:- "Wayleaves," by Mr. C. Vernier: "Engineering Specifications," by Mr. J. Shepherd: and "A Concentric Standard Dynamometer Wattmeter for Heavy Currents," by Mr. A. E. Moore.

"Advanced Text-Book of Magnetism and Electricity," in two volumes. By R. W. Hutchinson. London: University Tutorial Press, Ltd. Price 8s. 6d.

Plant for Sale.—The Oldham Corporation Electricity Committee has for disposal two Willans-Siemens 740-KW. sets, shunt-wound, 450-480 volts. Particulars are given in our advertisement pages to-day.

Patents and Alien Enemies.—Licences have been granted by the Board of Trade in respect of Patent No. 25,101/12 granted to Bauer, to Messrs. Fredk. R. Butt & Co., Ltd., and in respect of patent No. 26,941/06 granted to Meirowsky, to H. Clarke (Messrs. Clarke & Co.).

Catalogues and Lists.—Messrs. Laurence Norris and Co., 56, Kingsway, London, W.C.—Tabulated quantities and sizes of ball bearings offered for sale.

B.E. Co. (of London and Birmingham), Ltd., Mansion House Chambers, Queen Victoria Street, London, E.C.—Price leaflet of Hendon drawn-wire lamps.

Messrs. W. Sanders & Co., Falcon Electrical Works, Wednesbury.—36-page illustrated catalogue, describing their new patent Home Office fuseboard and Home Office ironclad switch.

Trade Announcement.—Messrs. Ashdowns, Ltd., have removed from Northfleet to Crete Hall Road, Rosherville, Gravesend.

Dissolutions and Liquidations.—Bakelite & Co., Ltd.—Sir W. B. Peat, the Controller, has applied to the B. of T. under Section 1, Sub-section (5), of the Trading with the Enemy Amendment Act, 1916, for his release.

Marine Smokeless Mechanical Stoker Co., Ltd.—A meeting is called for July 2nd, at 28, Bishopsgate, London, E.C., to hear an account of the winding-up from the liquidator, Mr. T. W. Gilbert.

Foreign Trade Catalogues.—The Commercial Intelligence Branch (Foreign Samples Section) of the Board of Trade, 32, Cheapside, E.C., has prepared an Index of Foreign Catalogues issued by German and Austro-Hungarian firms. These catalogues have been collected by the Branch from all parts of the world, and the Index (60 pages) contains two sections—one a Subject Index to Manufactures, in which electrical goods figure very considerably, the other being an Index of Firms by whom the catalogues were issued. As might be expected, the publications of the A.E.G., Siemens, Bergmann, and other such concerns in the collection are very numerous. The catalogues themselves may be seen by our manufacturers at the above address, but in certain cases where it is not convenient for manufacturers to inspect them in London they will be lent for short specified periods, so that firms may have an opportunity of studying them at their own works. We believe that in organising this collection the Branch has performed a valuable piece of war trade work, which cannot fail to be of both real interest and practical service.

LIGHTING AND POWER NOTES.

Australia.—Representatives of Boolaroo and Speers Point recently waited on the manager of the Sulphide Corporation works at Cockle Creek to discuss a proposal for the electric lighting of those districts. Particulars of the cost of wiring, also lighting and power costs were obtained, and it was decided to canvass the district in order to obtain a guarantee of 200 consumers.

The Southport (Queensland) Council has finally adopted the agreement for the electric lighting of the town; the Barcaldine (Queensland) Council has decided to borrow £6,000 to complete its electric lighting scheme.

A report has been submitted by the Federal Standing Committee on the proposal to erect a power house at the Flinders naval base, at a cost of £41,350, which course is now recommended.

Barrow-in-Furness.—Year's Working.—The annual report of Mr. H. R. Burnett, the borough electrical engineer, for the year ended March 31st last, shows that the total output sold was 13,429,260 units, as against 13,806,254 in 1915-16, which year it may be remembered, showed a great increase on the previous year's total of 3,597,410 units. The slight reduction in output was due to a private power house coming into operation, but the reduction through this cause was largely counterbalanced by the increased requirements of other consumers. The revenue increased to £63,114 from £59,208, and, after meeting operating expenses, the gross profit was £23,289, while the net profit, after payment of interest and sinking fund, was £11,223, as compared with £12,804 in the previous year. The increased cost of coal during the year represented £2,700, while rates and taxes were on an increased scale. It may be noted that during the year the output for power and heating totalled 11,448,890 units, or 85 per cent. of the total, and produced £41,384 of the total revenue of £63,114, the average price obtained for this supply being ·867d. per unit. Private lighting and domestic supply increased by 19 per cent., while power and heating supplies (other than to the large consumer previously indicated) increased by 26 per cent. Of the total capital expenditure of £179,231, some £93,607 or 52 per cent., has been offset by capital repayments, revenue contributions to capital and to the renewals fund.

Mr. Burnett draws attention to the necessity of accumulating as large a sum as possible, with a view to improving the efficiency of the undertaking at the earliest possible moment and thus meeting the demand for cheap power. It may be noted that the results recorded since the war started have been obtained without increasing the charges, and that the average price obtained for the whole supply during 1916-17 and 1915-16 has been 1·11d. and 1·02d. per unit, power and heating supply figuring at ·867d. and ·775d. per unit respectively. The total working costs during these years were ·712d. and ·605d., the maximum loads being 3,625 KW and 3,905 KW., and the load factors 42·3 and 40·36 per cent. respectively. During the year a 950-KW. rotary has been installed at the works in place of a smaller set removed to a sub-station; new ash plant has been installed, and plans prepared for new boiler plant. About 300 connections were made to the mains, including 100 workmen's houses, and the apparatus on hire reached 1,250 pieces, including motors, radiators, irons, kettles, ovens, hot-plates, arc lamps, &c. The total connections amount to 8,905 KW., and include over 3,000 H.P. of motors.

Bingley.—The accounts of the Council's electricity undertaking for the year ended March 31st show a deficit of £333; there has been extraordinary expenditure amounting to about £550.

Birmingham. Rate Relief.—The accounts of the electricity supply department show that the amount available for allocation to the rates will be £27,700, instead of the £25,000 promised. The amount handed over last year was £25,498.—*Birmingham Post.*

A fire occurred on Saturday night at the Smethwick power station of the Shropshire, Staffordshire and Worcestershire Power Co., due to a short circuit, and resulted in the shutting down of the station. It was anticipated that the full supply would be available on Wednesday.

Bolton.—Rate Relief.—The Electricity Committee has decided to allocate £2,000 in aid of the rates, instead of £1,500 as estimated at the beginning of the year. The Committee has passed a resolution congratulating the electrical engineer, Mr. W. J. H. Wood, on the successful running of the new generating station at Back-o'-th'-Bank.

Bridlington.—Year's Working.—The report of the deputy electrical engineer, Mr. F. Ffrench, on the working of the electricity undertaking for the year ended March 31st, discloses an unfortunate situation, due, of course, to the prevailing conditions.

The output sold, amounting to 270,220 units, compares with 460,734 units in the previous year and 535,000 units in 1913-14; while both revenue and expenditure fell off as well, the financial charges remained stationary, and in the result there was a deficit of £1,321, or nearly £1,000 in excess of that of the previous year. The position can be gauged from the fact that the average price received was 3·55d., while the all-in costs were 6·15d. per unit, as against 2·9d. in normal times.

Bury.—The Corporation Electricity Committee, after a full discussion, has decided to allow the price of electricity to remain as at present, until the end of September, when the matter will be further considered.

Canada.—According to the *Financier*, the directors of the British Columbia Electric Railway Co. report that the Legislature has amended the clauses of the Vancouver City Incorporation Act which protected the company against municipal competition with respect to lighting and power, and after June 1st, 1919, the city will apparently have the right to compete with the company, but further particulars are expected by the next mail.

Cardiff.—Price Increase.—It has been decided to increase the price of electricity by 5 per cent., commencing from April 1st.—*South Wales Echo.*

Continental.—Italy.—H.M. Embassy at Rome reports that the Supreme Council for Public Waters has granted concessions to three local companies for increases in water power to be derived from the River Nera in the Province of Perugia, and from the Rivers Piave and the Cordevole in the Province of Belluno. The Council is further considering a number of other applications for similar concessions, and is studying the water-power possibilities of various streams in the Cuneo and Rome districts, especially of the lakes of Albano and Nemi.

Switzerland.—A circular of the Federal Council to the Cantonal Government notifies the new law relating to water-power concessions, providing that at least two-thirds of the directors of a concessionaire company must be Swiss citizens and domiciled in Switzerland and that no transfer of the concession may be made without the consent of the conceding authority, comes into operation on January 1st, 1918.—*Board of Trade Journal.*

Spain.—A new company has lately been formed in Bilbao, with a capital of £250,000 and the title La Sociedad Productora de Fuerzas Motrices to establish a large hydro-electric station in the Province of Lerida. It is stated that the current generated at the new station, which is to have a capacity of 16,000 H.P., has already been contracted for by the Sociedad de Energia Electrica de Cataluna.

Croydon.—Proposed Loan.—The T.C. has considered an application for an increased supply of electricity to a local factory, at an estimated cost of £2,000. It was decided to make application to the L.G.B. for sanction to the borrowing of the amount necessary.

Darwen.—Price Increase.—At a meeting of the Electricity Committee, on May 24th, it was decided that the charges for electricity be advanced 10 per cent. above present prices.

Finchley.—Loan Sanction Refused.—The responsible authority having decided that proposed extensions are unnecessary, the L.G.B. has refused its sanction to the borrowing of £14,000 required for the purpose.

Glasgow.—The T.C. is recommended to support the movement of municipal electric supply authorities for obtaining increased representation on the B. of T. Committee on Electric Supply, and a resolution to that effect has been passed by the Electricity Committee.

The Corporation has decided that no new consumers can be connected with the electricity supply mains unless they are engaged on work of national importance.

Haslingden.—Price Increase.—The T.C. has decided to increase the charge for electricity for lighting purposes by ¾d. per unit, making the price 4¾d. The price of current supplied for power and heating, other than under special agreement, is to be increased 15 per cent. Councillor Waddington said that without the increase the Committee would be quite unable to pay its way, and he hoped it would be possible to bring the price back to 4d. per unit after the conclusion of the war.

Ilford.—New Plant Proposals.—In consequence of the refusal of the L.G.B. to sanction a loan of £10,000 for additional generating plant, the engineer has recommended a scheme of H.T. transmission with step-up and step-down plant between Ley Street and Grove Road sub-station, at a cost of £5,800, and tenders are to be obtained. It is reported that the results of running the electric coal wagon have been very satisfactory.

Keighley.—Yesterday the new plant at the Corporation electricity works was to be officially started up; the plant capacity now amounts to 10,000 KW.

Letterkenny.—E.L. Proposal.—The Asylum Board is asking the Urban Council to join in a scheme to provide an electrical installation for the institution, worked by turbines erected on the Lennon Falls at Kilmacrenan Bridge.

Llanelly.—The surveyor reported to the Roads Committee that in regard to the lighting account for the three quarters ended March 31st last, he had obtained a reduction of £203, which he recommended the Council to accept. The Committee decided that, as the lighting contract expired at the end of next year, to recommend the Council to open up negotiations with the company at once as to the renewal, so that the matter should be gone into thoroughly.

Llandudno.—Year's Working.—The working of the electricity undertaking for the year to March 31st resulted in a gross profit of £1,519; after allowing for repayment of interest and sinking fund charges, amounting to £3,527, there was a deficiency of £1,733, as compared with a deficiency of £1,331 the previous year.—*Liverpool Post.*

Manchester.—Rate Relief.—The budget, providing for an increased rate of 4·3d. in the £. was considered by the City Council last week. Ald. Goldschmidt, the chairman of the Finance Committee, said the increase was more than accounted for by the reductions in the proposed contributions from the trading departments. The Electricity Committee proposed to give only £16,570, as against £30,000, and the tramways £50,000, as against £100,000. The Finance Committee had passed a resolution that the Committees should be asked to make the same contribution as last year, and he thought the Council was justified in asking the Electricity Committee to provide £30,000, and moved that this be done. The discussion was adjourned for a fortnight, no decision being reached.

Stafford.—Proposed Loan.—Sanction to a loan of £8,700 for a new boiler, accessories, boiler house, &c., at the electricity works, has been applied for by the T.C.

St. Austell.—Street Lighting.—The U.D.C. has, by six votes to four, passed a recommendation from the Lighting Committee not to pay anything to the Electric Light Co. in respect of 95 public lamps which have not been used for a year.

TRAMWAY and RAILWAY NOTES.

Accrington.—Inter-Running.—A conference has been held between representatives of Haslingden and Accrington Corporations on the question of the basis on which the car-milage run by Accrington cars in Haslingden should be charged, and a new agreement for six months was come to, whilst it was decided to pay an additional ½d. per car-mile for the year ended March last. At Haslingden T.C. it was stated that the agreement was moderately satisfactory to both sides.

Ashton.—Increased Fares.—A proposal has been submitted to the Corporation Tramways Committee for raising the fares on all the routes, in order to meet the increase in working costs, and has been approved. The revision of fares on the system of the Stalybridge Joint Tramways Board is also under consideration.

Bingley.—Reporting on the local tramway service provided by Bradford, Mr. Snowden said 549,000 full 3d. fare passengers had been carried from Bingley to Bradford. The saving to the community, on the pre-war railway fare of 5½d., was £6.742, whilst on the present railway fares it was equal to £12,580. By workmen's cars in the morning men could travel the 6-mile journey for 1½d.

Dublin.—Continued efforts are being made to induce the B. of T. to take over the control of the Dublin and Lucan, and Dublin and Blessington electric lines, as is the case with other Irish electric lines.

Glasgow.—Lottery Tickets.—In view of the prominence recently given to the subject, the tramway department has issued a statement showing that since it started the sale of lottery tickets 11 weeks ago, the total receipts have been over £16,000, of which £12,500 was devoted to War Charity Funds, while over £3,000 was disbursed on pictures and War Savings Certificates, which were included among the weekly prizes.

A letter has been received from the Under-Secretary for Scotland, pointing out that the attention of the Lord Advocate has been drawn to the question of the tramway prize-drawing scheme; he desires to know what the Corporation intends to do, and says he may have to consider the desirability of taking steps to stop the drawing of prizes. A meeting of the Corporation has been called in consequence; the tramway manager, who originated the scheme, has suggested that an effort should be made to have the prize-drawing scheme legalised.

Keighley.—The employés decided to return to work on Saturday last, the Tramways Committee having refused arbitration (unless compelled) or otherwise to agree to the demand for increased pay for the women conductors. The employés are, it is understood, referring the matter to the B. of T.

Morecambe.—Proposed Electric 'Buses.—The Council is now agreed on the necessity of doing away with horse cars, but it is realised that electric cars cannot be provided during the war, and the scheme in contemplation is the purchase of electric 'buses, which might be obtainable almost at once.

TELEGRAPH and TELEPHONE NOTES.

Argentina.—A German company has applied to the Ministry of Marine for permission to establish within the City of Buenos Aires a radiographic station to communicate with the German capital. The applicants state that the station will only be used for the reception of messages. The Minister of Marine is reported to be giving favourable consideration to the matter.—*Review of the River Plate.*

A later report, in the *Morning Post*, states that a German wireless station has been established at Buenos Aires, and will begin experimental operations in a short time. Some of the newspapers are urging that steps should be taken to prevent its working.

Wayleaves for Telegraph Wires.—The House of Lords on May 18th, decided that the North British Railway Co. was not entitled to additional payment or compensation from the Postmaster-General in respect of wayleave for telegraph wires erected on the company's railways since 1885. The wayleave was acquired by the Postmaster-General under two agreements of 1868 and 1869, which provided that the Postmaster-General should pay the capital sum of £100,000 and an annual sum of £2,250 in respect of the perpetual wayleave right he had acquired and as compensation for any loss the railway company might otherwise sustain. It was admitted that the Postmaster-General was entitled to free wayleaves for wires which he caused to be erected from 1870 to the end of 1874 inclusive, but it was contended for the railway company that Clause 5 of the supplemental agreement of 1869, by necessary implication, conferred the right to further payments in respect of wayleaves for wires put down after the expiry of the first 15 years. The Lord Chancellor said that Clause 5 did proceed on the assumption that there was some limit to the number of wires which might be erected without payment, but it could not override the general tenor of the two agreements.—*Railway Gazette.*

Western Union.—The report of the Western Union Telegraph Co. for 1916 shows a total income of nearly 62 million dollars, and operating expenses nearly 49 millions. The multiplex system has been extended, and is giving satisfactory results; but for this the increased traffic could not have been adequately dealt with. At the close of the year, the company had 1,600,146 miles of wire in use, as well as 2,988 miles of land-line cable and 22,728 nautical miles of submarine cable. The offices numbered 25,234.—*T. and T. Age.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—August 22nd. N.S.W. Government Railways and Tramways. Thirty-six induction motors (Specification No. 488). September 19th.—One 225-H P. synchronous motor (Specification No. 489). Particulars from Electrical Engineer's Office, 61, Hunter Street, Sydney.

Melbourne. — July 25th. Victorian Railways. Step-down transformer and sub-station equipment for Sandringham-Black Rock electric tramway. Particulars from the Chief Storekeeper, Railway Offices, Spencer Street, Melbourne.

Dublin.—June 2nd. Coal for the electricity works, &c. Chairman of Supplies Committee, Town Clerk's office, City Hall.

Kingston-on-Thames.—Corporation. One 5-ton steam or electric wagon. Mr. R. H. Clucas. Borough Surveyor.

Newport (Mon.). — June 9th. Tramway Department. Construction of the Newport Light Railway, Section No. 2. See "Official Notices" to-day.

Spain.—June 14th. The authorities in Madrid of the Spanish railway known as the Compania del Norte. Electrification of about 39 miles of line in the Province of Asturias, which gives a connection with the port of Pajares. The line runs through a mountainous district, and comprises 79 tunnels, which represent a distance of nearly 16 miles. The altitude of the railway varies considerably, ranging from 1,150 ft. above sea-level at Pola de Lena to 4,080 ft. at Busdongo. The contract calls for a speed of about 20 miles per hour, and for trains weighing, excluding the electric locomotives, 330 tons.

June 14th. Municipal authorities of Zamora. Concession for the electric lighting of the town during 20 years.

Tenders have recently been invited by the municipal authorities of Viladeriat (Province of Gerona) for the concession for the electric lighting of the town during a period of 10 years.

CLOSED.

Glasgow.—T.C. Accepted tenders. Electricity Department (for 12 months) :—

Electricity meters.—Ferranti, Ltd. ; Chamberlain & Hookham, Ltd.
Single cables -Vulc. bit., sheathed, and ins.—Callender's Cable Co., Ltd.
Conc. and triple conc. cables.—Callender's Cable Co., Ltd.
H.T. cables.—W. T. Glover & Co., Ltd.
E.H.T. cables.—Callender's Cable Co., Ltd.
Rub.-cov. cables and flex.—Craigpark Electric Cable Co., Ltd.
C.I. boxes, section pillars, &c. (for six months). -Carron Co. ; Falkirk Iron Co., Ltd. ; Lion Foundry Co.

Tramways Committee (ordinary) :—

Commutators.—P. R. Jackson & Co.
Chilled-iron and scrap-iron brake blocks.—Carron Co.

High Wycombe.—T.C. Maintenance of electric fire-calls and the water-level indicator.: Mr. E. H. Milner. £25.

Johannesburg.—The Municipal Council has accepted the following tenders :—

Telegraph Manufacturing Co. 2,502 ft. ·013 twin cable, £250 ; 2,001 ft. ·004 twin cable, £150.
Rice, Wilson & Herd. 1,500 ft. ·013 twin cable, £200 ; 2,500 ft. ·022 twin cable, £375 ; 1,320 ft. 7 18 concentric cable, £181 ; 1,320 ft. 7 16 concentric cable, £231.

London.—Metropolitan Water Board. Electric lamps for six months : Pope's Electric Lamp Co., Ltd.

FORTHCOMING EVENTS.

Chief Technical Assistants' Association.—Saturday, June 2nd. At 3 p.m. At the Tavistock Hotel. Discussions (see "Notes" to-day).

Royal Institution of Great Britain.—Saturdays, June 2nd and 9th. At 3 p.m. Lectures V and VI, on "The Electrical Properties of Gases," by Prof. Sir J. J. Thomson, Pres. R.S.

Roentgen Society.—Tuesday, June 5th. At 8.15 p.m. At the Cancer Hospital, Fulham Road, S.W. Discussion on "The Future of the British X-Ray Industry."

Salford Technical and Engineering Association.—Saturday, June 9th. Visit to Messrs. Taylor Bros. & Co., Ltd., Trafford Park.

NOTES

A Marconi Anti-Submarine Device.—Senator Marconi, who is a member of the Italian Commission now visiting Washington, is in communication with the U.S. Navy Department respecting his plan to destroy submarines, which is said to have achieved the destruction of 13 submarines in the Adriatic within a few weeks.

Volunteer Notes. — County of London Engineer Volunteers (Field Companies). Headquarters, Balderton Street, Oxford Street, W.

Orders for the Week. By Lieut.-Colonel C. B. Clay, V.D., Commanding:

Monday, June 4th. Technical for No. 3, Right Half Company, at Regency Street. Drill, No. 3 Company, Left Half Company. Signalling Class. Recruits' Drill, 6.30.

Tuesday, June 5th.—Lecture, 6.30. Physical drill and bayonet fighting, 5.30 to 6.30.

Wednesday, June 6th.—Drill, No. 1, Left Half Company, 6.15.

Thursday, June 7th.—Drill, No. 3 Company, Left Half Company. Ambulance Class by M.O., 6.30. Signalling Class.

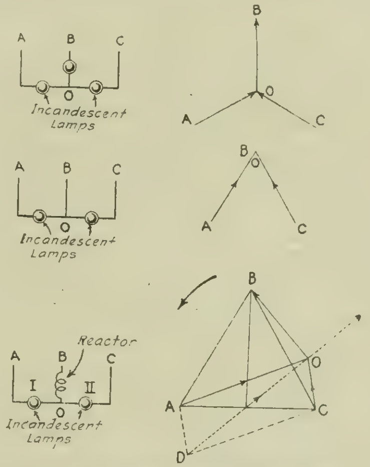
Friday, June 8th.—Technical for No. 2 Company, Left Half Company, at Regency Street. Drill, No. 3 Company, Right Half Company. Recruits' Drill, at 6.30 to 7.30.

Saturday, June 9th. N.C.O.'s Class, 2.30. Company Commander Hyman and the Instruction of Musketry.

Sunday, June 10th.—Parade Clapham Common Station (Tube Railway), 9.45 a.m., for work at Bombing School. Uniform. Rations to be carried.

Macleod Yearsley, *Adjutant.*

A Simple Method of Determining Phase Rotation. By connecting two incandescent lamps and a reactor (or condenser) in star, the phase rotation of any two or three-phase system can be readily determined by observing the relative brilliancies of the lamps. For example, if the lamps and reactor are connected with a three-phase system, as shown herewith, relative dimming of lamp II will indicate that the phase rotation is counter-clockwise, whereas reduction in relative brilliancy of lamp I indicates that the rotation is clockwise. If a condenser is used in place of a reactor, dimming of lamp I will indicate opposite rotation from that shown if the same lamp dims with a reactor in circuit. Where phase rotation has to be determined frequently, as may be the case where considerable reconnection of cable and overhead systems is required, or when numerous motors or transformers must be connected, it may be advisable to mount the lamps and reactors in permanent form.



Effect of Reactance on Y Voltages.

The action of the indicator can be explained by considering the voltage vector relations. For instance, suppose three equal resistances are connected in star, then the vectors will be equal and will fall 120° apart as shown. If the resistance of one circuit is reduced the vector representing the voltage across the reduced resistance will shorten, allowing the other vectors to lengthen, thereby decreasing the angle between the last mentioned vectors. Under the extreme conditions of no resistance in one leg of the star, the vectors AO and CO will assume the positions shown, which is an open-delta connection. However, if a reactance is inserted in one leg of the star and plain resistance, such as incandescent lamps, connected in the other legs, the intersection of the vectors will not fall on a median. On the other hand, the *locus* will be a circle whose diameter lies along a medium of the triangle A, B, C. Thus the voltage across one lamp will be increased while that across the other is reduced. The portion of the circle which the intersection of the vectors will follow, and consequently the relative briliancy of the lamps, depends on the phase rotation.

To show that dimming of lamp II indicates a counter clockwise phase rotation, and that reduction in brilliancy of lamp I indicates the opposite, consider the lower diagram showing the voltage relation with lamp II dimmer than lamp I. Since the incandescent lamps are non-inductive their currents will be in phase with the potentials across them and proportional thereto. Consequently vectors AO and CO may represent the current relations also. The resultant of these currents will extend in the direction DO and will be the same as the current through the reactors. OB which represents the potential across the reactor is perpendicular to DO since it is due principally to reactance. According to fundamental laws, the voltage across a reactor always leads the current, therefore the phase rotation will have to be in the direction indicated by the arrow to satisfy this condition. The converse can be proved in a similar manner, the same reasoning applying to two-phase circuits. —T. W. Varley, in the *Electrical World.*

Appointments Vacant.—Chief clerk (47s. 6d.), for the Rhondda U.D.C. electricity department; burgh electrical engineer, for Falkirk; shift engineer, for Reigate Council. See our advertisement pages to-day.

Disabled Soldiers and Sailors.—Admirable work is being done in Newcastle, at the Cowen training school, for the benefit of disabled soldiers and sailors. New electrical workshops have been provided by the trustees, and have been equipped with apparatus for teaching the elements of electric lighting and power, telephone, bell, and signal installation work, the accommodation being adequate for 20 men. A National gas engine of 10 B.H.P. has been installed, driving a Westinghouse 6-KW. dynamo, which is controlled by a Westinghouse switchboard and charges a 60-cell storage battery, which was presented co-operatively by six accumulator manufacturers. The workshop is fitted with benches and tools, large demonstration boards, telephones, arc lamps, instruments, and switchgear, &c., and the course of instruction, which lasts three months, covers interior wiring and the installation of electric light and power apparatus, bells, telephones, &c., as well as the construction and management of the plant, kinematograph projector operation, &c. The training given is as thorough as is possible in the time, and the progress of each man is reviewed every fortnight. The first lot of men began their training on January 12th, and all of them have completed the course and obtained suitable employment.

The trustees have expended more than £250 in equipping the school, and the course is free to disabled soldiers and sailors, some of whom are housed in the Cowen Home. Many electrical manufacturing firms have contributed to the equipment, and the Council of the Institution of Electrical Engineers, through the chairman of the Local Section, has supported the scheme. The electrical section of the Newcastle Chamber of Commerce, and several local firms, including the two electricity supply companies, have also assisted, while a number of local gentlemen have offered to give lectures on subjects in which they are specialists. The supply companies have made arrangements for the men periodically to visit electrical works, power stations, and sub-stations. According to the *Newcastle Daily Chronicle*, the men are keen to learn, and show remarkable aptitude for the work, the results being described as excellent. The Committee would be glad to receive notice of situations which may be vacant, the men being fitted for such work as the care and operation of country house and factory lighting plants, wiring for electric light and power, switchboard operations in power stations and sub-stations, wiring for bells and telephones, including mine signalling apparatus, dynamo and motor attendance, and kinematograph operation.

Communications may be addressed to Mr. W. D. Hunter, managing director and engineer to the Newcastle and District Electric Lighting Co., Ltd., 38, Granger Street West, Newcastle-on-Tyne. The cause is one which must commend itself to our readers; we cannot do too much for our disabled heroes, who have risked their lives and made great sacrifices for the safety of their country.

Wages of L.C.C. Employes.—The Traffic Conciliation Board of the L.C.C. has considered the application of the employés of the traffic section of the tramways department for an increase in wages of 1s. 8d. per day, or 10s. a week, and payment for overtime at the rate of time and a-half, and has decided that the war bonus of employés in the traffic section is to be increased to 1s. 6d. per day for each day worked in the case of male employés. Women conductors are to receive the present bonus of 6d. a day on appointment, an additional bonus of 3d. a day after three months' continuous service, a further bonus of 4½d. after nine months' continuous service, and the full bonus of 1s. 6d. a day after 12 months' continuous service. The arrangement of June 26th, 1914, under which motormen and conductors are paid at the rate of time and a-quarter for overtime, is to be extended to all persons employed in the traffic section. The advances are to commence on Thursday, May 24th.

The Electrical Conciliation Board has decided that fitters, turners, fitters' labourers, blacksmiths, hammermen, machine drillers, crane drivers, wiremen's mates, wiremen, and electricians employed at the Greenwich generating station are to receive war wages of 12s. a week, all other male employés at Greenwich generating station are to receive war bonuses as follows in place of the present war bonus: Men in receipt of 40s. a week or under, 10s. a week; over 40s. and not more than 50s., 6s. a week; over 50s., 5s. a week. Leading cable hands, cable hands, switchboard attendants, greasers, and cleaners at sub-stations, electrical attendant at Belvedere Road, wiremen's mates of the depôt wiring staff, and the night telephone operators at Camberwell and Shoreditch exchanges are to receive an additional war bonus of 4s. a week. Consideration of the application of the remainder of the telephone operators at Camberwell exchange is adjourned. The rate of pay of the wiremen of the depôt wiring staff is to be increased to 1s. 1d. per hour, the rate paid in excess of 10½d. an hour to be regarded as war wages. The advances are to be payable from May 3rd.

Electric Vehicle Manufacturing Licences.—According to the *Commercial Motor*, Mr. Annan Bryce asked the Minister of Munitions, in the House Commons on March 17th, whether he was aware that an active demand exists for electrically-propelled industrial vehicles deriving motor force from existing power stations using home-produced fuel, whereby the need for the import of fuel and fodder is diminished; whether the Edison Accumulator Co., having taken works for the manufacture of such vehicles in this country was licenced to produce only a very small number; whether it has been refused certificates to obtain the material necessary to complete even the licenced number; and whether he will now grant priority certificates for such material? Mr. Kellaway, in reply, said he was aware of the demand for vehicles of this character, and it was in view of that demand that the Edison Accumulator Co. were given a licence to manufacture a limited number of chassis in this country. No promise was, or could be, given that all materials required for such manufacture would be forthcoming, but the necessary priority certificates would be issued in respect of any vehicles ordered from the company in connection with work of national importance.

Labour Troubles and Problems.—Mr. Lloyd George, in his speech in the House of Commons last Friday, referred to the industrial unrest of which there have lately been serious evidences in different parts of the country. He said that the termination of the engineering strike afforded a very good opportunity for reviewing the whole of the labour position. Though the particular dispute which occasioned that strike had been happily terminated, there was a good deal of matter for further investigation. He continued: "There has been great unrest in some quarters. The Government have their views as to how that has been fostered, but, at the same time, there are some genuine grievances which have assisted the designs of those who have ulterior motives which have no special reference to the labour situation. Therefore the Government have decided to appoint commissions to inquire into the industrial unrest, and report on the operation of all war emergency legislation of the Government, and its administration in regard to labour, and to make recommendations which will tend to minimise the industrial unrest, especially in the shipbuilding and engineering trades, during the continuance of the war. It is proposed to divide the country into something like seven areas, and appoint a separate commission to investigate the causes of the unrest in each area. An effort will be made to secure the services of Labour representatives and of employers, with an impartial chairman in each case."

In our opinion, the Premier has been well advised to take this matter in hand now. To have allowed things to drift along of their own accord would have been suicidal. The institution of a thorough inquiry on lines which will promote confidence among the vast bulk of the working population who are out and out loyalists, and which will bring out the exact causes of real grievances and of mischievous dissension, may prevent not only a recurrence of recent troubles, but something worse. The inquiry is a war measure—necessary in order to help us win the war at an early date, and all right-minded people will hope for a speedy arrival at definite conclusions.

It is not to be supposed, however, that such an inquiry can deal with all the questions that Labour and Capital have in their minds as requiring settlement for after the war. The Reconstruction Committee of the Cabinet may have much to do with that larger matter. But the present investigation may do much to clear the air, and may go some considerable distance towards promoting the right atmosphere in which to deal with those other matters.

In the foregoing connection we have received from the Rotary Club of London full copies of speeches delivered by Mr. John Hodge, the Minister of Labour, and Sir Robert Hadfield, F.R.S., at a meeting of the Club in March. They deal in a very useful and informative manner with the question of the alliance of Capital and Labour, and are well worthy of a wide circulation and most attentive reading by both employers and employed. The speeches are published together in pamphlet form (2d.), and are to be obtained in quantity from the Reliable Advertising and Addressing Agency, Ltd., Publicity House, Bucknall Street, London, W.C. 2.

In the Parliamentary questions on May 24th, Mr. Kellaway (according to the *Times*) said that the recent labour troubles were attributed by the strike leaders to the abolition by the Government of the trade card scheme of exemption from military service, and to the clause of the Munitions of War Amendment Bill, dealing with dilution of labour on private work. The restraints imposed on labour by the Munitions of War Acts were, to some extent, contributing factors. The whole problem had been receiving the most serious consideration of his right hon. friend, who would be glad to consider any suggestions for securing a just settlement of these difficulties. In April the Minister of Munitions asked the Advisory Committee representing certain employers' organisations, including the Federation of British industries, to consider the question of industrial unrest, and their report was sent to him on May 21st. His right hon. friend also proposed to consult the Advisory Committee on the subject of the Munitions of War Bill.

Educational.—UNIVERSITY OF LONDON.—We have received a pamphlet describing the aims and work of the Appointments Board of the University, which was constituted by the Senate to assist graduates and students to secure appointments. A register of candidates is kept, and business employers desiring to get in touch with well-educated young men and women are invited to communicate with the Secretary of the Board, at the University, South Kensington, London, S.W. 7.

Zinc as a Substitute for Copper.—According to a series of diagrams published in the *E.T.Z.*, the use of zinc wires instead of copper in transmission lines involves an increased cost of about 30 per cent. for the same pressure drop, or about 70 to 80 per cent. for the same efficiency.

Detinning in Australia.—It is proposed to establish works in Sydney for the purpose of treating scrap tinplate, which has hitherto been shipped to Germany. It is estimated that over 300 tons of tinplate are thrown away annually in Sydney alone. An electrolytic process is to be used.

Institution and Lecture Notes.—Institution of Electrical Engineers (Dublin Local Section).—At the general meeting held at the Royal College of Science, Dublin, on 24th inst., the following were elected as officers and Committee for the 1917-18 session :—

Chairman : Capt. O. T. O'Kelly Webber, R.E.
Vice-Chairman : Mr. J. P. Tierney.
Committee : Messrs. Thos. Tomlinson, C. W. Kirwan, R. Tenham, G. M. Harriss, A. E. Porte, Wm. Tatlow, R. N. Eaton, A. G. Brunty, and W. Storey.

The resignation of the hon. secretary, Mr. G. Marshall Harriss, was accepted with regret, and Mr. R. N. Eaton, of 12, College Green, Dublin, was appointed as his successor. A paper, "Notes on the 1916 Edition of I.E.E. Wiring Rules," by Mr. A. G. Brunty, was read and discussed.

Chief Technical Assistants' Association.—To-morrow afternoon (June 2nd), at 3 o'clock, at the Tavistock Hotel, this Association will resume the adjourned discussion on "Problems of Transmission and Distribution." There will also be a discussion on "Questions of Labour Arising out of the War."

Institution of Mining and Metallurgy. On May 24th a paper by Mr. W. R. Ingalls on the question "Shall Great Britain and America Adopt the Metric System ?" was discussed. Mr. Sulman opened the discussion, supporting the author in vigorous opposition to the compulsory adoption of the metric system, and Mr. Harry Allcock followed, ably advocating an affirmative reply to the author's question. The remaining speakers were fairly evenly divided in opinion pro and contra.

South African Institute of Electrical Engineers.—On April 19th, Mr. A. Ballard read a paper entitled "Notes on Three-phase and Ward-Leonard Winding Equipments."

Diesel Engine Users' Association.—We have received a brochure containing particulars of the constitution of the Association and the privileges of membership, notes on the proceedings during 1916, and a complete list of members, with particulars of the plant in their charge, up to March 31st, 1917. The number of members at that date was 83, and the total H.P. of plant represented was 50,318.

Strike.—The members of the Liverpool branches of the Electrical Trades Union, after being on strike for a fortnight, returned to work on Friday. Dr. Addison, the Minister of Munitions, agreed to receive a deputation to consider the matters in dispute, relating to dilution of labour and other points.

Inquiries.—A correspondent asks for the name of the maker of "Crenoid" insulating material. Makers of the "Telephos" electric gas lighter are asked for. A correspondent wants small quantities of vacuum-treated magnetic iron.

Prohibited Exports.—The Supplement to the *Board of Trade Journal* of May 31st contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported from Denmark, France (including Algeria), Italy, Japan, and the Netherlands. The Supplement also contains the list of articles (complete to date) which are prohibited to be exported from the United Kingdom.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The Bexley U.D.C. has increased the salary of the electrical engineer and tramways manager, Mr. H. P. Stokes, by £100 per annum as from January last.

The salary of Mr. F. T. Wright, charge engineer, Southwark electricity works, has been increased, as from April 1st last, and for six months after the termination of the war, from £3 to £3 5s. per week, rising to £3 10s. per week.

Mr. W. F. Bladon, who has been manager of Barrow-in-Furness tramways, on behalf of the B.E.T. Co., for the last 20 years, has given up that position to take up another appointment under the same company. Last Friday evening he was presented with a gold watch by the employés at Barrow. A satchel was presented to Mrs. Bladon. Mr. Dobson, who has been assistant manager at Barrow since October last, is Mr. Bladon's successor.

General.—According to the *Times*, Lord Moulton, Director-General of Explosives Supply, has been nominated for election as president of the Institution of Gas Engineers for the coming year.

Mr. Herbert M. Curtis, of Blackburn, who prior to joining the Army was the contract official at Blackburn Telephone Office, is among the *Transylvania's* survivors.

Mr. B. H. Collins, well known in the American advertising agency field, has joined the publicity staff of the Society for Electrical Development, in place of Hill Griffith, First Lieutenant, Cavalry, Officers' Reserve Corps, who has been called into active service.

Roll of Honour.—Captain C. R. McGowan, H.A.C., son of Dr. McGowan, Maghara, Co. Londonderry, reported severely wounded in France, was, before going on service, an electrical engineer in the employment of the Post Office.

Captain J. Parkinson, R.E., who was "mentioned" in Sir Douglas Haig's last dispatch, is an electrical engineer, and an Associate Member of the Institution of Civil Engineers.

Private C. H. Garrett, West Yorks. Regiment, reported wounded, was on the office staff of the Bradford electricity department.

Sergeant Leslie Brand, R.F.A., who has died of wounds received in action, was employed in the engineering department of the Leeds Corporation tramway depôt.

Lieutenant N. Sizer, who is mentioned in Sir Douglas Haig's dispatch, was when war broke out engaged as an electrical engineer with the Westinghouse Co., Manchester.

Sapper T. Turner, R.E., who has been decorated with a Serbian Order, was before enlisting an employé of the Anglo American Telegraph Co.

Sapper L. Wyld, R.E., killed in action, aged 19 years, was employed by the Rawtenstall Corporation as an electrical mechanic.

Gunner J. M'Ilwraith, R.G.A., killed, was with Messrs. Baxendale, Manchester.

Mr. J. C. Curl, of Rochdale, aged 28, was lost in a disaster to the boat on which he was wireless operator.

Private J. E. Staley, Manchester Regiment, previously reported missing, now reported killed, was with Messrs. Baxendale & Co., Ltd., Manchester.

Lance-Corporal R. Schofield, of the Newcastle tramways department, has been dangerously wounded.

Lieutenant Tom Hamilton, West Yorkshire Regiment, who has been reported missing since May 12th, is the fourth son of Mr. J. B. Hamilton, general manager of the Leeds tramways department. Mr. Hamilton has five sons serving in the Army.

The death from wounds of Lance-Corporal J. Holmes, A. and S. Highlanders, aged 20 years, is reported. He was employed with the General Electric Co., Glasgow.

Mr. Kenneth Smith, who was a student apprentice at the Rugby works of the B.T.H. Co., has died on active service in France.

Pioneer W. Stewart, R.E., who was with the Rio Light and Power Co. at Rio de Janeiro when he came to England in November, 1915, to enlist, has died in France of wounds received in action.

Lance-Corporal W. Smithson, Manchester Regiment, formerly an electrician with Messrs. W. Brierley & Son, of Radcliffe, is reported missing.

Second-Lieutenant C. W. Butterfield, North Staffs. Regiment, reported missing and believed killed, was employed at the works of Messrs. Siemens, Stafford.

Second-Lieutenant H. Lewis, A.S.C. (Mechanical Transport), believed to have been drowned at sea, was formerly in the electrical department of Messrs. Harding Bros., of Hereford.

Corporal Richards, of the Torquay Corporation electricity works staff, has been wounded in action.

Mr. Harold Camp, who has died from wounds received in action, was for over 14 years the outdoor representative of the Leyton U.D.C. electric light department. He was 40 years of age.

Gunner G. Grainger, R.F.A., formerly of the India-Rubber Co., Silvertown, has been killed in action in France. Private W. T. Bonser, Essex Regiment, also a former Silvertown employé, is a prisoner of war in Germany, and Private H. Edgecombe, Argyle and Sutherland Highlanders, formerly of the same company, has been wounded in France. Rifleman E. S. Smith, Rifle Brigade, was recently wounded in France. All the above were in the general office at the Silvertown Works.

Second-Lieutenant V. C. Russell, Suffolk Regiment, younger son of Mr. Stuart A. Russell, works manager to the India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd., Silvertown, has been wounded a second time, and is now in hospital in this country. Second-Lieutenant Russell has been twice mentioned in dispatches.

Private A. J. Cheetham, London Regiment, son of Mr. A. Cheetham, manager of the tire department of the India-Rubber Co., Silvertown, was dangerously wounded on May 15th. Private Cheetham has previously been wounded, on November 29th, 1916. He was formerly in the aero tube department of the India-Rubber Co.

Corporal E. H. Trowbridge, London Regiment, formerly in the electric light department of the India-Rubber Co., Silvertown, was severely wounded in France on May 16th. Private H. A. Barr, London Scottish, formerly in the buying department, has been wounded a second time. Private J. Brennan, Duke of Cornwall's Light Infantry, formerly in the general office of the company, was recently wounded in France.

Obituary.—Mr. R. W. Gauntlett.—We regret to record the death of Mr. Reginald Wilson Gauntlett, late London office manager for Messrs. Bruce Peebles & Co., Ltd., of Edinburgh, which took place on Monday, May 28th, at his residence, 31, Clifton Hill, St. John's Wood, N.W. Mr. Gauntlett's large circle of friends will learn of his death with regret, and will extend their sympathy to his widow and children. Messrs. Bruce Peebles have lost a valued servant, who during his lifetime earned the esteem and respect of all who came in contact with him.

Mr. H. Cruse.—Mr. H. Cruse, who had for a long period been in business as an electrician at Lewes (Sussex), has died at the age of 60 years.

Mr. H. F. Parshall.—The many friends of Mr. Horace Field Parshall, of Penbury Grove, Penn, Bucks., will desire to join with us in an expression of sympathy with him on the death of his wife, which occurred on May 23rd after a long illness.

Captain John Chamberlain.—We have received the following personal tribute to the late Captain Chamberlain from Mr. G. Hookham:—

"Captain John Chamberlain was the son of the late Mr. Arthur Chamberlain, and nephew of Joseph Chamberlain; his elder and only brother, Arthur, is chairman of Kynochs. John Chamberlain was at school at Rugby, and afterwards spent some months in France mastering the language. In matters of commerce and factory organisation he had the inestimable advantage of being trained under his father, who had little short of genius for such affairs. In process of time he took the management of three important companies, viz., Tubes, Ltd., Smith's Stampings, Ltd., and Chamberlain and Hookham, Ltd. In every case he vastly improved the position of these undertakings, turning those that had been less successful into striking successes, and in the case of the last mentioned more than doubling the profits. I can only speak of his loss to this firm as irreparable. Of the personal loss I can hardly trust myself to speak at all—we were all so fond of him. Of an affectionate nature himself, he everywhere attracted affection. In the office and factory he was simply worshipped. In saying this, I am conscious of using a hackneyed expression, and one that is often used in exaggeration, but it is no exaggeration here. Being engaged in such important affairs at home, and with a wife and young family, his friends, with one voice, advised him that it was no duty of his to join the Army, at any rate, at that time. His own conscience, however, advised him differently, and there was no more to be said. He volunteered in the first few weeks of the war. He was severely wounded, and on recovery returned to the Front. He was at last struck down and instantly killed by a stray shell at Brigade Headquarters. Not the least among his attractive qualities was his ever-ready humour. Just before his first departure for France it took the form of saying to me. 'And, you know, the worst of it is I'm such a coward'—which, of course, merely meant that his imaginative brain always insisted on his realising and appreciating the dangers. There are two kinds of courage: one of the man whose spirit carries him forward regardless of all but unconscious of danger, the other of the man who is fully conscious and continually aware of the risks, and yet unflinchingly does his duty. There cannot, I think, be much doubt as to which is the higher form."

NEW COMPANIES REGISTERED.

Southport Electric Supply Co., Ltd. (147,492).—Private company. Registered May 17th. Capital, £1,000 in £1 shares. Objects, as title. The subscribers (each with one share) are: J. Lawyer, 1, Kirklees Road, Birkdale, buyer; S. Stroud, 40, Dinorwic Road, Birkdale, solicitor; E. Stafford, 10, Marshside Road, Churchtown, sales manager. The first directors are: J. Lawyer, S. Stroud, E. Stafford, and J. Bennett. Registered office: 99b, Eastbank Street, Southport.

Apex Electric Accumulator Syndicate, Ltd. (147,516).—Private company. Registered May 21st, by Geo. C. Bingham, 62, New Broad Street, E.C. Capital, £25,000 in £1 shares (10,000 pref.). Electrical and mechanical engineers, manufacturers of electric accumulators and other appliances, &c. The subscribers (each with one pref. share) are: G. Thomson, 65, London Wall, E.C.2, chartered accountant; H. Thomson McConville, 36, Conway Road, Southgate, N.14. The first directors are to be appointed by the subscribers. Registered office: 65, London Wall, E.C.2.

Electric Holdings, Ltd. (147,558).—Private company. Registered May 24th by Waterlow Bros. & Layton, Birchin Lane, E.C. Capital, £300,000 in £1 shares (200,000 6 per cent. cum. pref.). To subscribe for, purchase, or otherwise acquire all or any of the debenture stock and pref. and ord. shares of the British Westinghouse Electric & Manufacturing Co., Ltd., and in particular to purchase all such debenture stock and shares now held by the Westinghouse Electric & Manufacturing Co., incorporated in Pennsylvania, U.S.A., and its nominees, and to enter into agreements (1) with the said American company, (2) with the said British company and the Metropolitan Carriage, Wagon & Finance Co., Ltd., (3) with the said American and British companies, and (4) with the said American company, the Westinghouse Machine Co., the Westinghouse Electric Export Co., and the said British company. The subscribers (each with one share) are: R. A. Pinsent, 6, Bennetts Hill, Birmingham, solicitor; G. J. Withington, 29, Bowyer Road, Saltley, Birmingham, solicitor's clerk. The first directors are: F. D. Docker, L. A. Hiley, and H. Walker. No share qualification required. Remuneration as fixed by the company. Solicitors: Pinsent & Co., 6, Bennetts Hill, Birmingham.

Sheppey Motor Transport Co., Ltd. (147,552).—Private company. Registered May 23rd. Capital, £20,000 in £1 shares. To take over the business carried on in the Isle of Sheppey by the Sheerness and District Electric Power & Traction Co., Ltd., and T. Standen & Sons, and to carry on the business of pier, motor-car, steam and motor boat, omnibus, wagon, and cab proprietors, garage keepers, carriers by land and sea, &c. The subscribers (each with one share) are: G. J. Somerville, Electrical Federation Offices, Kingsway, W.C.2, electrical engineer; T. Bower, 1, Kingsway, W.C.2, company secretary; T. H. Underhill, 1, Kingsway, W.C.2, accountant; A. Charlton, Tramway Depot, Sheerness, electrical engineer; Mrs. E. Standen, 181, Shortlands Road, Sittingbourne; W. A. Standen, 183, Shortlands Road, Sittingbourne, haulage contractor; A. F. Standen, Southdown Road, Sheerness East, motor engineer; F. J. T. Standen, 181, Shortlands Road, Sittingbourne, motor driver. Minimum cash subscription, eight shares. The first directors are: G. J. Somerville (chairman), A. Charlton, W. A. Standen, and A. F. Standen. Registered office: 1, Kingsway, W.C.2.

E. B. Magnetos, Ltd. (147,542).—Private company. Registered May 23rd. Capital, £8,000 in 6,000 pref. shares of £1 each and 8,000 ord. shares of 5s. each. Manufacturers of and dealers in magnetos, dynamos, accumulators, coils, carburettors, speedometers, accessories, engines, motor-cars, aircraft, &c. The subscribers (each with one share) are: E. D. Oppert, 15, St. John's Wood Park, N.W., retired merchant; J. Hope, 9, Frognal, Hampstead, N.W.3, machinery representative. The first directors are to be appointed by the subscribers. Qualification, 100 shares. Registered office: 16, Howick Place, Victoria Street, S.W.

British Lighting & Ignition Co., Ltd. (147,508).—Private company. Registered May 19th by Surtees, Phillpotts & Co., 6, St. Helen's Place, E.C. Capital, £100,000 in £1 shares. Manufacturers of and dealers in motor and other carriages, railway, and tramway rolling stock, vehicles, cycles, and aircraft, and parts and accessories thereof, electricians, electrical and general engineers, suppliers of motive power, traction, light, and heat, &c. The Board of Trade has authorised this company to acquire the undertaking of the Bosch Magneto Co., Ltd., the books and documents of which are liable to inspection under the Trading with the Enemy Act. The subscribers (each with one share) are: R. B. Phillpotts, 6, St. Helen's Place, E.C., solicitor; H. V. Surtees, 6, St. Helen's Place, E.C., solicitor. The first directors are to be appointed by the subscribers. Qualification, £500. Remuneration (except managing director), £250 each per annum, and £500 for the chairman, or, in lieu thereof, 5 per cent. of the net profits, when 5 per cent. is earned on the ord. shares, divided between them. Solicitors: Surtees, Phillpotts & Co., 6, St. Helen's Place, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Direct Spanish Telegraph Co., Ltd. (6,732).—Capital, £95,000 in 13,000 ord. and 6,000 pref. shares of £5 each. Return dated April 11th, 1917. 12,931 ord. and 6,000 pref. shares taken up; £94,655 paid. Mortgages and charges: Nil.

City of London Electric Lighting Co., Ltd. (34,406).—Capital, £1,200,000 in 80,000 ord. and 40,000 pref. shares of £10 each. Return dated April 4th, 1917. 70,595 ord. and 40,000 pref. shares taken up; £1,105,950 paid. Mortgages and charges: £800,000.

County of Durham Electrical Power Distribution Co., Ltd. (61,591).—Capital, £425,000 in £1 shares. 400,000 shares taken up; £400,000 paid. Mortgages and charges: £250,000.

W. J. Furse & Co., Ltd. (121,420).—Capital, £20,000 in £1 shares (9,000 pref. and 11,000 ord.). Return dated April 14th, 1917. 9,000 pref. and 9,835 ord. shares taken up; £6,384 paid; £12,451 considered as paid. Mortgages and charges: £5,000.

City of Oxford Electric Tramways, Ltd. (91,106).—Capital, £150,000 in £1 shares. Return dated March 8th, 1917. 63,000 shares taken up; £1,007 paid; £61,993 considered as paid. Mortgages and charges: £42,800.

CITY NOTES.

Anglo-Argentine Tramways Co., Ltd.

The gross receipts during 1916 were £2,714,226, less working expenses (including £96,000 carried to depreciation renewals reserve, in addition to £257,366 expended on ordinary maintenance) £1,956,668, leaving £757,557, plus £40,008 interest on investments, &c., and £94,120 brought forward, making £891,685. This is dealt with thus:—Annuity to City of Buenos Aires Tramways Co. (1904), Ltd., £70,660; interest and sinking funds on debenture stocks, £587,821; sinking fund for redemption of preference and ordinary shares, £6,236; dividend on 5½ per cent. cum. pref. shares, £176,000; carry forward, £50,969. Traffic receipts increased by £5,588, and passengers by 1,437,360. The abnormally high cost of fuel still continues to prevail, the increased traction charges, notwithstanding economies in consumption, being £161,477. In all departments the strictest economy has been exercised. In view of the foregoing conditions, no dividend can be distributed for 1916 on the 5½ per cent. cum. second pref. shares. The general manager says that it is almost as difficult as last year to forecast traffic prospects for 1917. The great unknown factor, of course, is developments in Europe. Local affairs had shown a very slight improvement in some ways during the past few months, but all classes of crops had been exceptionally poor this year owing to the prolonged drought, and the now abundant rains had come too late in most parts to improve immediate prospects. They might feel the results of this later in the year, and if they maintained their traffic of last year, with perhaps an increase of 1 per cent., it was about as much as they could expect. As regarded net profits, the cost of coal was never a more uncertain factor than now. Excluding the fuel question, they would, he was sure, compare favourably with last year, and expenses would be kept down to a low figure. Annual meeting: June 7th.

Lisbon Electric Tramways, Ltd.

Net profit for 1916, £51,021, plus £8,736 brought forward. There has been put to depreciation reserve £25,000, and the usual 6 per cent. pref. dividend absorbs £25,533, leaving £9,224 to carry forward. In order to make the year's appropriation to depreciation reserve up to the necessary £30,000, £5,000 was transferred from the Exchange reserve for this purpose. Passengers carried 76,620,194, against 67,101,249; earnings Es. 2,324,655 $58, against Es. 2,022,142 $93. The working expenditure increased out of all proportion, and exceeds the figure of the year 1915 by Es. 336,896

$730, owing to prices of coal and other supplies and of labour. The profits are further affected by the lower rate of exchange, the average of which has fallen from 35.97d. to 33.73d. These adverse conditions are more pronounced at the present moment, and there is every probability that they may yet become more severe. Efforts of the company to secure an increase in tariff, were opposed by the Municipality and the Government, and they were dropped for the time being, but the matter will be raised again this year. Notwithstanding the increased traffics, the company has sustained a very heavy diminution of profit compared with pre-war years. In 1913, after the payment of debenture and preference interest there was an available balance of £78,153, against £25,488 in the past year—a falling off in profits of £52,665, showing the effect of the war. It was, therefore, essential to secure the company's financial position against all contingencies, and they must forego the usual recommendation of a dividend on the ordinary shares. The board record appreciation of the services of the local board, of Mr. Kolkhorst, the general manager, and of the staff.

Calcutta Electric Supply Corpn., Ltd. At the annual meeting, held in London on May 23rd, the Chairman said that the generation costs had increased by £1,652, owing to the production of nearly 3,000,000 additional units. Income-tax paid in India increased by £4,330, owing to the Indian rate of tax having been more than doubled. The amount of excess profits duty was difficult to ascertain, but it was covered by the large carry forward. The speaker briefly explained why it was not now so necessary as formerly to put so large a sum to the depreciation and renewals account, and referred again to the agitation by a certain section of the Calcutta public for reduced charges, which he mentioned a year ago. These persons claimed that the several reductions already made were the result of their movement. It would obviously be useless to attempt to undeceive them. The policy of the directors had always been to maintain an equitable attitude both to the consumer and to the shareholder. All reductions hitherto made had been in accordance with the declared policy of the company, which no doubt the majority of the Calcutta public fully recognised. The Government of Bengal had, however, appointed an expert committee to satisfy them as to the reasonableness of the demands for reductions, and that committee last November summed up the situation by stating that the arguments of the critics on the question of excessive charges were "generally misleading and fallacious." Notwithstanding this, the Bengal Government had published a resolution stating that the Governor in Council had carefully considered the question as to whether he should now exercise his statutory powers with a view to secure reduction, and that there was a "strong *prima facie* case for such action on his part." The directors felt that the matter could not have received full consideration, and they had pointed out in the proper quarter the serious difficulties which such a resolution, based on so slender a foundation, brought upon those charged with the administration of the company's affairs. They had still before them the grave necessity for restoring confidence in the minds of English investors in Indian concerns, which this action must go far to disturb. They were not without hope that the incident might be closed in a manner satisfactory to all parties. The whole matter had unfortunately brought them very unwillingly into some antagonism with the Government of Bengal, and it had also postponed a further reduction which they had under consideration to announce from January 1st, and which, had it not been for this ill-informed agitation, would have been given effect to. The delay caused by the Trades' Association Memorial had, however, given them the opportunity to reconsider their position with reference to the increased taxation imposed upon them both in India and in England since the commencement of this year. The Excess Profits Duty for 1917 was to be on an 80 per cent. basis, as compared with 60 per cent. in the past two years. Their profits earned during the war had increased over those of the pre-war period solely because the large outlay of capital provided long before the war was dreamt of, had begun to bear fruit. Their profits were in no sense war profits; indeed, the war had affected them adversely, and the tax fell upon them with a severity which hardly appeared equitable. In respect of 1915 the duty claimed by the revenue authorities at 60 per cent. amounted to £21,661, but in respect of 1916 it would be considerably heavier. In India, too, a super-tax of 25 per cent. had been imposed, regarding which they found it difficult to obtain any accurate information, but which would certainly add to their burdens during the war. They had, however, obtained a concession from the Government, by way of relief in respect to the English taxation, the rate of tax payable being reduced by the rate paid in India. The directors were confronted with several conflicting considerations: a desire to continue their policy of reducing the consumers' costs; of giving the shareholders some reward for the venture they had successfully made; a doubt as to the stability of their position engendered by the Government action; and an uncertainty as to further requisitions that might be made on their resources on account of the war. They had, however, attained a position in other respects which strengthened them financially to a very considerable extent. Owing to the abnormal conditions of the money market they were not writing off anything this year against depreciation of investments. The want of additional plant had the effect of preventing their output from increasing, and their agent had been obliged to announce that they could not entertain proposals for new connections beyond the capacity of the existing plant. The increases of revenue which had been a marked feature of the past few years were not likely, therefore, to continue during the war period, at least, not to the same extent. Considering all the circumstances, however, they had decided that the best course was to continue their policy of reducing charges undeterred and unaffected by the side issues created by the agitation in Calcutta, but at the same time with due regard to the grave issues brought about by the war. They were, therefore, announcing a reduction in the flat rate of one-quarter of an Anna per unit as from July 1st. The cost of this would be between £12,000 and £14,000 per year in a full year of operation. This would very considerably benefit the smaller consumers and those whose consumption of fan units did not greatly exceed their light units; it was subject to the proviso that if the exigencies of the war imposed the necessity they might have to revert to a higher price. They were recommending an increase in the ordinary dividend by one-half per cent., costing £2,750. Instead of the staff bonus on profits they had granted a war bonus of 10 per cent. in salaries for the war and six months after. They had lost three consignments of stores (meters, bitumen, gutters, and covers, &c.) owing to sinking of steamers. New coal contracts had been arranged, one for three years and the other for two years, at slightly increased prices.

Kalgoorlie Electric Power and Lighting Corpn., Ltd. Mr. E. POPE presided at the annual meeting, on May 24th. He expressed regret that they had been unable to maintain the profit at the level of the previous year. The higher cost of stores and supplies of every kind had been a factor in the reduction of the profit, and another cause had been increased taxation, but the main cause had been shortage of labour, due partly to the large number of men who had joined the Colours, and partly to the action of the dominant Labour Party, who insisted on the internment of all technically enemy aliens. Many of the men were either Poles or Slavs, nominally Austrian subjects, but having no sympathy whatever with the Central Empires. This shortage of labour had interfered with the efficient working of the mines and, by reducing the output of ore, had lessened the demand for electric power. It had also caused a rise in the price of firewood, which they felt more this year than last. The new arrangement made with the trustee of the debenture holders meant that between now and the end of the year they had to find £3,600 for interest and £31,200 for repayment of principal, a total of £34,800. Next year they would require £2,100 for interest and £7,500 for repayment—a total of £9,600. With those payments to make in discharge of debt, they must not consider the directors unduly timid if they hesitated to pay the usual preference dividend next October. They would be delighted to pay it if they could safely do so, but they might have to postpone the payment until after the end of the year repayments to the debenture holders. They could not negotiate a new debenture issue to pay off the old in these days of stress and strain of war, so the money must be provided, if possible, out of profit. He ventured to hope that after the final repayment of the debenture debt there would be annually a sufficient margin of profit remaining, after the payment of the full 6 per cent. on the pref. shares, to reward the long-waiting holders of the ordinary shares with a reasonable dividend. Their stocks in hand and in transit increased, because it was prudent to hold larger stocks of supplies owing to transport difficulties. The financial position as shown by the investments improved considerably during the year. They had sold a stock of copper wire not immediately required, owing to its abnormally high price. They anticipated being able to meet all their end-of-the-year payments without serious difficulty. They had not been doing well during the first four months of 1917, but the result was rather better than for the same period of 1916. The general position of the mines on the Kalgoorlie gold fields was not as good as a year ago. If the war went on until this time next year, as seemed very likely, it would probably then be again worse, as there was still a tendency to a further labour deficiency and increased prices for supplies.

Stratford-on-Avon Electricity Co., Ltd.—Mr. W. H. JACKSON presided at the recent annual meeting. He said that the year had been a progressive one so far as the units sold were concerned, the increase being 8,238, but the lighting units showed a decrease of 13,000, and that had made a considerable difference in the receipts. Power units increased by 13,000, and heating by 8,000. The directors regretted that they could not recommend a dividend as they had had to put money to depreciation, as they did not do so last year. They must be prepared for heavy expenditure in the early future in respect of mains renewal and battery extension, but present prices were prohibitive. It was most unfortunate that the mains were giving so much trouble and anxiety, and he could not help saying that whoever supervised the work on them was responsible for their present condition.

Calcutta Tramways Co., Ltd.—The report for 1916 states that the revenue amounts to £119,681, plus balance brought forward £6,812. With the proposed final dividend, the distribution on the ordinary shares will be 9½ per cent. for the year, leaving £9,595 to carry forward. The reserve for depreciation, &c., at the commencement of the year stood at £81,481, after deducting therefrom £8,613 written off for renewals during the year and adding £20,000 proposed to be allocated thereto, the reserve will stand at £92,868. In addition to this, the directors have opened a separate reserve fund for depreciation of investments, to which they transfer £2,000.

Swansea Improvements & Tramways Co., Ltd.—The report for 1916 states that the revenue amounted to £72,312, an increase of £7,258. After deducting all expenses chargeable to revenue, the surplus was £13,571, plus £2,415 brought forward. The traffic receipts show a considerable increase compared with the previous year, but nearly the whole of the increase has been required to meet increased expenses. A dividend of 6 per cent. on the ordinary shares is to be paid, carrying forward £2,588.

Electro-Bleach & By-Products, Ltd.—The company announces that, although the audit has been completed, the directors are not yet able to present the balance sheet for 1916. The Ministry of Munitions, owing to great pressure of work, have not yet been able to adjust the duties payable by the company in respect of that year.—*Times.*

British Electric Traction Co., Ltd.—The directors have decided to place £15,000 to reserve, and to recommend a dividend of 3 per cent. on the ordinary stock the same as last year—carrying forward £97,593.—*Financial Times.*

United River Plate Telephone Co., Ltd.—Final dividend, 5 per cent. on the ordinary shares, making, with the interim dividend, 8 per cent. for 1916, free of income-tax, carrying forward £6,990.

Reduction of Capital.—*Creed & Co., Ltd., Croydon.* A petition has been presented for confirming the reduction of capital from £130,000 to £90,000.

Doulton & Co., Ltd.—After paying the preference dividend, the balance of £13,552 is to be carried forward.

STOCKS AND SHARES.

Tuesday Evening.

The war news of the Bank Holiday week-end produced nothing sufficiently exciting to move Stock Exchange prices on the return of members to their accustomed haunts. Discussion concerns itself with age-raising prospects. If men up to the half-century are to "go," can the Stock Exchange carry on? Lord Derby declared in the Stock Exchange itself that the House was a necessary part of the national machinery. But were the age limit advanced to 50, or even to 45, it is questioned whether the Stock Exchange business could continue.

The gorgeous weather helped to stimulate a little demand for Home Railway stocks. Undergrounds are better again, the Income bond being 1½ up at 82. Buyers have come in from provincial centres, and they seem prepared for the next coupon to be 4 per cent., the same as last, although in the market the hope is expressed that 5 per cent., to something more, may be paid. Metropolitan Consolidated is also a good spot, with a rise to 23¼. The efforts of a few mild speculators to snatch an occasional fiver from "Mets." make the motive power for these movements. The Surplus Lands stock has improved to 49. Considerable interest is taken in the suggestion that Capital and Labour should declare a truce for the rest of the war.

Recent events led to inquiry as to the price of Folkestone Electricity shares. Ordinary and 5 per cent. preference are both of the nominal value of £5, fully paid, and the quotations are 3¾-4 in each case. Business was last done at 3⅞ in the ordinary, and at 3 15/16 in the preference; this occurred in February and March respectively. Seven per cent. was paid on the ordinary last year. There is also a 4½ per cent. debenture stock, quoted at 80, as against 94 on the outbreak of war; interest is payable in February and August. The market in the three classes of capital has always been largely local.

Amongst other provincial companies, Bournemouth and Poole ordinary stand at 8¼, the 4½ per cent. preference at 7½, and the 6 per cent. second preference at 9¾. Oxfords are 4¼ and 4¾ for ordinary and preference respectively. Newcastle-on-Tyne ordinary £1 shares are 18s. 9d., and the 5 per cent. preference 17s. 6d. Urban ordinary have stuck for several weeks at 3s. 6d., and the 5 per cent. preference changed hands early in May at 37s. 6d.

The list of London shares is quiet, but prices keep up with noticeable strength. City ordinary shares are difficult to buy under 12. County ordinary remain firm at 10½. Chelseas have been dealt in at 52s. 6d. and 53s. 9d.; Charing Cross at 3½. There is a little going on in Brush ordinary on the basis of 25, but the debenture stocks are hardly mentioned. Metropolitan ordinary are wanted at a trifle over 50s.

The telegraph market is characterised by its usual strength. Anglo-American preferred is ½ up, Eastern Extensions rose ⅛, Eastern Telegraph ordinary gained a point, and Great Northerns, at 36½ ex dividend, have recovered part of the amount deducted. Oriental Telephones are firmer, but Marconis are attracting less attention again, although the price keeps very firm at 58s. 9d., Americans being 16s. 6d.

Brazilian Tractions, following their recent erratic course, have lost a point; and British Columbia Electric Railway stocks are still very flat, the 4½ per cent. debenture going back 4 points to 60. The preferred shares are 5 points down at 37½, and the fear of competition is debited as being the reason for the pressure to sell which has caused such heavy declines in the price. The Argentine group is steady, and interest has again died out in Mexican shares and bonds.

British Westinghouse preference gained another 1/16 as the direct result of the recent meeting at which the scheme for reorganising the capital, and for bringing control of the company on this side of the Atlantic, was agreed to. Edison Swan are lower at 10s.; and amongst other low-priced issues, Cordobas have fallen 9d. to 4s. Babcock & Wilcox are up ⅛ to 3 1/16, following the trend of iron and steel shares as a whole. Prices in this section have been mounting daily, and armament shares participated in the strength of the market. The rubber group is hard; and the fact that, on pay-day this week, dividends were deducted from shares in the cases of 55 different rubber companies, advertised the attraction of rubber share for speculative-investment purposes.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend		Price		
	1915.	1916.	May 29, 1917.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	9	6½	—	£6 18 6
Charing Cross Ordinary ..	5	5	3½	—	7 2 10
do. do. do. 4½ Pref..	4½	4½	3¼	—	6 18 6
Chelsea	4	3	2⅞	—	5 4 4
City of London	8	8	11¾	—	6 16 2
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10⅝	+ ⅛	6 11 9
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	7	10	5¼	—	5 11 7
London Electric	3	8	1	—	Nil
do. do. 6 per cent. Pref.	6	4	3¾	—	5 6 8
Metropolitan	8	8	2⅛	—	6 0 0
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 4 0
St. James' and Pall Mall ..	8	8	6¼	—	6 8 0
South London	5	5	2¾	—	7 5 6
South Metropolitan Pref. ..	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	5¾	+ ⅛	6 1 9
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	97½	+ ½	6 3 1
do. Def.	33/6	1½	22½	—	6 13 4
Chile Telephone	8	8	6 5/16	—	5 15 4
Cuba Sub. Ord.	5	5	8	—	6 5 0
Eastern Extension	8	8	13⅝	+ ⅛	*5 17 6
Eastern Tel. Ord.	8	8	139	+1	*5 15 1
Globe Tel. and T. Ord.	7	7	12½	—	*5 12 0
do. Pref. ..	6	6	10⅛	—	5 18 5
Great Northern Tel.	22	22	36½ xd	+ ¼	6 0 7
Indo-European	13	13	49½	—	6 11 4
Marconi	10	10	2 15/16	—	8 8 0
New York Tel. 4½	4½	4½	99	—	4 11 0
Oriental Telephone Ord. ..	10	10	2 3/16	+ 1/16	4 11 6
United R. Plate Tel.	8	8	6⅝	—	*6 0 9
West India and Pan.	6d.	6d.	1⅛	—	2 4 5
Western Telegraph	8	8	14	—	*5 14 4
Home Rails.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	23¼	+ ½	4 6 0
do. District	Nil	Nil	16	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A" ..	Nil	Nil	6/6	+6d.	Nil
do. do. Income	6	5	82	+1½	*6 2 0
Foreign Trams, &c.					
	1914.	1915.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	3 1/16	—	8 19 6
do. 2nd Pref. ..	5½	5½	2⅜	—	—
do. 5 Deb. ..	5	5	69	—	7 5 0
Brazil Tractions	4	4	47	— 1	Nil
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	60	—	8 6 8
do. do. Preferred	—	Nil	37½	— 5	Nil
do. do. Deferred	—	Nil	32½	— 2	Nil
do. do. Deb.	4½	4½	60	— 4	7 1 8
Mexico Trams 5 per cent. Bonds	—	Nil	40	—	Nil
do. 6 per cent. Bonds	—	Nil	30	—	Nil
Mexican Light Common ..	Nil	Nil	14½	—	Nil
do. Pref.	Nil	Nil	22½	—	Nil
do. 1st Bonds ..	Nil	Nil	37½	—	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	3 1/16	+ ⅛	4 18 0
British Aluminium Ord. ..	5	7	26/9	—	7 7 10
British Insulated Ord.	15	17½	12½	—	7 0 0
British Westinghouse Pref. ..	7½	7½	2 7/16	+ 1/16	6 3 0
Callenders	15	20	13⅝	—	7 6 10
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	8 7/16	—	6 18 0
Edison & Swan, £3 paid ..	Nil	—	½	— 1/16	Nil
do. do. fully paid ..	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	70½	—	5 13 6
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9¾	—	6 3 1
do. Ord.	10	10	15	—	6 18 4
Henley	20	25	15½	—	8 1 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India Rubber	10	10	11⅞	—	*8 8 4
Telegraph Con	20	20	87	—	*6 9 10

* Dividends paid free of income-tax.

STATIC SUB-STATIONS.

[COMMUNICATED.]

Because the static sub-station is a simple and reliable part of a distributing system, it has been at times sadly neglected and its purposes misinterpreted and abused. It is distinguished from the rotary sub-station by reason of the fact that it often gets much less attention than it really requires, whereas in a rotary sub-station it is necessary at all times to have some responsible person in attendance. A visit once a week is as much as many of the most self-respecting static sub-stations usually get, while many are not visited or inspected for weeks on end, for although some distribution systems have specially-appointed sub-station attendants, whose sole duty it is to keep clean and in thorough working order the sub-stations entrusted to their care, on others, the work is delegated to the jointers as a spare-time job, with the result that whereas those most handy receive a fair amount of attention, those more remote are hardly ever inspected.

This latter system is undoubtedly bad, but even where attendants are specially employed, the right sort of man is, in many instances, not secured. The writer has met several who had absolutely no idea of what was happening inside the transformers beyond the fact that, say, 3,000 volts "went in" on one side, and only 200 "came out" on the other. He was once asked by an attendant what happened to the 2,800 volts. Another attendant was surprised to learn that his transformer was immersed in oil.

These may be exceptional cases—the writer hopes that they are; but the fact remains that there are such, and that it is impossible for them to do justice to their jobs or to themselves.

A proper and complete system of records should be adopted for all sub-stations. It is not sufficient to have a register showing the location of them and the number of transformers installed. What is required is a full knowledge of the amount of work each transformer is doing. The central station is well provided with instruments to measure the output and to ensure that machines are not overloaded, while numerous sub-stations are absolutely devoid of instruments, and the mains engineer will measure the output of a sub or a transformer by the rise in temperature. It is true that he has ammeters on his feeders at the central station, but there may be three or four sub-stations to one feeder, and the knowledge thus obtained is therefore not of very great value. The best means of measuring the loads on sub-stations or transformers is by ammeters, preferably recording, on the secondary side. As the majority of sub-stations are visited only during the day-time, readings obtained on ammeters other than of the recording type are apt to be very misleading, for although in some industrial centres the day load may equal, or even exceed, the night load, generally speaking, it is the night load which determines the transformer capacity necessary.

Integrating watt-hour meters are also a real necessity on the L.T. side of transformers, yet they are rarely employed throughout a system.

As in many other matters electrical, there has in the past been very little standardisation in sub-station practice. Not only is this noticeable in the construction of different sub-stations, but even the number of sub-stations required for the best distribution appears to be a very arbitrary matter. Of course, this must necessarily depend, to a very large extent, on the area covered by the supply and the special requirements of the district, but the lay-out of a system must not be determined solely on these two points. Other matters, such as capital cost and running expenses, are quite as important, but in exactly the same way as it is wrong to be guided entirely by the first two points, so is it an error of judgment to pay too much attention to the latter. A happy medium must be struck, so that the supply may be made as perfect as possible, but, at the same time, as cheaply as possible.

In comparing various systems that the writer has come into contact with, he has been struck by the differences in the numbers of sub-stations employed. For the purpose of this article, it is proposed to compare two. The areas covered and the number of units supplied are practically the same, although one district is slightly more industrial, while the other is more residential. There is consequently a margin of difference in the numbers of consumers and in the load factors of the two supplies, and there is a very great difference in the number of sub-stations in the two cases, for the former, with less consumers, uses more than three times the number of sub-stations employed by the latter.

This is largely accounted for by the fact that in numerous instances in the industrial district, sub-stations have been erected on the factory premises, and serve that factory alone. Now, it is thoroughly expedient, where possible, to persuade the consumer to build the sub-station at his expense, or to set apart some portion of his buildings for this purpose, but the thing can be pushed too far. From the point of view of capital cost, it may, under such conditions, pay to make a new sub-station; but when it comes to the question of running costs, a different tale is to be told. A glance at the following figures will show the relative costs of running two sub-stations, the first being used for a group of consumers, and the second for one consumer only. While the writer does not claim that these figures have been actually obtained by measurement, he knows of cases where the conditions assumed are generally satisfied.

In the first case, he has taken a 50-KW. transformer on a load factor of 25 per cent.—a very fair figure; while in the second case, a 30-KW. transformer is installed on private premises, and supplies a demand of 10 KW. for 10 hours a day, remaining practically idle for the rest of the 24 hours.

The magnetising loss in the first case would be, roughly, 6,000 units per annum, and the output about 100,000 units per annum. In the second case, the magnetising loss would be about 5,000 units and the output about 35,000 units per annum. Copper losses have not been taken into account, because they are dependent upon the load taken, and would not be largely affected by the number of transformers used.

The figures show that the percentage of magnetising units compared with the output is, in the first case, 6, and in the second instance 14. Now the difference between the two outputs, 65,000 units per annum, would require two other transformers under the same conditions as taken in the second case, which would mean another 10,000 units a year wasted in magnetising current.

It is clear, therefore, that the system which employs an excessive number of sub-stations is not efficient, because of the huge magnetising losses. Yet the writer knows of a system that boasts 70 sub-stations for an annual output of less than 5,000,000 units. Taking an average of two transformers per sub-station, this would mean an annual magnetising loss of about 750,000 units, or about one-seventh of the output. To this must be added the copper losses of the system, so that, roughly, one million units are wasted annually, or a fifth of the whole output.

For an output of 5,000,000 units a year, about 30 sub-stations should be ample, and, in the second case quoted above, an even less number was used, and the units "unaccounted for" were in the region of 400,000.

The saving is apparent, for even at generating cost these lost units mean a considerable cash value. There is, again, a great difference in the management and lay-out of these two systems. The 70 sub-stations are left to the uncertain care of the jointers, and the writer has seen some of them in a far from pleasing condition. So little attention has been given some of them that a considerable depth of water has been known to accumulate over the floor of one of them at least. In another instance, one of the H.T. fuses was not making contact, having been shaken loose by vibration, perhaps some weeks before it was discovered. The load on this sub-station was, therefore, thrown on to others linked with it, and the margin of "safety" was so great that no indication was given that this fuse was loose.

On the other hand, the system with the smaller number of sub-stations employs two men permanently to look after the transformers, switchgear, fuses, &c.

There is, however, a point in favour of this latter system which has been, on certain occasions, of as much importance as the regular periodic inspection of the sub-stations. There is probably no central station of importance in this country that has no peak load during the evening, and it is perhaps during these hours that the majority of calls for assistance from the consumers are received. This is to be expected, for it is during the evening that the greatest number of consumers are using current.

In most places, there is a distinct centre to the town, where are concentrated all the most important shops. It is particularly advisable to have someone very handy to these shops in case of emergency, because a failure of supply during their busy hours may mean a great deal to them. The central station is rarely erected in the centre of the town, and if in case of a breakdown, either in a single shop or in a whole street, a man has to be dispatched from the works, or a jointer called out from his home, an annoying delay is the inevitable result.

It is much wiser to keep a man on the spot, and this special emergency man can well be one of the sub-station attendants. This system is actually adopted in the second of the cases we are comparing, and it is certain that much satisfaction has been given to unfortunate consumers by the prompt attention and assistance they have received when in difficulties.

All the gain, however, is not with the consumer, because the engineer responsible for the lay-out of the system was wise enough to realise beforehand the needs of the central portion of his town. The quantity of electricity used in the shopping centre of a town during the day is very small compared with the quantity consumed during the evening. It is, therefore, good practice to take out several transformers during the day time, and use them only as the load comes on.

A large sub-station in telephonic communication with the works has therefore been erected in the middle of the shopping area, and it is here that the attendant on emergency shift waits for a call. In addition, however, he has to watch his ammeters, make a record of the load at regular intervals, and switch in other transformers as they are required, and take them out again as the load goes off.

This effects a considerable saving in magnetising units, and quite probably the wages of the two attendants are entirely paid by this one economy. The same thing can, of course, be done automatically, but, on the whole, the writer is of the opinion that the man on the spot is of more value than an automatic relay.

The town with 70 sub-stations has no large sub-station in the centre of the town which is regulated either by an attendant or automatically, neither does a man stand-by at night in case of breakdown. Compared with the second town, therefore, it is at a serious disadvantage. The present is a time when the minimum of labour should be employed, but the remarks in this article refer generally to pre-war days, and will apply equally to the good time which is to come after the war.

There are several other points which the writer had hoped to discuss, but these, chiefly on the design and equipment of static sub-stations, must be reserved till another time.

It goes without saying that all sub-stations on a system should be interlinked, as then no serious interruption of supply takes place, even if a transformer or a sub-station is temporarily out of use.

It may yet happen that some standard may be set in sub-station practice not only as regards numbers and management, but also in construction, so that an engineer can ring up a firm, and within a very short time have the whole equipment in one of his sub-stations changed for new by the simple process of taking off a few nuts and fixing up the new standard switchgear, &c., just as he would fit new brushes to a motor.

U.S. Farm Electrification.—The Washington Water Power Co., of Spokane, Washington, has closed a contract with the owner of a 10,000-acre farm west of Sprague, Washington, to install complete electric equipment for all purposes on the farm. This will include three 15-H.P. motors to run the pumps for the irrigation project, a 10-H.P. motor for the chop mill, a smaller motor for a wood saw, and a portable motor for general purposes. All of the farmhouses, bunkhouses, barns, feeding sheds and feed cellars are to be electrically lighted. The equipment will be the largest and most complete on any farm in the Northwest.

THE FARADAY SOCIETY.

General Discussion on "Osmotic Pressure."

As an interesting change from the consideration of subjects of direct technical interest, the Faraday Society, at their May meeting, discussed some of the fascinating problems connected with the far-reaching subject of solution. On this occasion, the president, **Sir Robert Hadfield**, F.R.S., having contented himself by suggesting that "there's nothing like steel," and that even osmotic pressure might justify its existence if it succeeded in explaining the wonderful properties of carbon in iron, invited **Sir Oliver Lodge**, F.R.S., a distinguished exponent of this branch of chemical physics, to preside over the discussion. The choice was a happy one, for Sir Oliver has a wonderful gift for seeing rock-bottom where physical phenomena are concerned, and his penetrating comments and lucid interpretations were by no means the least interesting features of a very enjoyable and illuminating discussion.

Those whose physical chemistry is rusty, may be reminded that osmotic pressure is the pressure—real or supposed, and perhaps even negative exercised by a substance in solution, say when sugar is dissolved in water. This pressure, or quasi-pressure, cannot be observed quite directly, but its effect is made most obviously visible by separating a solution from the pure solvent by a semi-permeable membrane, which, to keep to one illustration, will allow the water to pass through, but not the sugar. One can prevent the water from passing into the sugar through the membrane by exerting a back-pressure in the solution.

Prof. **Alfred W. Porter**, F.R.S., who opened the debate, defined osmotic pressure as the equilibrium difference of pressure between a solution and the pure solvent when separated by a membrane permeable to the solvent alone. That is the direct method of defining and measuring osmotic pressure, and it has been experimentally utilised in America by Morse and others, and in England by the Earl of Berkeley, F.R.S., who took part in the discussion. Osmotic pressure can also be measured indirectly, since it can be shown by means of thermodynamic reasoning to be connected with the lowering of the vapour pressure of a liquid when a solid substance is dissolved in it. The fundamental fact about osmotic pressure, however measured, is that in dilute solutions it exactly obeys the ordinary gas law, $pv = \mathrm{RT}$. This strange fact led van't Hoff, many years ago, to put forward the famous theory of solution which would make the process purely physical, or anyhow kinetic. The osmotic pressure is caused by the solute in its effect to diffuse and expand, just as a gas expands and fills a room, and it is completely analogous in origin to the pressure of a gas in a closed vessel.

Just as the gas law needs modification for gases under high pressure or low temperature, so does the osmotic pressure relationship; but this fact, maintains Prof. Porter, no more militates against the truth of the kinetic theory, than it does in the corresponding case of gas. He has suggested a modified formula, $p(v - b) = \mathrm{RT}$, to fit the whole range of measurements, where b is a function (not quite constant) of the volume of sugar present, and from the variations in which the degree of hydration of the sugar can be calculated. Investigation of the Brownian movements (the strange, erratic motions of colloidal particles in suspension made visible in the ultra-microscope) prove that translatory molecular movements do actually occur in a liquid, and Prof. Porter maintains that the *causa causans* of the whole phenomenon of osmotic pressure is the molecular bombardment of the solute. A knowledge of this indicates the only way in which the value of the pressure has been calculated from any direct theory of the mechanics of the solution. The dissolved substance is everything that matters, as Sir Oliver neatly put it.

The next speaker, **Dr. F. Tinker**, of the University of Birmingham, maintained, on the other hand, that the membrane is everything that matters, that the phenomenon has no meaning apart from what happens at the membrane, and that it is in the selective action of this where one is to look for the physical explanation desired. On this view, even the allied phenomenon of lowering of vapour pressure in a solution is one which takes place at a semi-permeable membrane, for such is the free surface of a solution which allows the solvent to pass across it, but not the non-volatile solute. Similar in character to, but not identical with this, is the process of osmotic diffusion, according to Dr. Tinker's conception, and osmotic flow takes place because the pure solvent induces a greater pressure of concentration of moisture inside the membrane than the solution does. Why this should be the case is not at present clear, and various causes for it have been suggested, such as selective absorption on the part of the colloidal membrane, or surface tension, or selective chemical affinity and the formation of loose chemical combinations, or catalysis. The cynic may be forgiven if he regards many of these explanations as allotropic forms of "ignoramus."

Neither of the above theories satisfied **Mr. W. R. Bousfield**, K.C., F.R.S., who put forward the claims of yet another theory of oosmtic pressure. The former was unsatisfactory, because it left out of account the activity of the solvent; the second, because what took place at the membrane was really irrelevant, and not essential to osmotic phenomena. Mr. Bousfield takes into account the molecular constitution of water, which, according to the now generally-accepted opinion, is a ternary mixture of monohydrol or steam molecules (H_2O), dihydrol molecules $(H_2O)_2$, and trihydrol or ice molecules $(H_2O)_3$. The relative amounts of the three constituents depend on the temperature; near the freezing point there are many ice and few steam, near boiling point there are many steam and few ice molecules. Mr. Bousfield showed that the osmotic relationships can be deduced on the hypothesis that the steam molecules behave as a perfect gas in the interstices of the solution—a not entirely acceptable assumption. Not in the expansive force of the solute molecules, but in the active energy of the steam molecules is to be sought the origin of osmotic pressure, and these are to be visualised as darting into the regions of less vapour pressure and pushing aside the more inert solute molecules, whose function is thus not to increase the activity of the solution, but to decrease it by destroying some of the steam molecules on which vapour pressure depends.

A somewhat similar theory, but based on the known association between solute and solvent, was put forward in the course of discussion. This regards osmotic pressure as the diminution in that portion of the internal pressure in a liquid due to the heat movements of its molecules, caused by the loading of the solvent molecules by the solute. This loading or association explains at once the lowering of vapour pressure produced in solution, and it indicates clearly why there should be a difference of pressure on the two sides of a semi-permeable membrane, and why the pure solvent should flow through as it does into the solution.

Finally must be alluded to the conception apparently favoured by Sir Oliver Lodge. In the interior of every liquid is an intrinsic pressure due to the mutual attractions of its molecules—a pressure of enormous magnitude. It is the diminution in this pressure from the direction outwards near the surface of a liquid which is held to account for surface tension. This pressure will be increased, thinks Sir Oliver, when sugar is dissolved in water, and it is this increase in pressure which is the osmotic pressure.

It cannot be said that the meeting came to a final decision as between the rival theories, but it cannot fail to be of value for the advocates to have met and stated their views and criticisms fairly and directly in each other's presence. This is the value of such discussions, and we must anticipate as a result of the present one not only a clearing of our notions as to what solution means, and few subjects are of more fundamental importance to the physicist and chemist, but also a starting point for newer investigations and the discovery of fresh truths.

WAYLEAVES.

We have received from Mr. C. Vernier an advance copy of his further reply to the discussion in London on his paper read before the Institution of Electrical Engineers, which we reproduce below:—

I regret that Mr. Chamen's valuable communication, which gives the proposals of the Joint Committee of the Incorporated Association of Electric Power Companies and the Incorporated Municipal Electrical Association, only reached me after I had completed my reply in the May number of the *Journal*. The importance of these proposals merits special consideration in that they are the considered conclusions of a committee whose competence is indubitable. I think it is only right, however, that I should call attention to some of the limitations of these proposals, limitations which I am confident the Committee themselves would be the first to acknowledge, and which I think must be attributed, in the words of Mr. Chamen, to "such powers as it is reasonable to expect that Parliament will give," to which I would add, "under a private Bill." Briefly, these proposals may be summarised as follows:—

(1) The undertakers may apply to the Board of Trade for a certificate of the public utility of a main.

(2) On receipt of such an application, the Board of Trade will notify the landowners and invite them to forward their observations within one month.

(3) The Board of Trade may thereafter decide to issue or withhold a certificate of public utility, either with or without a local inquiry.

(4) The amount of the compensation and all other questions arising in respect of the lines, unless mutually agreed between the parties, shall be fixed by a single arbitrator appointed by the Board of Trade. This same arbitrator shall sit continuously.

The first three of these proposals are closely in agreement with the views I have given in the paper and in my reply to the discussion. The fourth is also on the lines of one of my proposals put forward for discussion. In this case, however, I made certain stipulations adopted from recent Acts, such as the Housing and Town Planning Act, 1909, designed to reduce the costs of arbitrations. Unless the cost of arbitrations is minimised, the powers contained in the Committee's clause can seldom or never be exercised to limit exorbitant rents, but will only be useful in the most obstinate cases of a complete refusal to allow the grant of a wayleave. An ordinary Board of Trade arbitration is by no means an inexpensive method of settling disputes, and taking into account the costs of the arbitration and legal expenses in connection therewith, the outlay will seldom be less than £50, and may easily run into three figures.*

To this must possibly be added the cost of a Board of Trade inquiry before a certificate of public utility is granted, which would have to be borne by the undertakers.

As I mentioned in my reply, on account of the number of landowners commonly encountered on a route, the amount of wayleave rent involved in any particular case is often under £10, and seldom exceeds £20 per annum, which means that recourse to arbitration will usually absorb the utmost possible saving on rentals for many years. This would not, perhaps, be serious if awards in such arbitrations were accepted as a precedent in the fixing of rents by other landowners, which by no means follows, but it is really only in this way, and also through the moral effect of a Board of Trade certificate of the "public utility" of the proposed main, that undertakers could expect any relief from exorbitant rent charges under the proposed Bill.

I would here make the suggestion that if arbitration is the method adopted, all landowners, tenants, and occupiers on the route of a main declared by the Board of Trade to be of public utility, and desirous of having the question of compensation determined by arbitration, should be convened at one and the same hearing of the arbitration in order to reduce expenses. I assume, of course, that the arbitrator would have in his discretion the awarding of the expenses of the arbitration.* This is very important, as unless the arbitrator can exercise discretion in the award of costs, landowners who wished to secure exorbitant rents might refuse to quote reasonable terms, so as to compel the undertakers to go to arbitration, knowing full well that the terms they demand are not less good than the terms the undertaker would be likely to secure in an arbitration, plus the expenses and trouble of the arbitration.

Further, it is suggested that the same Board of Trade arbitrator sitting continuously shall hear and determine "all" questions arising in respect of the line or lines authorised by any certificate of the Board of Trade.

As the questions which an arbitrator will be called upon to decide will be chiefly compensation questions, the arbitrator should be an expert practical surveyor, preferably not in private practice. Engineering questions should be excluded from all matters of reference to the arbitrator, and should be decided on an appeal by the Board of Trade.

I received an impression during the discussion that the effect of an arbitration was not always clearly understood, as some speakers seemed to infer that because it is proposed that the Board of Trade should appoint the arbitrator, the settlement of the dispute is in their hands. This is not the case, as the Board of Trade merely appoint the arbitrator, but have no authority to vary his award. Moreover, where in an Act it is directed that a question is to be determined by arbitration, the matter is outside the jurisdiction of a court, which can only interfere to set aside the award in the event of misconduct by the arbitrator, or where an arbitration or an award has been improperly procured.†

The suggestion that all questions in respect of a line should be determined by a single arbitrator sitting continuously must, therefore, be considered from the point of view that as no provision has been made in the draft clause for an appeal to some judicial body, *e.g.*, the Railway Commissioners, the various awards of the arbitrator must be accepted in all cases as final and binding upon the parties.‡

It further presupposes that the awards given by the arbitrator will generally be in a sense favourable or acceptable to the undertakers, but if this should not turn out to be the case the promoters having deliberately secured by their Act—assuming this is granted—that matters in dispute must be determined by the same arbitrator sitting continuously, and having made no provision for an appeal, there is no appeal from his decisions unless these are *ultra vires* or improperly secured, and the undertakers cannot call for his removal except on the ground of misconduct. For my part, I do not consider this at all satisfactory, and I suggest that this matter requires further consideration and amendment by inserting a right of appeal to the Railway Commissioners.

The least satisfactory feature of these proposals is the absence of any provisions designed to limit the total time which must elapse between the date when the undertakers make an application and that when the work can actually be commenced.

This period will, even in the most favourable of cases, be made up as follows:—

(*a*) Time for the Board of Trade to consider the application and notify landowners.

(*b*) One month allowed to the landowners to reply and make their observations.

(*c*) Time taken up by the Board of Trade in considering these replies and deciding whether to issue a certificate or hold a public inquiry.

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* In two cases of Board of Trade arbitrations within my experience, which were of the simplest character, not occupying the arbitrator's attention for more than one hour, the total costs amounted to close upon £50.

* Arbitration Act, 1889, Section 11. Board of Trade arbitrations are regulated by the directions in a special Act (*e.g.*, Section 28, Electric Lighting Act, 1882, and by the Board of Trade Arbitration, &c., Act, 1874. Further, the Arbitration Act, 1889, regulates all arbitrations in so far as the directions in that Act are not inconsistent with the provisions of any special Acts governing the arbitration on the matters in dispute (Arbitration Act, 1889, Section 24).

† Electric Lighting Act, 1882, Section 28.

‡ Arbitration Act, 1889 (First Schedule, par. *7*.)

(*d*) Time taken up by a local inquiry (if any).

(*e*) Time taken by the Board of Trade to consider their official's report of the local inquiry (if any) and to issue the certificate of public utility.

(*f*) Time taken up by the arbitrator in holding the arbitration proceedings and considering and making his award.

Of these periods only two have any limit placed upon them, viz., (*b*) and (*f*). The latter is restricted in any case by the provisions of the Arbitration Act, 1889, to three months.*

These two periods may therefore together extend to as much as four months.

This last period could be very satisfactorily reduced if powers were granted, as advocated in the paper, to enter upon and use the land before compensation is fixed, as provided in Section 85 of the Lands Clauses Consolidation Act, 1845, for with such powers the time taken up by the arbitration proceedings and the issue of the award could in urgent cases be practically eliminated.

This leaves the time which the Board of Trade would require to carry out the various stages of the procedure outlined in paragraphs (*a*), (*c*), (*d*), and (*e*).

Lest I be thought guilty of exaggeration, I have looked up the time taken by the Board of Trade in signifying their consent in some recent cases to the erection of E.H.T. overhead lines. This approval, as is well known, is of plans of the route, and a description and design of the line. The latter are in many cases replicas of designs previously approved. In four cases, previous to the war, the shortest time was 10 weeks, and the longest 13 weeks, and since the war, the shortest time was nine weeks, and the longest 13½ weeks, except in two special cases of munitions lines, where the period did not exceed three weeks. In all cases, except the last two, approximately one month of the time is taken up in advertising the scheme in the public Press on behalf of the Board of Trade, at weekly intervals for two consecutive weeks, inviting observations from the public during a period not exceeding 21 days.

From my own experience, I estimate that this could not be laid down at much less than eight weeks for each stage, or, say, between four and six months in all, provided no local inquiry is held, to which must be added certainly one month for the landowner's reply, and possibly not less than three months for arbitration, if compulsory powers for entry are not provided.

The total time absorbed in an ordinary straightforward case in securing expropriation is, therefore, not likely to be less than eight months, and may easily run into a year and more.

From these considerations, I conclude that, as in the case of the limitation of exorbitant rents, the powers proposed to be conferred by this Bill can never be exercised except in the most obstinate cases of the refusal of a wayleave, where no alternative for a diversion, even at a greatly increased cost, presents itself.

Mr. Chamen thinks that in the large majority of cases, the bare facts of the existence of these powers would be sufficient to cause the property owners to make reasonable agreements. I agree that this possibility is not to be under-rated, but only after a certificate of public utility has been issued.

We must, further, not overlook the fact that with compulsory powers new factors are introduced into the situation. There are, for instance, property owners who can be led into an agreement, but will not negotiate under the shadow of compulsion, others who will refuse to discuss a wayleave for a main unless the applicant can produce a certificate of its public utility, and yet others who will refuse to discuss or name terms for compensation, but would elect to have the terms settled by arbitration. It is not sufficient, therefore, to rely upon the moral influence of these powers unless these are backed by effective legal machinery.

I do not believe that the electrical industry will ever secure those facilities under a private Bill to which it is justly entitled, and in a matter so vitally essential to the economic life of the nation it is the duty of the Government to initiate and carry through legislation which will remove present obstacles and difficulties.

The prospect opened up by the recent appointment of a Board of Trade Departmental Committee offers an opportunity for a much bolder policy which should be pressed unflinchingly. As, moreover, the electrical industry cannot reasonably expect to secure greater facilities from Parliament than it considers essential to its best and freest development, our claims to this Committee should not be vitiated by any thoughts of pre-war prejudices or fettered by any such considerations as hampering precedents. I am here referring not merely to the question of compulsory wayleaves, but also to the larger questions referred to this Committee, with which the subject of this discussion is so intimately bound up.

In the words of the Prime Minister, addressing a Labour deputation, a week or two ago:—

The war presented an opportunity for the reconstruction of the industrial and economic conditions of the country such as had never been presented in the life of probably the world. There was no time to lose, and he believed that the after-the-war settlement was the settlement that would direct the destinies of all classes for generations to come.

"I am not afraid of the audacity of your proposals. I believe the settlement after the war will succeed in proportion to its audacity. The readier we are to cut away from the past, the better are we likely to succeed. I hope that every class will not be hankering back to pre-war conditions. Think out new ways. Think out even new ways of dealing with old problems. Don't always be thinking of getting back to where you were before the war. Get a really new world."

I think it would be well if I recapitulated the several points which I would consider essential to a really useful practical scheme for compulsory wayleaves:—

(*a*) That a certificate of the public utility of a proposed main be granted or, alternatively, an order for the compulsory acquisition of easements be issued by the Board of Trade on the application of statutory undertakers in suitable cases.

(*b*) The total time allowed from the date of application to the issuing of a certificate or of an order not to exceed three months.

(*c*) Compulsory powers to be allowed for entry upon the land in urgent cases before the determination of the compensation.

(*d*) The method adopted for the fixing of compensation to be in the first instance of the cheapest and most readily accessible description, supplemented by a right of appeal to some judicial body. The determination of all technical questions to be in the hands of the Board of Trade.

(*e*) The terms of tenure to be in perpetuity (or for at least 50 years), subject to the landowner's right to the reasonable use and development of his land, and for this purpose to require the removal or diversion of a main on giving sufficient notice at the cost of the undertakers. A right of appeal to the Board of Trade to be allowed in case of dispute. The wayleave rents to be subject to revision at periodical intervals, as this is essential if the terms of tenure are to be in perpetuity, or for a long term of years.

(*f*) Wayleave rents to bear some relation to the rentals which are received by the owner for the ordinary use of his land.

(*g*) Compensation to be given, and apportioned equitably by the tribunal duly appointed to all beneficially interested in the land.

(*h*) All persons beneficially interested in the land on a given route, in the event of disagreement, to be convened at one and the same proceedings for the determination of the compensation if this is an arbitration or an appeal.

(*i*) Damages occasioned in the execution of the work to be settled separately from the amount of compensation for the wayleave.

(*j*) Compulsory powers to be granted for the cutting and trimming of trees.

(*k*) Special provisions to be made for the grant of a compulsory wayleave in the case of owners who either cannot be found or are absent from the country, as in the Lands Clauses Consolidation Act, 1845.

The second part of Mr. Chamen's communication deals with the abolition of the local authority's power of absolute veto on the question of the erection of overhead wires. The suggested clause, except in one respect, could not be improved upon, and should finally remove all doubts as to the power of a local authority to prevent and obstruct the development of overhead transmission and distribution lines mainly on private property.

There should, however, be some limit to the time allowed to the Board of Trade for a decision as to whether the consent of a local authority is being unreasonably withheld, which, I suggest, in such a simple matter, should not exceed two months, and preferably only one month. I have given an example in my reply to Mr. Welbourn where the time which elapsed in one such case was five months, and this is not greater than I would expect in ordinary cases if there is no limit placed upon it by law.

ECONOMIES IN LIGHTING IN RELATION TO FUEL SAVING.

At the annual meeting of the Illuminating Engineering Society, when the new President, Mr. A. P. Trotter, took the chair, a discussion upon the above subject took place.

Mr. L. Gaster, who opened the discussion, said that the first point to consider was the extent of the economy in fuel that could, in any circumstances, be expected to result from restriction in lighting. The actual output of coal last year was 30 million tons less than that of the last year before the war. The actual amount of coal used for lighting purposes was difficult to arrive at, but, in giving evidence before the Committee on the Summer-Time Act, Mr. H. Faraday Proctor stated that the total units generated for both light and power was about 2,000 millions, of which 23 per cent. was estimated to be used for lighting. Assuming 4½ lb. of coal per unit sold, this would be equivalent to about one million tons of coal used for the lighting load. From figures put forward by the managing director of the Sheffield Gas Co., it might be assumed that the total consumption of coal for lighting by both gas and electricity supply authorities was well within six million tons, or only 2½ per cent. of the total coal output of the country. When it was recalled that a very considerable portion of this was used for indispensable purposes, *e.g.*, in munition and other factories, it would be seen that we must not form too extravagant a conception of the possible economies in the lighting field. This impression was confirmed by a study of the saving estimated to be made during the operation of the Summer-Time Act for four and a half months in 1916. According to the report of the Committee, the combined saving on the part of the gas and electricity supply authorities was about 320,000 tons. It would clearly be folly to aim at an undue diminution in munition and other factories or in the streets. In the latter case, especially, any fuel saving accomplished would be of small value in proportion to the risk to safety and the public inconvenience so caused. At the same time, whilst the recent alteration in street lighting in the Metropolitan area had been a great improvement, there was probably still opportunity for inquiry in connection with the screening devices sometimes adopted. He therefore suggested as a preliminary to any restriction of lighting with a view to fuel economy the division of illumination into four main categories:—

---

* First Schedule (par. C).

(1) Safety, as regards prevention of accidents.

(2) Lighting for indispensable purposes, such as munition works, &c.

(3) Lighting for public convenience.

(4) Luxury and spectacular lighting.

The first two divisions of lighting clearly ought not to be interfered with except in cases where it could be clearly and indisputably shown that the light was excessive or wrongly applied for the purpose in view. Division (3) would only be touched in case of grave necessity, whilst division (4) would be the first to which further restrictions would be applied. Even before the war it was pointed out that the exhibition of large numbers of lamps, or very powerful lamps of undue brilliancy, outside shops and places of entertainment was a bad policy; by a little ingenuity it should surely be possible to attract the public attention without this species of glare. Similarly, in shop window and restaurant lighting there was frequently waste. In some cases this took the form of lamps shrouded in crinkled paper, a relic of the period of severe restrictions in lighting, when wasteful methods of obscuring lamps were in common use. The allocation of a certain amount of electricity or gas for specified purposes or for a given area might be considered, and methods of using the available light to the best advantage made more familiar to the general public. An educational movement would probably be better than hard-and-fast regulations. In conclusion, Mr. Gaster suggested that the whole question should be submitted to a joint committee, on which the Society should be represented, during the summer months, with a view to advising the authorities regarding the best steps to be taken when the winter months arrived.

Mr. H. Faraday Proctor, in a communication, said it was a reasonable assumption that diminution in the consumption of electricity due to economies being advocated would not exceed about 10 per cent. Such a reduction would result in lowering the coal consumption of electrical undertakings by 1⅓ per cent. only, having regard to the fact that the lighting units sold by electrical undertakings were only about 23 per cent. of the total output. The reduction would amount to a saving of 60,000 tons of coal for the whole of the United Kingdom. The loss in revenue to the electrical undertakings would be about £500,000 per annum. As few, if any, electrical undertakers were making more than a reasonable profit on their capital outlay, a diminution in revenue unaccompanied by a corresponding diminution in costs must ultimately result in an increase in the charges, or, at least, in the postponement of a reduction of the same. In either case, the consumer was not likely in the long run to reap a financial benefit commensurate with the reduction of his consumption of energy. It was, therefore, of little use looking to a substantial reduction in coal consumption as resulting in economy in lighting. To conserve coal, the raw material must be used efficiently. The burning of coal as fuel prior to the abstraction of the by-products was in itself wasteful, but the great power stations were among the least sinful in their methods. Assuming, for the sake of argument, that the coal consumption of the average privately-owned engine per H.P.-hour was double that of the engine in an up-to-date power house, the change-over of only 16,000 KW. of load of 25 per cent. load factor from privately owned plant to pubilc supply mains would result in a saving of about 60,000 tons of coal per annum. (The losses in belting and other inefficiencies superseded were set against the transmission losses.) Thus a comparatively small change-over by power users to up-to-date methods of driving would result in economies that would balance those obtainable from general lighting economies and would benefit all parties concerned. Economy in lighting must be looked upon purely as a war measure, and that solely with a view to a small reduction in the coal consumption throughout the country. He hoped the Government would in the near future bring pressure to bear upon the users of private plants, whether by taxation or otherwise, and compel them to use the public supply wherever such was available on reasonable terms. The end to be aimed at was that the burning of coal should be prohibited except to licensed users. The result would be enormous economies, and such a clear atmosphere in our country that, amongst other things, economy in artificial lighting would be an indirect result.

Mr. J. F. Crowley thought the suggestion to submit this matter to a joint committee was a very sound one. A point to be remembered in connection with the necessity for using coal more efficiently was that the output of coal in this country per worker in the coal industry had been steadily falling for the past 50 years, and to-day it stood lower than the output per man in any country of any size in the world. As regarded the use of coal for power purposes, none of the authorities now considering this problem suggested that there should be less power used in the future. Indeed, the demand was for the greater use of power, and therefore if we were to conserve our fuel supplies we could only do so by improving our methods of power production and the use of the power afterwards. As to lighting, he favoured restrictive measures, if necessary, quite apart from war measures, in connection with luxurious lighting such as display advertisements and things like that. As with power, the problem was one of the efficient production of light and its application.

Mr. J. S. Dow said the policy of the Illuminating Engineering Society had always been that much of the display lighting was excessive and quite unnecessary for the purpose in view, and it mostly came on at a time when the supply authorities found it no easy matter to deal with the factory load. That also applied to the short time during which this outside lighting was now indulged in under the new regulations, as regarded street and shop lighting.

Mr. A. P. Trotter said he had paid some attention to this matter, but had not succeeded in making much of it. Economy was, of course, essential at the present time, although when it came to be reckoned out it would be found that the amount of coal actually saved was extraordinarily small so far as the economies in domestic houses were concerned. At the same time, there were the other economies that had been pointed out, and although he was not at all sure that it was not an undue interference with the liberty of the subject to say that he should not do these things, yet he confessed that tobacconists' shops were, before the war, and to some extent were again now, painfully dazzling in the amount of outside light that they employed. They would say that it was only advertisement, but he was rather doubtful as to the effect of treating this class of lighting from the point of view of economy. There was one serious and absurd waste going on in many parts of London, and that was the continuance of arc lamps in opal globes which were now painted black. These arc lamps were originally taking 9 amperes, and were probably still taking 7 amperes, as otherwise they would not regulate. A 60-volt incandescent lamp could be used on these posts without any alteration of the wiring and an obvious economy effected at once. Why it was not done he did not know.

Mr. Gaster, replying to the discussion, said that, whether the authorities accepted the advice or not, he felt it was the duty of the Society to offer advice as to where economies could be made.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

CHILE.—By a law, dated January 8th, the 50 per cent. increase in Consular fees imposed last year for the period April 1st to December 31st, 1916 (see the Electrical Review for June 23rd, 1916) has been re-imposed.

ARGENTINA.—New laws have recently been promulgated amending in certain respects the Tariff Law in force. By Law No. 10,220, dated February 21st, a duty of 5 per cent. *ad val.* is to be levied until December 31st next on goods entitled to duty-free importation under the Law in force (with certain specified exceptions). [Among the articles affected by the new Law are plant and material for electric tramways.]

Law No. 10,221, dated February 21st, provides that until December 31st, 1917, a surtax of 2 per cent. *ad val.* shall be levied on goods which, under the Tariff Law, are subject to an *ad valorem* duty of from 10 to 20 per cent., and that this surtax shall be increased by 5 per cent. in the case of goods on which the existing duty payable exceeds 20 per cent. *ad val.* [Electrical goods are not directly affected by this Law.]

BRITISH DOMINIONS AND POSSESSIONS.—Complete lists of the articles which are prohibited to be exported to various destinations from British India, Canada, New Zealand, South Africa, Newfoundland, Egypt, Malta, Cyprus, Mauritius, Ceylon, Straits Settlements, Hong-Kong, Nigeria, Gold Coast, Jamaica, Barbados, Trinidad and Tobago, and British Guiana, have been issued as Supplements to the *Board of Trade Journal* for April 19th and 26th. The information in these Supplements supersedes that given in the Supplements issued on January 18th and 25th respectively. Copies of the Supplements may be obtained, price 3d. each (post free 4d.) from H.M. Stationery Office, Imperial House, Kingsway, W.C. 2.

FRANCE AND ALGERIA.—A complete translation of the new French Ministerial Decree of April 13th, which restricts the importation of goods into France and Algeria from foreign countries, has been published in the official *Board of Trade Journal* for April 26th. The new Decree contains:—

1. A list of goods which may be imported freely into France and Algeria, without previous authorisation, in virtue of the provisions of Article 2 of the Decree of March 22nd;
2. A list of goods which may be imported into France and Algeria only under special licence; and
3. A list of articles the importation of which is to form the subject of a special Decree.

The Decree provides that the prohibition of importation shall not apply to—

(*a*) Importations under the "temporary importation" *régime*, when the goods are subsequently to be re-exported;
(*b*) Transhipment operations in roadsteads and ports;
(*c*) Transit operations to neutral countries, governed by special agreements.

Included in the list mentioned in (1) are crude asbestos, crude mica, graphite, caoutchouc, balata, and gutta-percha. List (2) includes commercial advertisements, but nothing of special interest to the electrical industry, which is chiefly concerned with list (3) in which the following are included:—Iron and steel wire; copper, pure or alloyed with zinc, tin, aluminium or manganese; lead; tin; zinc; nickel; mercury; antimony; cadmium; bismuth; cobalt; dynamo-electric machines; electrical wire and cables; armatures for dynamo-electric machines, and detached parts; electric accumulators and detached parts; dry batteries; zinc manufactures; manufactures of nickel alloyed with copper or zinc.

Goods not included in the Lists are subject to the arrangement as to "contingents"—see the ELECTRICAL REVIEW for April 20th. These goods may for the present be imported without special permission until the quantities which will be allowed in have been fixed.

A Presidential Decree dated April 14th provides that the functions conferred on the "Comité des dérogations aux prohibitions d'entrée" are to be delegated to the "Commission Interministérielle des Bois et Metaux" in so far as concerns goods in List 3.

A further Ministerial Decree, also dated April 14th, provides that merchants or manufacturers who desire to import goods specified in List 3, for delivery to a public authority (State, Department, or Commune), either in the condition in which they were imported or after having been worked or manufactured, must submit to the competent authority four copies of an application in the prescribed form, and must attach thereto documentary evidence, with an indication of the use to which the goods are to be put, and their weight or measurement.

When the goods to be imported are destined to be stored in a shop for sale or to be delivered to the public, either in the rough state or after having been worked or manufactured, the merchants or manufacturers must submit the application to the Ministry of Commerce, 66 rue de Bellechasse, Paris.

The authority concerned is to transmit four copies of the application, with its opinion thereon, to the secretariat of the "Commission des Bois et Metaux," 14, rue de la Trémoille, Paris.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & CO., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

6,812. "Swivelling trolley pulleys of overhead electrically-propelled vehicles." A. WOOD. May 14th.

6,823. "Synchronised mechanism under electrical control." P. J. R. CRAMPTON. May 14th.

6,835. "X-ray couch permitting of war surgery and radioscopy." A. E. DEAN. May 14th.

6,870. "Couplings or connections for electric cables of railway vehicles, &c." J. STONE & CO. AND M. WALTON. May 14th.

6,871. "Brush and terminal contact mechanism of dynamo-electric machines." A. H. DARKER AND J. STONE & CO. May 14th.

6,889. "Method of installing and disposition of electrical equipment for motor vehicles." T. L. D'ORVILLE REEFMAKER. May 14th.

6,849. "Process of electric spot-welding." R. H. LE HOFFER & T. E. MURRAY. May 14th. (U.S.A., June 28th, 1916.)

6,920. "Signs, telegraphs, &c., electrical advertising devices." H. K. HARRIS. May 15th.

6,927. "Attachment for magnets." C. O. BASTIAN. May 15th.

6,932. "Electric motor control systems." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). May 15th.

6,936. "Loading coils for telephone circuits." G. E. BAIRSTO, BRITISH INSULATED & HELSBY CABLES, LTD., AND H. H. HARRISON. May 15th.

6,952. "Electrical connections for utilising voltage curve in metal-vapour rectifiers fed with polyphase current." Akt. Ges. Brown, Boverie et Cie. May 15th. (Germany, May 18th, 1916.)

6,993. "Means for sealing openings in roof and walls of electric furnace through which electrodes are introduced." H. ETCHELLS & H. A. GREAVES. May 16th.

7,001. "Electric resistance elements." BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO. May 16th. (U.S.A., June 8th, 1916.)

7,004. "Electric lampholders." CABLE ACCESSORIES CO. & F. H. REEVES. May 16th.

7,009. "Electric switches." FYFE, WILSON & CO. AND F. C. STOCKEL. May 16th.

7,016. "Electromagnetic apparatus for controlling discharged torpedoes." A. WATKINS. May 16th.

7,034. "Magneto ignition apparatus for internal-combustion engines." AKT. GES. BROWN, BOVERI ET CIE. May 16th. (Germany, May 16th, 1916.)

7,058. "Electric switchboards and manufacture thereof." W. A. RINGROSE. May 17th.

7,080. "Electrical measurement of sound." M. WALKER. May 17th.

7,092. "Electric fuses." E. G. NICHOLLS. May 17th.

7,093. "Automatic selectors for telephone systems." SIEMENS & HALSKE AKT. GES. May 17th. (Germany, May 4th, 1916.)

7,118. "Sparking plugs." A. HARMS & J. A. TURNER. May 17th.

7,122. "Radio-signalling systems." L. DE FOREST & C. V. LOGWOOD. May 17th. (U.S.A., May 23rd, 1916.)

7,137. "Telephone receivers." A. MARR. May 18th.

7,141. "Electric batteries of flashlights." H. BIEBER. May 18th.

7,150. "Wireless telegraph aerials." S. HALL. May 18th.

7,156. "Electric motor controllers." P. S. BROOK & J. A. HIRST. May 18th.

7,185. "Electric condensers." DUBILIER ELECTRICAL SYNDICATE. May 18th. (U.S.A., May 2nd, 1916.)

7,191. "Apparatus for control of dynamo-electric machines." W. [illegible]. May 18th.

7,200. "Microphones." S. G. BROWN. May 18th.

7,206. "Ionic relays, amplifiers or detectors." S. G. BROWN. May 18th.

7,254. "Telephone, &c., receivers." S. G. BROWN. May 19th.

7,262. "Ignition devices for internal-combustion engines." G. ROESCH AND C. TALBOT, LTD. May 19th.

7,269. "Sparking plugs for internal-combustion engines." IMPERIAL TRUST FOR THE ENCOURAGEMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH & J. D. MORGAN. May 19th.

7,270. "Electric contact-making devices." R. W. PAUL. May 19th.

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specification will be printed and abridged and all subsequent proceedings will be taken.

914. AUTOMATIC FIRE ALARMS. J. Jones. January 20th, 1916. (105,575.)

6,828. PROCESS FOR PURIFYING LIQUIDS. Elektro-Osmose Akt. Ges. (Graf Schwerin Ges.). June 10th, 1915. (100,638.)

6,498. METHOD OF AND APPARATUS FOR STERILISING WATER AND OTHER POTABLE LIQUIDS. W. J. Mellersh-Jackson (C. F. Burgess Laboratories). May 4th, 1916. (105,641.)

9,243. LIGHTHOUSE AND BEACON LIGHTS. W. F. A. Richey, W. A. Jewett and H. J. S. Stobart. June 30th, 1916. (105,678.)

12,610. WIRELESS CONTROL SYSTEMS. M. [illegible]. September 6th, 1916. (105,702.)

6,104. METHOD OF AUTOMATICALLY TAKING UP SHRINKAGE OF COILS OF ELECTRIC TRANSFORMERS AND OTHER ELECTRIC APPARATUS. J. Hall & J. R. Kirk. April 28th, 1916. (105,800.)

6,745. ELECTRICAL RADIATORS. J. S. A. Primrose. May 11th, 1916. (Cognate application, 6,746/16.) (105,809.)

7,694. ELECTRICAL SWITCHES. H. W. Cox & J. H. Thorne. May 31st, 1916. (105,824.)

8,500. SECONDARY ELECTRIC BATTERIES OR ACCUMULATORS. H. Deere and Chloride Electrical Storage Co. June 16th, 1916. (105,828.)

9,921. INTERCOMMUNICATION TELEPHONE SYSTEMS. J. W. Dargey. July 14th, 1916. (105,838.)

11,114. BATTERY CELLS OR TANKS. W. C. Fairweather (Lake Torpedo Boat Co., U.S.A.). August 7th, 1916. (105,849.)

16,453. PROTECTIVE DEVICES FOR ELECTRIC CIRCUITS. W. J. Mellersh-Jackson ([illegible] Electric Controller Corporation, U.S.A.). November 16th, 1916. (105,871.)

Electrolysis in Open Suppurating Wounds.—Charles Russ states that electrolysis can be applied to all suppurating areas provided these are such as to permit the superposition of a column of fluid through which the current can flow. Many septic war wounds could be healed in this way without pain and without the irritation of antiseptic solutions. Given an open suppurating surface, an irregular wound, or a sinus discharging pus, the first step is to submerge the lesion in sodium chloride solution, 1 or 2 per cent. This is done in the case of ulcers of the leg, for example, by placing over the ulcer a glass cylinder, which is made fluid-tight to the healthy skin by plasticene. A carbon or platinum foil electrode is just submerged in the sodium chloride contained in this cylinder, and under the limb is placed a large saline-soaked pad. The pad is made the negative electrode and the disk over the ulcer the positive, and a constant current of a few milliamperes is passed. Thereupon the chlorine atoms become linked to the bacteria in the granulations, and in moving to the positive electrode they carry the organisms out of the ulcer. There is also a strong germicidal effect proceeding within the contents of the glass cylinder, and, further, an increased blood flow is induced in the part. The aim of the electrolysis is to provide a liquid highway (NaCl) for the bacterial emigration from the wound. The author adds that, while the chlorine atoms are carrying the organisms and pus cells out of the blood, sodium atoms, of course, are entering the tissues, and care must be taken that the amount of sodium is not excessive, or the alkalinity set up will be painful, and there may be a retardation of healing due to the toxic effect of sodium upon the cell protoplasm. The ideal to be aimed at is to keep the reaction at the body surface neutral or only slightly alkaline. Certain organic acids of rather low conductivity if mixed with sodium chloride are comparatively little decomposed, and if only a small current flows, the acid (as such) is free to neutralise the alkalinity of the sodium atoms as they arrive at the cathode. The author concludes that the clinical results so far obtained justify a much more extended use of electrolysis.—*British Medical Journal.*

THE
ELECTRICAL REVIEW.

VOL. LXXX. JUNE 8, 1917. No. 2,063

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: June 8, 1917. [No. 2,063.

	Page
Recruiting and Experience	617
Galalith on Tour	618
Development of the Redditch Electricity Undertaking (*illus.*)	619
Some Notes on the Measurement of the Insulation Resistance of a Live Three-Wire Network, by G. W. Stubbings (*illus.*)	620
New Electrical Devices, Fittings and Plant (*illus.*)	622
Correspondence—	
Static Sub-stations	623
Trade after the War	623
"Business as Usual"	623
War Items	624
Legal	624
Some Patent and Trade Mark Cases	625
Business Notes	626
Notes	629
Reviews	631
City Notes	633
Stocks and Shares	635
Market Quotations	636
Exports and Imports of Electrical Goods during March and April, 1917	637
A Concentric Standard Dynamometer Wattmeter and Non-Inductive Standards of Low Resistance, by A. E. Moore (*illus.*)	637
Reinforced Concrete Transmission Poles (*illus.*)	639
The Importance of Hygienic Factory Conditions	640
New Patents Applied for, 1917	640
Abstracts of Published Specifications	640
Contractors' Column	Advertisement page xxii

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Telephone Nos.: City 997; Central 4425 (Editorial only).

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Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

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RECRUITING AND EXPERIENCE.

WHEN the House of Commons was about to adjourn for the Whitsun recess, the Prime Minister announced the intention of the Government to set up seven Commissions to inquire into the causes of Labour unrest. We trust that that important inquiry is now in progress, for upon the result of its investigations very much may depend. But it would be unwise were silence to be preserved respecting another form of unrest which, while it does not demonstrate or parade itself in the same ways, is undoubtedly very prevalent in not unimportant quarters. This particular unrest would probably be better described as uncertainty and the spirit of unsettlement that it entails.

It is, of course, recognised that in times when hardly anything or anybody can fairly expect to escape the moulding influence or chiselling of tragedy and sacrifice, and when there are ever-changing factors emerging, there can be no rigid or continuous policy in respect of detail. There may even arise emergencies when large policies may have to undergo revision so long as vital principles are not endangered. To millions of us there are many matters connected with the war which are, and probably will long remain, obscure; it must be so, because the people as a whole cannot be told without the enemy knowing too. But it is excusable if the people are tempted to wonder, when certain courses of action are adopted, the reasons for which they are unable to fathom, whether the authorities themselves are not in doubt. Among the certain and very gratifying matters of recent date we find the intervention of America with vast resources of material and ships, and, sooner or later, with millions of young fighting men; also the lessening of the submarine peril. We have also been given to understand that there are millions of men of military age in various industries in the United Kingdom from which we are able to draw our required fighting forces as the work of substitution progresses. A member of Parliament, in a recent letter to the *Times*, put at six figures the number of young colliery workers who were available for release—many of them eager for service, while the older men and the people of their localities desired them to take their rightful place. The National Service movement called clamorously for men to volunteer for industrial service of many kinds. Two or three hundred thousand applied, some thousands were found positions, and now little is being heard of the matter save by means of poster or hoarding.

A month ago an invitation was issued by the War Office calling for men above the recognised and Parliamentary military age to volunteer for various classes of service. This proposition, however, has not yet matured. Whether the announcement was premature or ill-considered, or whether something developed of which the country was in ignorance rendering that particular step undesirable, we, of course, cannot know, but all these things working together have been responsible for that kind of unrest or uncertainty that we find to be so prevalent among the older men who have been for several years, and are now, bearing the stress and strain of commercial and industrial life. The latest phase of the matter is the decision of the Army Council to have pink forms prepared of all registered men who are between the ages of 41 and 40. As usual, the newspapers have their different versions of what this move means. Some seem to consider it as the prelude to the introduction of compulsory military service; others suggest that particulars as to the occupations of the men in question are required, which may indicate some form of industrial service as being intended, but without any indication of enlistment in the near future. The latter view is more intelligible to the layman than is the former, for he wants to know what progress is being made with the efforts to release the younger men from industrial pursuits, and to what extent American fighting men may be counted upon at an early date. We naturally see that it is one of the weapons of war to mystify the enemy, confusing him as to our immediate strength, and as to our reserves and their source. Yet we have to remember how unsettling is the effect of the present uncertainty upon commerce, finance, and many branches of industry.

The average man perceives the strongest possible reasons against raising the military age a single year until the younger men who are engaged in work in which substitution is possible have had the opportunity of using that physical strength and adaptability in which they are naturally the superiors of their elders. Not the least disturbing element in the uncertain situation is its effect upon the numerous businesses which are already bearing voluntarily liabilities or obligations in respect of those who on leaving their employment temporarily to take up active service had their salaries in part maintained. Firms who carry this voluntary burden, and pay all the necessary war taxes, find themselves faced with the possibility of their older and higher salaried men, and their principals, too, being called to the Colours, and there is a limit to their ability to supplement Army pay. Furthermore, they have rearranged their businesses in keeping with changing events, advertising for and engaging men above the military age. These men have just got into the running, and they, too, become liable at the same time as the managers and others who, by long experience and service, have been maintaining the businesses which have enabled the fighting men's allowances to be paid. As the *Times* pointed out recently, for every head of an important business between the ages of 30 and 40 there may well be a hundred between the ages of 40 and 50. We believe that if the leaders of industry were consulted on this point by the Army Council, or by the War Cabinet, whichever is responsible in such a case, they would be able to give very striking evidence in support of that statement. We have to win the war. That is the prime consideration of all of us, but shall we not be more likely to wage it more effectively if we minimise as much as possible any further interference with industry and trade? The Minister of Munitions has desired to introduce dilution in private industry in order that such industry shall remain as far as possible efficiently intact in readiness for our returning forces. But we cannot take the heads, the managers, the men of experience in such connections, those who, too, maintain businesses, earn profits, and pay allowances and heavy taxes, without seriously hampering the industrial machine. We greatly admire the valuable service that women are rendering in clerical work and in mechanical operations in engineering and other industry, but you cannot train women or fresh older men to take the place of such men as we have indicated.

Sir Wm. Robertson has said that we are making a 75 per cent. effort at home supporting the 25 per cent. effort of the Naval and Military Forces. Both he and the Prime Minister, too, have expressed their convictions concerning the Press as an essential part of the nation's fighting organisation, an admission, we believe, that there must be certain important discriminations exercised unless the efficiency of the 75 per cent. home effort is to be seriously impaired. In the *Newspaper World* recently we read a fully-informed article in which it was shown that if the Tribunal rules of the past year are to be applied in connection with any possible compulsion in the case of men of 41 to 50, it will be impossible to publish hundreds of weekly newspapers, and many of these are essential for the purposes of those engaged in munition-making industries and for maintaining trade connections in readiness for after the war. The Stock Exchange, too, has been much perturbed by the prospect which threatens to take the older men who are maintaining that institution. It is even said that if these men "go" the Stock Exchange must practically close. We cite these two types of cases as forceful examples of many others in general industry proving the need for the most careful discrimination unless we are going to work little short of financial and industrial disaster.

Let us quote one more: The chairman of the Kalgoorlie Electric Power & Lighting Corporation, Ltd., recently spoke as follows concerning the feeling of the company's tramway manager that he must respond to the call for volunteers:—

> Sir Wm. Robertson agreed the other day with a statement that the Military and Naval Forces are doing 25 per cent. of the work required to keep the war and the Empire going successfully, and that 75 per cent. of it is being done by the rest of the population. Assuming this to be correct, it is clear that the men who are in charge of important civilian work necessary to hold the industries of the Empire together and produce some of the sinews of war are already doing the best they can do for their country, and should stick to their work. From this aspect, selective compulsory service seems to be better for the country than the voluntary enlistment of men experienced in business and technical affairs who are already more effectively employed.

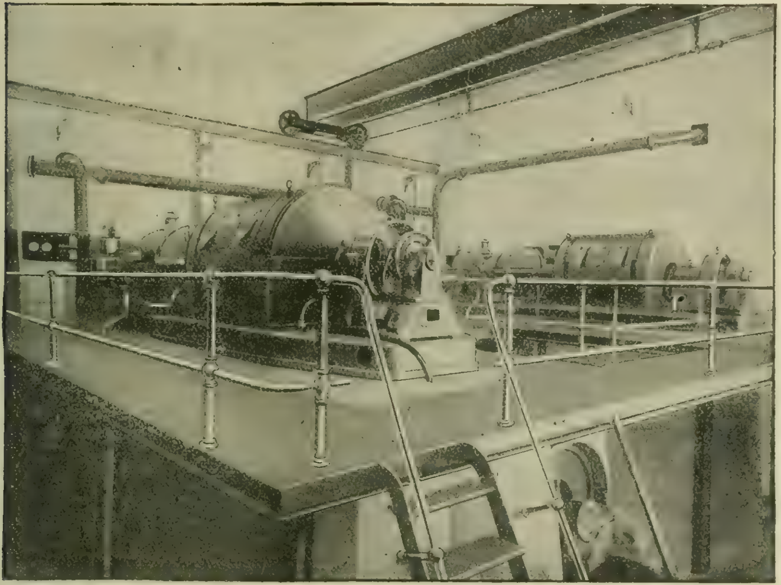
We have, perhaps, touched upon a subject which is a little removed from our ordinary concerns, but we do so because we consider it desirable that the present uncertainty should be removed, that the trade and industry, commerce and finance, of the country should be protected, and that all possible measures should be taken to insist upon the young men taking their rightful place. To secure the last of these ends cannot give rise to further discontent in Labour circles, for the raising of the age may often mean that the older men will be called to fight the while the younger men—perhaps even their own able-bodied sons—are allowed to stay at home.

Galalith on Tour.

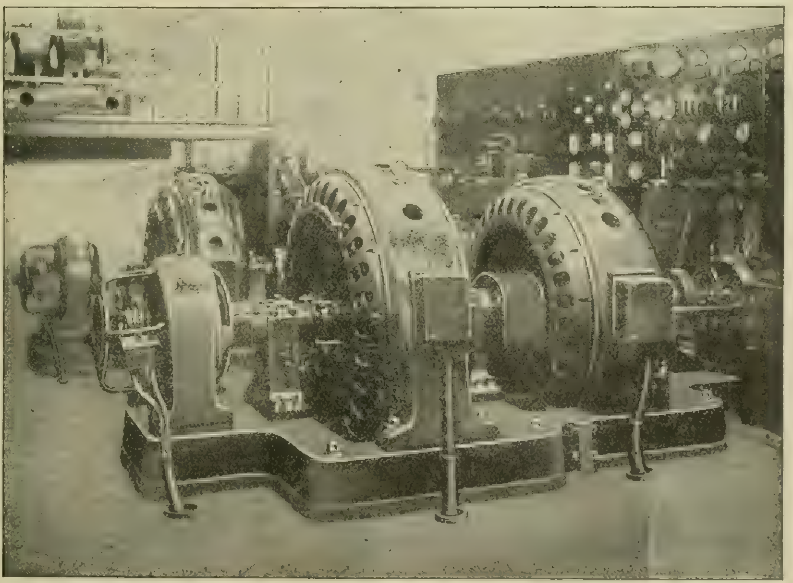
We remember reading somewhere, long ago, the story told by a journalist of a paragraph which he had perpetrated, and which, reproduced in succession by one journal after another, had circulated through the Press of the entire English-speaking world. During recent months we have witnessed a similar sequence of adventures in connection with the insulating material known as "Galalith," a German product made from milk, which we introduced to our readers in 1912. A paragraph describing galalith, as though it were a novelty, recently went the round of the English and American technical Press, and has just cropped up once more in the *Electrical World*, which quotes it from the *Electrician*. We have watched its progress with increasing interest, wondering the while whether some exceptionally able advertising agency were at work, or whether the editorial staffs of our many contemporaries were troubled with short memories. Owing to its German origin, galalith, we believe, cannot now be obtained in this country, but we may remind our readers that in April, 1915, we drew their attention to a British substitute (then known as "Kasenoid," but now called "Erinoid"), also made from milk, and designed expressly to take the place of galalith. We cannot but regret that the latter has, somehow, achieved so effective an advertisement.

DEVELOPMENT OF THE REDDITCH ELECTRICITY UNDERTAKING.

We recently referred in our "Notes" to the remodelling of the electricity supply arrangement of the Redditch Urban District Council, with a view to meeting the growing demand for cheap power in the area.



Parsons Turbine Plant, Redditch Electricity Works.



E.C.C. Motor-alternators at Redditch Electricity Works.

The original undertaking was inaugurated in 1899, and provided a single-phase 70-cycle supply at 2,200 volts to numerous underground transformer sub-stations from which L.T. consumers were supplied.

By March, 1911, the demand for energy for power purposes had outstripped all others, the undertaking selling over 600,000 units for such purposes, as against 173,000 units for private lighting; the need for radical alterations was such that in 1914 Messrs. Handcock & Dykes were instructed to consider and report on the whole matter, and they ultimately recommended the adoption of the three-phase system of supply, with modern turbine plant, and re-arrangement of the underground mains.

This work has now been completed, and the new plant was brought into use in September last. This consists of two 1,000-KW. Parsons turbo-alternators, each capable of carrying 1,500 KW. under overload conditions, which operate on steam at 150 lb. pressure with 150° F. superheat. These sets have a speed of 3,000 R.P.M., and generate three-phase 50-cycle energy at 2,200 volts between phases and neutral, which is earthed, so that any of the original 2,200-volt single-phase feeders can be connected between any phase wire and neutral. All future extensions will be made on the three-phase system, except for very small motors, and it is anticipated that the majority of the existing power consumers will desire to substitute the more efficient and cheaper three-phase motors for their existing plant.

Meantime, in order to give flexibility to the system, two motor alternators of 150 KW. and 300 KW., respectively, have been installed to supply single-phase 70-cycle energy from the three-phase plant, or three-phase energy from the single-phase plant. A new three-phase switchboard has been supplied by Messrs. Bertram Thomas, consisting of 14 operating panels with H.T. gear in stone cubicles behind; a Brown-Boveri automatic pressure regulator has been provided.

To meet the needs of the condensing plant, a new tower capable of dealing with 174,000 gallons of water an hour has been supplied by the Film Cooling Towers Co.; the old cooling tower will be removed to make room for boiler-house extensions.

Meanwhile, a new 13,000 lb. Babcock & Wilcox boiler has been fixed in a temporary structure at the end of the new portion of the engine house; this is complete with superheater, pumps, &c., and has an independent steel stack and induced-draught plant. In connection with the distribution, the numerous original underground transformer sub-stations have been replaced by five main sub-stations in brick buildings, containing Ferranti oil-cooled transformers, with B.T.H. truck-type H.T. and British Insulated L.T. switchgear; one of the sub-stations is at the generating station, and of the others two are adjacent to factories.

Glover three-phase, four-core H.T. and L.T. cables have been laid throughout the principal parts of the district; these are of the diatrine paper-insulated, lead-covered, steel-armoured type, laid direct in the ground, the work having been carried out by Mr. R. N. Mayne, the Council's electrical engineer, with direct labour. All joints and service boxes have plumbed lead joints enclosed in iron boxes fitted with armour grips.

At the time that Messrs. Handcock and Dykes submitted their report the output for the previous year had been 1,323,876 units, and it is anticipated that with the new plant the output should shortly reach 3,000,000 units, and that under the new conditions a substantial reduction in the cost of production will be made.

SOME NOTES ON THE MEASUREMENT OF THE INSULATION RESISTANCE OF A LIVE THREE-WIRE NETWORK.

By G. W. STUBBINGS.

The subject of measuring the insulation resistance of live three-wire networks has from time to time received considerable attention, and various tests for this purpose have been proposed. It is, however, probable that at least in the majority of the smaller central stations these tests are not used, owing to the supposed difficulty or inconvenience in making them. In such stations reliance is placed on the readings of the recording ammeter in the earth connection, it frequently being considered that, provided this instrument indicates a reasonably small leakage current, all is well with the network. This state of affairs is greatly to be deplored, for not only is this conclusion entirely fallacious, but proper testing of the network is quite a simple matter, and such tests, periodically taken, form a most valuable guide as to the conditions of the mains.

A few words may be said regarding the readings of the centre zero ammeter in the earth connection. Such readings are purely differential, and, of course, do not enable the insulation resistance of the network to be determined. They are, however, very useful, if, as is customary, the instrument is of the recording type. Small faults can frequently be located by an intelligent inspection of the ammeter chart, if such faults are on consumers' installations. The time that a fault comes on and goes off will sometimes give a useful indication of the class of premises where the fault is to be found. The writer recollects a case of a partial earth being discovered in this way by the recording ammeter indicating a dinner hour that was fixed at a different time from elsewhere. Faults on street lighting circuits can often be traced in the same way. It has been frequently stated that a neutral fault will effectively shunt the earth ammeter, and will cause it permanently to read zero. It should be borne in mind that this is only true when there is an appreciable resistance in the earth connection. When, as is frequently the case, the earthing resistance is short-circuited by a fuse or circuit-breaker, the fault will act as a neutral feeding point, and considerable currents may circulate from the neutral bus-bar through the recording ammeter to the neutral fault. This is the more likely if the neutral fault be on a small distributor remote from a feeding point, where the potential of the distributor may be considerably different from that of the neutral bus-bar. The writer has experienced such a case when the circuit-breaker in the earth connection, which was set at 25 amperes, was repeatedly opened, owing to a dead earth on the neutral of a large consumer's installation. Such occurrences can, of course, be instantly differentiated from faults on an outer by the fact that when the circuit-breaker is opened the potential of the neutral remains at that of earth, and the ammeter reads zero.

The tests that have been proposed for the determination of the insulation resistance of a live network mostly depend upon the alteration of the potential of the neutral by the creation, or the removal, of an artificial fault. The most valuable of these tests is that described by Dr. Alexander Russell, in which the potential of the neutral above or below earth is determined before and after breaking the earth connection. If i be the current through the earthing resistance, and v and v_1 be the potential difference of the neutral and earth before and after breaking the earth connection respectively, then R, the insulation resistance of the network, is given by the formula $R = (v_1 - v)/i$. This can be rewritten $R = v_1/i - r$, where r is the value of the earthing resistance. By the use of an instrument with overlapping pointers, a device has been contrived that enables v_1/i to be read directly, so that by mental subtraction of r, which is, of course, known once for all, the insulation resistance can be determined without calculation. It would seem impossible to improve upon so simple a test. Objections have been raised on account of the necessity of breaking the earth connection. Seeing that this connection need only be broken for a sufficient time to read v_1, this objection does not seem to be so very serious, especially as it is quite simple for the switch in the earth circuit to be held in by a spring, thus obviating any possibility of its being left in the off position. It should also be remembered that there is no possible objection to breaking the earth connection unless this will cause the potential of the neutral to travel away from earth to a considerable amount. If, therefore, r is small, it is improbable that v_1 will be so large as to be dangerous. This point does not seem to have been properly appreciated, for a speaker before the Institution of Electrical Engineers, some years ago, dealing with this matter, objected to Russell's test, on the ground of the undesirability of breaking the earth connection, and then went on to describe an additional test, in which the potential of the neutral was moved 200 volts from that of earth. There is, of course, the possibility of a dead earth occurring during the few seconds that the earth switch is out, when, if the neutral be sound, the potential of the other outer will rise to double the normal voltage from earth. This possibility is not great, certainly not great enough to vitiate the usefulness of this important test.

As the insulation resistance of the network can be calculated from observations of the results of any alteration of the value of an artificial fault, it is not difficult to devise other tests in which the opening of the switch in the earth circuit is not necessary. One such test is Raphael's. In this test, it will be remembered, the ammeter with the resistance in series is shunted with a resistance of exactly equal value. If d_1 and d_2 be the readings of the ammeter, or of any instrument giving deflections proportional to the current, before and after shunting, R the insulation resistance of the network is given by $R = r\,(d_1 - d_2)/(2\,d_2 - d_1)$, r being the value of the resistance and ammeter in series. This test, besides other limitations, suffers from the disadvantage of requiring an additional resistance. Another test was suggested by Mr. Taylor in a paper read before the Institution of Electrical Engineers in 1903, in which the voltage difference between the neutral and earth is brought to zero by an adjustable artificial fault on an outer main, when R is given by $R = v/(i_1 - i)$, i_1 being the current in the artificial outer fault, and v and i having the same values as before; this test, like Raphael's, requires additional apparatus, in this case in the shape of an adjustable resistance of some size, the provision of which might involve some expense.

A simple test, which to the writer's knowledge has not been before suggested, can be employed when a moderate resistance is normally short-circuited by a fuse or circuit-breaker. In this test the current in the earth connection is observed with the resistance short-circuited, and, again, with the circuit-breaker or fuse opened. Calling these currents i_1 and i respectively, and the potential of the neutral with the circuit-breaker open v, the insulation resistance of the network is given by $\mathrm{R} = v/(i_1 - i)$. The arrangement is shown in the diagram, fig. 1, and the proof is simple.

Let the voltage between the outers and neutral be E, and the fault conductivities of the positive, negative, and neutral mains be respectively c_1, c_2, and c_0; we have, the circuit-breaker being closed,

$$c_1 \mathrm{E} - c_2 \mathrm{E} = i_1.$$

With the circuit-breaker open we have :—

$$c_1 (\mathrm{E} - v) - c_0 v - c_2 (\mathrm{E} + v) = i.$$

Subtracting the second of these equations from the first, $v (c_1 + c_2 + c_0) = i_1 - i = v\,\mathrm{C}$, C being the combined conductivity of the three mains. We therefore obtain—

$$\mathrm{R} = v/(i_1 - i).$$

This test is almost as simple as Russell's, but is not open to the objection which applies to this latter test. If conditions be such that the reading of the earth ammeter is very small with the circuit-breaker closed, an artificial fault of known resistance can be put on one of the outers to increase this reading. The insulation resistance, as calculated, will, of course, include this resistance, and must, therefore, be corrected accordingly.

The combined insulation resistance of the network, as found by any of these tests, is of limited value by reason of the fact that the separate insulations of the three mains are still unknown. The problem of obtaining these separate values is one of considerably greater difficulty than that of finding the combined value. It is obvious that it is impossible to solve the problem by the use of artificial faults, and consequently other means must be found. Of the three insulation resistances it is, perhaps, most desirable to know that of the neutral, as a serious diminution in the insulation resistance of either of the outers is usually indicated by the recording ammeter in the earth connection, simultaneous faults on the two outers being of rare occurrence. An approximate method of obtaining the insulation resistance of the neutral can easily be contrived on the assumption that the insulation resistances of the outers are so high that the positive and negative leaks are negligible. By causing the potential of the neutral to travel away from earth by an artificial leak on an outer, it is possible by measuring the current in the leak and the current returning through the earthing resistance to obtain the current returning through the neutral faults. The arrangement is shown in the diagram, fig. 2.

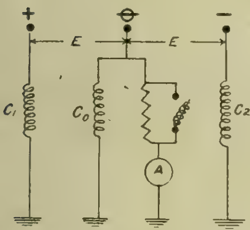


Fig. 1.

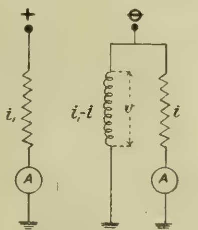


Fig. 2.

If i_1 be the current in the leak, i that in the resistance, and v the potential of the neutral, we have $i_1 - i$ as the current in the neutral leaks. The insulation resistance of the neutral is accordingly $r_0 = v/(i_1 - i)$. As before stated, this result is only accurate if the insulation resistances of the outers are very high compared with that of the neutral. If, therefore, this method gives a satisfactory value of the neutral insulation, the actual insulation resistance will be slightly higher.

In order to obtain accurate values of the separate insulation resistances of the three mains, it is necessary to introduce another alteration to the existing conditions, and it has been suggested by Dr. Gisbert Kapp and Dr. Dennis Coales, in a communication published in the *Journal* of the Institution of Electrical Engineers in 1909, that this can be done by altering the voltage across each side of the system. The method depends upon raising, first, the voltage on the positive side, and then the voltage on the negative side, the voltage across the outers meanwhile being maintained constant. The alteration in the potential of the neutral from earth with a moderately high resistance in the earth circuit is obtained, and from the observed data the insulation resistances of the three mains can be calculated. The method can be readily adapted so that it is not necessary to open the circuit-breaker in the earth connection, if means are employed for determining with fair accuracy the alteration in the current in the earth connection. If the normal voltage across each side of the system be E, and this be increased on the positive side by an amount e, which will, of course, not be sufficient to exceed the deviations in voltage allowed by authority, the voltage on the negative will be diminished by a similar amount. These voltages will now be respectively $(\mathrm{E} + e)$ and $(\mathrm{E} - e)$. Let the current in the earth connection, the short-circuiting circuit-breaker being in, be i_1. The positive voltage is now diminished, and the negative raised, to assume values of $(\mathrm{E} - e)$ and $(\mathrm{E} + e)$ respectively, when the current in the earth connection will be i_2. These conditions can be represented by the following equations, c_1, c, c_0, having the same values as before :—

$$c_1 (\mathrm{E} + e) - c_2 (\mathrm{E} - e) = i_1.$$

$$c_1 (\mathrm{E} - e) - c_2 (\mathrm{E} + e) = i_2.$$

Subtracting $$2\,e\,(c_1 + c_2) = i_1 - i_2.$$

$c_1 + c_2 = (i_1 - i_2)/2\,e$, and $c_0 = \mathrm{C} - (i_1 - i_2)/2\,e$, C being the combined conductivities of the three mains as found by Russell's or some other test.

If conditions are such that the current in the earth connection is very small, an artificial leak can be introduced to give good readings, and if this same leak be used to determine R or C its value need not be known, as it will be included in the value of $c_1 + c_2$ as found in the second test, and also in the value of C, and its effect will therefore be eliminated. This test will, of course, fail if the fault on the neutral is so great as to cause currents to circulate between it and the neutral bus-bar; but as has been before pointed out, this state of affairs can be detected at once by opening the circuit-breaker in the earth connection, when the potential of the neutral will not alter; this being the case, a bad neutral fault will be indicated, and quantitative measurements will be quite superfluous. The test may otherwise be of some value, as it is not difficult to carry out, the alterations to the voltage across the outers being easily made by the switchboard attendant.

It has been suggested to measure the insulation resistance of the neutral by drawing away its potential from earth by an artificial fault, and by observing the increase in the currents in the neutral feeders. This method is of doubtful use unless the insulation of the neutral be very low; as, in order to get observable alterations on the neutral feeder ammeters, it will be necessary to subject the neutral to an undesirable potential from earth, and thus reproduce, in a worse form, the disadvantage of Russell's test. If the neutral insulation be very low the test suggested earlier in this article will be of greater service. The method of observing the alterations in the current in neutral feeders is invaluable in locating a neutral fault, as, in these circumstances, a considerable artificial leak will not greatly alter the potential of the neutral, and considerable currents can be caused to flow through the fault. By testing and transferring, a neutral fault can by this means be localised to as small a section as may be desired.

It is hoped that the above notes will assist to dispel the popular idea that insulation tests on a live network are complicated or difficult. By the use of an instrument with overlapping pointers mounted on a panel with suitable switchgear, Russell's test becomes one of the extremest simplicity, and can be performed periodically by so comparatively unskilled a person as a switchboard attendant. If the breaking of the earth connection be considered undesirable, Raphael's test, or the one suggested by the writer, can be employed, the latter requiring no special apparatus and a very simple calculation. It is, of course, impossible to anticipate or prevent all faults by periodical testing, as it is well known to mains engineers that a distributor section that tests approximately perfect to-day may go down to-morrow, while another section may show a low test and last for years. Nevertheless, apart from mechanical damage and accidental causes, such as the flooding of a disconnecting box, faults, as a rule, take some time to develop; and it therefore follows that an incipient fault should be indicated by a lowering of the insulation resistance of the network. These remarks apply especially to the neutral of the system, for as in this case the conductor is but rarely very much removed from earth potential, an incipient fault will take longer to develop, but will possibly break down instantly if subjected to full voltage by a dead earth on an outer. It is therefore desirable frequently to check the insulation of the neutral, to avert the possibility of a dead earth causing a shut-down. The neutral test described by Dr. Kapp and Dr. Coales, already referred to, or the adaptation of this test suggested by the writer, may be of use in this connection.

In conclusion, it may be of interest to refer to a remark made by Dr. Sumpner, speaking before the Institution of Electrical Engineers, in 1904, on the subject of network testing. It was pointed out that Russell's test depends upon a simple principle stated by a French scientist over 30 years ago. This principle may be stated as follows: If in any complicated system of resistances and E.M.F.'s two points are joined by an adjustable resistance, by observing simultaneous values of the current in this resistance, and the voltage across it, the resistance of the system between the two points in question can, by Ohm's law, be calculated by dividing the alteration in voltage by the alteration in the current. This most interesting point does not seem to have received the attention that it deserves. The formulas for Russell's and Raphael's tests can be immediately deduced from it. In each case i and v, i_1 and v_1, being simultaneous values of the current in the earth connection and the potential of the neutral respectively, the insulation resistance R will be given by $R = (v_1 - v)/(i - i_1)$.

In Russell's test—$i_1 = 0$ and $R = (v_1 - v)/i$.

In Raphael's test—$v_1 = K\,r\,d_1$, and $v = K\,r\,d_2$

$$i = 2\,K\,r\,d_2, \text{ and } i_1 = K\,d_1$$

$$R = r\,(d_1 - d_2)/(2\,d_2 - d_1).$$

In the test suggested by the writer—$v = 0$, $R = v_1\,(i_1 - i)$.

These results are so simple, compared with the rather cumbersome algebraical expressions usually employed to establish the formulas, as to be worthy of notice.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Earth Detector for Transmission Lines.

In order that operators may be warned of any grounds on the 1,200 miles of 2,200-volt lines of the Southern California Edison Co. as soon as they develop, Mr. G. E. Armstrong has devised an earth detector, which is more sensitive than the static type, and in addition gives an audible as well as a visible signal. The outfit includes three Y-connected 2,200/122-volt transformers, across the secondaries of which are connected carbon lamps, arranged symmetrically inside a cylindrical case with a ground-glass front, and separated by partitions. Between the primary, neutral, and earth is connected a high-resistance telegraph relay, with an alarm bell.

When a "ground" occurs on any one of the lines the potential across the transformer connected to that phase will be reduced and the potential of the remaining transformers slightly increased. Coincidently, current will flow from the neutral to ground, and the lamp which is connected across the grounded phase will be dimmed or extinguished, depending on the resistance of the ground, and the other lamps will increase in intensity. At the same time the current flowing from neutral to ground through the telegraph relay will ring the alarm bell. The relay is so connected, however, that its coils are automatically short-circuited directly after transmitting the signal, to protect them against excessive voltages which might occur.

With this equipment "grounds" having as high a resistance as 500,000 ohms can be detected visually by comparing the lamp intensities. Much higher resistance grounds than can be indicated by the lamps can be detected audibly by the alarm bell operating. Extremely poor grounds, such as a wire lying on dry and painted cement inside a station, have even been detected by the device.

"Hightensite," a New Insulating Material.

One of the conditions exerting a controlling influence in the electrical engineering industries, the existence of which was revealed to us by the war, was the fact that the manufacture of certain essential classes of insulating materials was an almost absolute monopoly in German hands. We refer especially to moulded compositions, of which "Stabilit" was the most important, as was exemplified in the legal proceedings recently reported in our pages, this being *par excellence* the most suitable material for use in the manufacture of magnetos and similar apparatus requiring the highest insulation. Fortunately, in this connection, as in so many other industries, the skill and ingenuity of British manufacturers have not been found wanting. Compelled to find substitutes for the formerly imported materials, they have completely retrieved the situation. We have just received from the Park Royal Engineering Works, Ltd., of Cumberland Avenue, London, N.W. 10, samples of their new "Hightensite" insulating material, which, it is claimed, is even better than "Stabilit"; it is a hard substance, tougher than ebonite, taking a very clean-cut thread and susceptible of a high polish. As an insulator, Hightensite takes a place in the highest rank, and its dielectric strength, as determined by the National Physical Laboratory, is over 20,000 volts per millimetre; it is also non-inflammable and non-hygroscopic, but is not suitable for use in contact with oil, owing to rubber being one of its constituents.

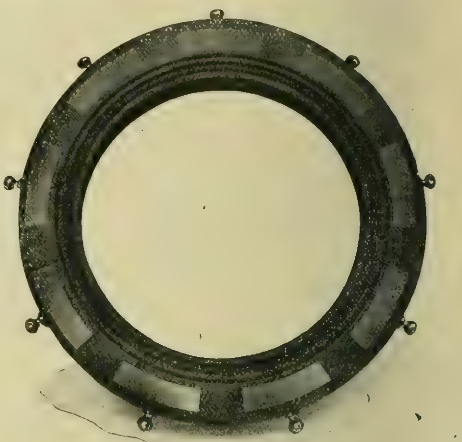


Fig. 1.—"Hightensite" Distributor.

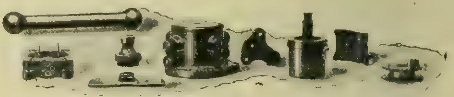


Fig. 2.—Small Moulded Parts of "Hightensite."

Hightensite is made in the form of rods and sheets, but its chief uses appear to lie in the direction of moulded parts, with or without metal fittings embedded in them. We have before us a 9-point distributor for a rotary engine, and must express our admiration for the beauty of the fitting as a work of art, apart from its electrical and mechanical properties. We are informed that over 100,000 parts are now in hand for various Government orders. The accompanying illustrations show the distributor above mentioned, and a variety of small parts for magnetos and similar applications.

Electrical Exhaust Fans.

Messrs. S. G. Leach & Co., Ltd., of 26-30, Artillery Lane, E.C., recently issued a new exhaust fan list, LF 7, one of a series of eight fan lists.

The fans are fitted with the ordinary box blade or the more efficient patented Beedle blade—the latter in the 2, 3 and 4-way types, the 2-way being most efficient on free intake and discharge, whilst the 3 and 4-way types are more suitable for working against resistance.

The fans are motor or belt-driven; in the former case direct-current series motors of the totally-enclosed or semi-enclosed pattern are fitted, starters with automatic features being recommended for D.C. fans above 24 in. size, and if above 240 volts working pressure, and for all sizes for higher pressures.

Induction type short-circuited rotor A.C. motors are also fitted, for single or polyphase working; 12-in. to 18-in. diameter fans can be made for use on 25 to 133-cycle supply; fans from 24 in. to 36 in. for 25 to 83-cycle supply, and larger sizes for any frequency from 25 to 60 cycles.

The smaller fans are grease lubricated, and in A.C. and larger size D.C. fans ring oilers are provided. All parts of the fan and motor are interchangeable, so that replacements can be quickly and cheaply made.

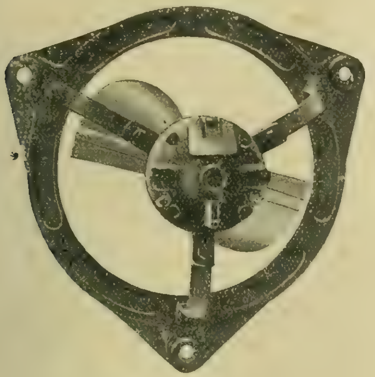


Fig. 3.—Two-way D.C. Beedle-blade Fan.

We illustrate in fig. 3 a 2-way Beedle-blade fan with D.C. motor, and in fig. 4 a box-blade fan with A.C. motor.

It may be of some interest to quote from the tabulated data contained in the list, that a 2-way Beedle-blade D.C. fan, 24 in. size, at 600 R.P.M., gives 4,800 cb. ft. per min. air discharge on 120 watts, while a 24-in. A.C. box-blade fan at 560 R.P.M. gives 3,500 cb. ft. per min. air discharge on 165 watts, the figures referring to free intake and discharge.

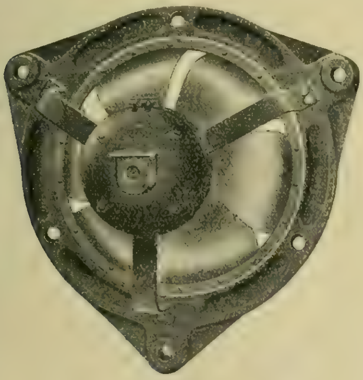


Fig. 4.—A.C. Box-blade Fan.

A series of curves shows the more efficient results obtained with the Beedle-blade type of fan, but experience indicates the necessity of knowing the exact conditions of working in order to obtain the best results.

Messrs. Leach & Co. specialise in fan work, and supply the usual accessories, such as regulating resistances, starters, louvre and butterfly shutters, &c.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Static Sub-stations.

With regard to your contributor's article on "Static Sub-stations," an arbitrary comparison of the number of sub-stations in two areas of supply, without reference to pressure, system (two or three-wire), or the age of the undertaking, is, unfortunately, a counsel of perfection only having an academic interest for a great many districts. How many engineers, in charge of undertakings, considered in their day the *dernier cri* in electric supply, do not dream of the unattainable ideals indicated by your contributor? How many, in thinking of their systems, would not "shatter them to bits and then remould them nearer to the heart's desire," if the barrier of finance did not intervene?

Mains Engineer.

June 2nd, 1917.

Trade After the War.

With reference to the article and correspondence on the above subject which has appeared in your paper lately, I send herewith a cutting from the *Lyttelton Times* of March 28th, which has some bearing on the subject, and may be of interest at the present time.

Comment is hardly necessary, as the results of the proposal are obvious. The men on their return from America will naturally recommend the apparatus which they are used to, which will be American. If British goods are to have a big field here, some form of advertising and popularising British manufactures must be begun.

The training of engineers in England in the manner offered by the American Commercial Attaché to Australasia would seem to be an exceedingly practical scheme, which merits consideration.

A.M.I.E.E.

New Zealand.

From the *Lyttelton Times*, N.Z.

Before the Chamber of Manufactures, at Melbourne, a few days ago, Prof. Kennedy, American Commercial Attaché to Australasia, delivered a very interesting lecture on the advantages of modern methods in business and the possibility of closer co-operation between manufacturing Australia and her big brother, manufacturing America. . . . . The lecturer explained the methods of training adopted by large companies in America, such as the Westinghouse Co. and the General Electric Co., who specialised among their apprentices and themselves reared their own skilled mechanics, foremen, and high technical men. He stressed the value of specialisation and factory organisation as aids to industrial success, and predicted an industrial renaissance in England after the war. On behalf of the American Bureau of Domestic and Foreign Manufactures, he was empowered to offer to train Australian apprentices in America, so that they could bring back to Australia the best and latest in the American industrial world. The chief qualification was that the applicants should be graduates of technical schools. Other desirable qualifications were quickness of observation, earnestness, grit, good health, democratic ability to get along with men, and ambition. The apprentice who did not possess these qualifications would be unlikely to complete his course. A living wage of $50 to $75 (£10 to £15) a month would be paid during apprenticeship.

[In this connection, we may draw attention to the excellent scheme devised by Mr. Harper, city electrical engineer, Melbourne, which was described in our issue of April 20th, 1917.—Eds. Elec. Rev.]

"Business as Usual"?

I beg to enclose you an advertisement cut out of a paper, and as, at the present time, most of us who have in the past done any considerable amount of business are in the condition that almost the only thing we are looking forward to is to preserve business connections, it seems rather odd that anybody should be in a position actually to want trade in this manner; it is more particularly pointed when I notice in the same issue that a firm at Huddersfield have a running advertisement for 20 wiremen for Government work. I am quite sure that most firms with the few men they have left have more than enough to do to keep their old customers running without wanting to take any new work on, and if this optimistic gentleman who advertises has such a superfluous staff, I think I could recommend the attention of the Tribunals or the Ministry of Munitions to him. It will be interesting to know where the new buildings are going up, unless these are Government factories.

Contractor.

June 2nd, 1917.

[COPY.]

ELECTRICAL Installation Contractor requires correspondents in various towns to report upon likely business openings: liberal remuneration. Manufacturers' and Builders' Agents, and others conversant with building and electrical developments, communicate with H419, Evening Post, Leeds.

National Insurance (Unemployment) Acts, 1911 to 1916.

—Contributions are payable in respect of :—

2,270 X.—Workmen employed in the gas department of a City Council, and engaged in drilling holes in gas lamp pillars, or in painting lamps in a workshop.

WAR ITEMS.

Municipal Employés for Military Service.—The Glasgow T C 's Special Committee recommends that 24 employés in the service of the Glasgow electricity department, and 71 additional employés, provided suitable substitutes are found for them, be released for service with the Colours.

Exemption Applications.—The Military appealed to the East Sussex Tribunal against exemption until August 9th granted to two electrical fitters (41 and 30, and passed for general service), and to July 9th allowed to the manager (33, B 1), engaged with a Brighton firm of electrical engineers. The men are engaged in much work at hospitals, and the firm pleaded a depleted staff, 25 of the staff of 35 being boys and women, the skilled men left numbering only five. In the case of the fitter aged 30, the exemption was made final; in the other two cases the exemption was confirmed.

At Bexley, a review was made of conditional exemption held by R. Puffitt (35) and T. Grady (37), both in Class A, motormen on the U.D.C. tramways. The Military Representative said that such men were required for transport service. Mr. Harris said that the men came on the staff at a very critical time, when others went into the Army. The Tribunal respited the appeal until six other cases were gone into. The Tribunal also dealt with the cases of A. R. Williams (40, B1), engineer and tram depôt superintendent; A. H. Duly (29), stoker-driver; C. E. Higgs (41), engine fitter, &c.; and W. E. Wicks (21, C 3)) mains assistant; all of whom had been de badged. The case of Wicks, who is medically unfit, was adjourned until he is called up; in the other cases three months' exemption was conceded.

At Oxford, the Electric Light Co. asked for three months' exemption for W. C. Coates (27), shift stoker, but the appeal was refused. The company also appealed for F. R. Stevens (27), engine fitter, and H. J. Brooks (31), shift stoker, and the Military appealed against three months' exemption granted to S. J. Wright (33), switchman. It was stated that the cases had been dealt with as between the dilution officer and the military representative, and the latter agreed to the cases being dismissed in view of exemption granted by a Government department.

At Winchester, the Military appealed against conditional exemption held by a shift engineer, aged 19, in Class A, on the staff at the Corporation electric light works. The manager, Mr. Ayton, said that of 26 men employed at the works, 17 were of military age, one being unfit owing to his having a short leg. The man appealed against was previously on the clerical staff, but he came originally with the idea of taking up electrical engineering, and he took over the work of a shift engineer in August, 1915. An effort was being made to get a girl substitute. The works were kept running for 24 hours in eight-hour shifts, and if he lost one of his shift engineers the others would have to work in two shifts of 12 hours each. They had lost 17 men from the works, and their places had been taken by men not of military age, boys, and girls. The appeal was allowed and the exemption cancelled, with one month's grace.

Before the Essex Tribunal, the military appealed against conditional exemption held by H. T. Baker (37, C 1), who is engaged as an engineer at the Ilford tramway depôt. It was urged that it was very important that the trams should be kept running, because there were so many munition workers in the district. The appeal was disallowed, and the exemption continued.

Folkestone Tribunal has, on a review, confirmed conditional exemption held by W. R. Varney (39), electrician at the Electric Theatre

Worcester Tribunal has given exemption until September 30th to W. Tetstall (21), electrician. He is the only man left in the business of Mr. C. E. Abell, who is a lieutenant in the Army.

Mr J. M. Joseph (26, C 3), dealer in electrical fittings, of Leyton, has been given exemption until the end of September.

Mr. W H. Meredith (35), electrical engineer, Lye, was appealed against by the military, he having been given three months' exemption by the Local Tribunal on the ground that he is in a certified trade. The appeal was allowed.

At Denton, Manchester, a number of appeals by the Military Representative against exemption granted to tramway employés were heard. The Military Representative asked that men classified as A or B 1 should have their certificates cancelled, but not to be called up until substitutes were provided, and until Mr Anderson, the manager of the Oldham, Ashton & Hyde Electric Tramways Co. was satisfied that the substitutes were acting satisfactorily. The Tramway Co. opposed the application, and on their behalf it was pointed out that it was an important and necessary undertaking, and that it had already lost as many men as could be spared. Fifty-two employés, including mechanics and electricians, had gone into the Army. Twelve motormen had their certificates varied, the Chairman saying they would be put in reserved occupations so long as they continued as motor drivers, or until a competent substitute was provided by the military authorities.

G. Dring, station foreman of the Ilfracombe Electric Light and Power Co., Ltd., was, on May 31st, granted by the Ilfracombe Tribunal a further extension to October, when the case will again come forward. Mr. H. Stewart, the resident engineer, appeared for the company. The case was not pressed by the military authorities.

LEGAL.

An Irish Electrical Assessment.

The Lord Chief Justice of Ireland, sitting in the Appeal Court, Dublin, agreed that the hearing should be taken up as early as possible of the case of the Clones Electric Light and Power Co., appellants, and the Commissioner of Valuation, respondent, which, it was explained by counsel, raises an important point of valuation law. The matter arises on a case stated by County Court Judge Johnston, at the request of the Valuation Commissioner, who is dissatisfied with a decision of the Judge at Monaghan.

The plaintiff company appealed against an order imposing a revised valuation of £100 (which included £20 upon the appellants' power station), assessed upon the undertaking. The first valuation had been £75 and £25 respectively, making an aggregate of £100. Appellants submitted that the revised valuation was excessive. The County Court Judge reduced the valuation to £75, apportioning £25 to the buildings, &c., and engines therein, and £50 to the mains, poles and easements. The questions for the High Court of Appeal are :—(*a*) Assuming it to be a question of law, not of fact, was the County Court Judge right in holding that the accumulators, dynamos, switchboard and shafting and electrical instruments were not machinery for the production of motive power? and (*b*) was the County Court Judge right in eliminating the present value of the machinery from the calculation as to the "landlord's allowances," and treating that value as part of the tenant's capital in respect of which "tenants' allowances" should be made?

The Lord Chief Justice said an important point of principle was involved, and the Court would like to have it fully argued on a day, or days, suitable to all parties.

Dundalk Electric Lighting Loans.

In the Chancery Division of the High Court of Justice in Ireland, before Mr. Justice Barton, on Friday last, the Dundalk Urban Council's application in respect of electric lighting capital came on for hearing, the defendant being the Attorney-General for Ireland.

Plaintiffs sought a declaration that under the Public Health Act and the Electric Lighting Acts the Local Government Board were entitled, if they thought fit, to grant a loan to provide working capital or working balance to enable their electric lighting undertaking to be carried on, wages to be paid, and other expenses to be met until revenue could be collected. The Council had entered into a contract to supply current for power and lighting to the Great Northern Railway of Ireland for their works at Dundalk, and for that purpose had ordered two Diesel engines; but, owing to the war, the delivery of the engines had been delayed, and the Council had been unable for one year to carry out their contract with the railway company, thus causing a loss of £1,800 in revenue. Owing to this situation the estimated revenue had been depleted, and the Council applied to the Local Government Board for sanction for a loan of £2,000, but they replied that they had no power to sanction such a loan, as it was only for permanent works, and not for working capital, that a loan could be granted. They granted £3,000 for additional plant required.

Mr. Dickie, K.C., for the Council, opening the arguments, cited several cases to establish the right to seek the opinion of the Court on the point of law, notwithstanding the decision of the Local Government Board. He entered at large into the question of the meaning of the term "capital," urging that working capital was as necessary as the capital cost of plant, since, he said, there was no use providing plant unless the Council had the funds to pay for it, and the Council had no authority to strike a rate for this purpose, though they could, at the end of the year, strike a rate for any deficiency.

Mr. T. F. McGahon, chairman of the Council, furnished details of the capital expenditure on plant. The Council in the first year, to provide working capital, advanced, he said, £580, and later they permitted the electricity department to retain a large share of its income in order to finance the working, with the result that the department remained in debt to the Council on account of interest and sinking fund. This was felt to be an unsatisfactory arrangement, and the Council wished authority to overdraw the bank account of the electricity undertaking for the purpose of, from time to time, paying wages and running expenses, as would be done in like circumstances by any commercial concern, instead of having the concern in debt to the Council.

In cross-examination, Mr. McGahon said that, owing to the delay in getting the railway company's contract under way, the Council had been involved in heavy capital charges, and their application to the Local Government Board Inspector was alternatively for leave to re-borrow the amount thus paid while the railway scheme was non-productive, or for a loan for working capital.

Mr. Spalding, electrical engineer, detailed the arrangement for supplying working capital to the undertaking.

For the Attorney-General, Mr. Wylie, K.C., held that under the Public Health Act, which was the foundation of the Council's borrowing powers, money could only be borrowed for permanent works.—The further hearing was adjourned until this week.

SOME PATENT AND TRADE MARK CASES.

[FROM A LEGAL CONTRIBUTOR.]

Those who write in the papers about the law's delays and seek to explain the slowness of the legal machine, sometimes attach a portion of the blame to patent and trade mark cases. While it is true that enquiries as to the rights of patentees do occupy a considerable portion of judicial time, the general public knows very little about them. When a breach of promise case is in the list the reporters flock to that particular court, and take note of everything that occurs. On the other hand, when a patent case is called on for hearing, the reporters box is vacated almost at once.

In these circumstances the public have little opportunity of studying the details of this class of case except through the columns of the technical press, and even a technical paper must needs exercise a certain amount of discrimination. For instance, it is not every patent case that would interest the electrical engineer. The invention of a new kind of safety pin might concern his amiable lady, but a case concerning it would not be likely to involve any principle which really affected him in his business.

In the following paragraphs will be found collected together a few recent patent, trade mark, and passing-off cases which appear to be of general interest to readers of the Electrical Review.

Amongst patent cases, those which have to do with failure to work the patent in this country have naturally taken a somewhat prominent position.

In R. Ward's patent (33 R.P.C. 408) an application was made under Section 27 of the Patents and Designs Act, 1907, to revoke a patent granted to Wardwell for "Improvements in or relating to winding machines for yarn threads, tapes, and the like" on the ground that the patented article was manufactured exclusively or mainly outside the United Kingdom. It was contended on behalf of the patentee that there was no manufacture of the patented article either in the United Kingdom or elsewhere, inasmuch as the machine which was admittedly manufactured outside the United Kingdom did not come within all the claims of specification, and that consequently the section did not apply. Alternatively, it was contended that the machine comprised many castings which could only be obtained satisfactorily in the United States. It was held by the Comptroller-General that the machine manufactured in the United States embodied the patentee's invention, or at any rate, an important part of it; that it was covered by many of the more important claims, and must therefore be considered as a "patented article." Further, the reasons given for non-manufacture in the United Kingdom were not satisfactory. He, therefore, decided to revoke the patent, but suspended the making of the order for one month to allow the patentee an opportunity of applying to amend his specification by striking out such parts as admittedly embodied the patented article which was manufactured in the United Sates and not in this country. The applicant was awarded 35 guineas costs.

In another recent case, an attempt was made by a patentee to secure a prolongation of the term of his patent. It never was easy to obtain an extension of time; and this case affords a favourable example of the difficulty there is in persuading the court to allow a patentee to enjoy his monopoly for a longer period than 14 years.

In 1899 a patent was granted for a "method of and apparatus for effecting the storing up of speech or signals by magnetically influencing magnetisable bodies." One of the claims was for: "The herein described method of receiving, storing and reproducing messages, signals, or the like, by subjecting a magnetisable body, such as steel wire or strip, to the action of an electro-magnet which moves along it, or along which it is moved, the coil of this magnet being first in connection with a transmitter, so that the wire or strip is influenced in a manner corresponding to the signals transmitted, and the coil being then in connection with a telephone receiver by which the signals which influenced the wire or strip are reproduced." A petition for the extension of the patent was presented by the assignees of the patent, an American company, which was not a manufacturing, but only a promoting, company. The bulk of that company's stock was held by a Danish company, which itself was not a manufacturing company, the manufacturing in Denmark being done by another Danish company. No attempt has been made to work the patent in the United Kingdom, beyond an endeavour to form a company for the purpose. The invention was of great scientific merit, and apparatus made in accordance with it gave good results, but, although many attempts had been made to produce a commercially useful apparatus, no success had been achieved before the date of the presentation of the petition. The petition did not state the fact that the patentee, with an associate, had received £10,000 from the sale of shares in one of the foreign companies; it stated that the great defect in the machines had been their difficulty of adjustment and their fragility, but the patentee in his evidence stated that a machine exhibited did not suffer from fragility. It was held that the petitioners had not shown that the merits of the invention were such as, in the interests of the public, would justify the extension of the term of the patent, and that they had not explained or attempted to explain or justify their not having attempted to put the invention into use in this country; also that if an extension were granted the benefit of it would belong directly to the petitioners (who had not done anything to develop the invention), and indirectly to the Danish company, and still more indirectly to the patentee; and that the petitioners were wanting in the required *uberrima fides*, in that they had not stated in their petition the patentee's profit, and had stated that the machines suffered from fragility. The petition was dismissed.

It is often convenient for a patentee who has attached a trade mark to his patented article to limit the use of that trade mark to the top of the patented article, especially in a case where he grants a licence to use the patent. The validity of this practice was discussed in the *Bowden Wire Ltd. v. Bowden Brake Co., Ltd.* The plaintiff company, who were the proprietors of the patent for the well-known "Bowden Wire" used in connection with the transmission of power for cycle and motor-cycle brakes, in 1901 promoted the defendant company, and transferred to it that part of their business which was concerned with brakes for pedal cycles only. In 1903 the plaintiff company registered a trade mark for brakes for velocipedes consisting of a picture of a coil of wire with the word "Bowden" enclosed therein, and they granted a licence to the defendant company to use this mark in connection with the brakes for pedal cycles. The licence was limited to the continuance of the letters patent. In 1904 the plaintiff company registered the same trade mark in respect of certain other goods in Class 13. The directors of the two companies were substantially the same until shortly before the commencement of the action. On the expiration of the patent, the defendant company continued to use the mark, not only on brakes for pedal cycles but also in respect of brakes for motor-cycles, which they then began to manufacture. The plaintiff company brought an action to restrain the defendant company from using the trade marks on any goods manufactured by them. The defendant company contended that the licence was ineffective, and that the mark had been used by them for a great number of years, not only with the knowledge but also with the concurrence of the plaintiff company. The defendant company moved to expunge the trade marks, and alleged that they were not distinctive, and that they were calculated to deceive.

It was held that the defendant company had no general right to continue to use the trade mark after the term of the licence had expired, and no right to prevent the plaintiff company from continuing to use the mark in the same manner as they had used it since the registration. It was also held that the trade marks were distinctive and not deceptive, but that on the ground of non-user, an order should be made under Section 35 (1) of the Trade Marks Act, 1905, varying the entry of the first-mentioned trade mark by restricting it to brakes for road vehicles other than velocipedes or cycles wholly propelled by the physical force of the rider. No costs of the motion were given except that the applicants were ordered to pay the registrar's costs. In the action an injunction against infringement of the trade marks, limited in accordance with the above-mentioned restriction, was granted with costs.

While dealing with patent and trade mark cases, it may be convenient to say a few words about passing-off actions. A trader frequently owns that which is better than any patent or trade mark, namely, a good name, in the use of which he is protected by the courts. A recent case may be cited in this connection in order to show in what circumstances the courts will interfere.

It was laid down many years ago that a man will not generally be restrained from using his own name in connection with goods made or manufactured by him, unless it is clearly shown that he has intended to deceive the public. The principle was re-affirmed in a case relating to pianos. It appeared that John Brinsmead & Sons, Ltd., the well-known pianoforte makers, brought an action against Edward George Stanley Brinsmead, a pianoforte manufacturer, and Waddington & Sons, Ltd., pianoforte dealers, to restrain them from passing off pianos made by Stanley Brinsmead as and for the pianos of the plaintiff company, and they also charged the defendants with conspiring together to so pass off the pianos. The plaintiff company put on the fall of their pianos the words "John Brinsmead & Sons, London," in capital Roman letters surrounded by lines. On the fall of the pianos made by the defendant there appeared in a running hand the name "Stanley Brinsmead," with a broad dash at the foot of the "d" coming back under the whole of the name, and the word "London" in printed Roman characters underneath. In the curls of the initial "S" in small letters were placed the names "Edward" and "George." The evidence showed that a "Brinsmead piano" meant to the trade and to the public a piano made by the plaintiff company, and that the christian name used by the plaintiff company and those of the defendant company were not generally known. It also appeared that the defendants' pianos were cheap instruments, and had a sale amongst a different class of people from that to which the plaintiff's company's new pianos were sold. The defendants, Waddington and Sons, Ltd., previously to and at the trial, offered to submit to an injunction restraining them from passing-off, if the charge of conspiracy were withdrawn, which offer was not accepted by the plaintiff company. The evidence against Waddington & Sons, Ltd., showed that they had advertised pianos of the defendant Brinsmead as "Brinsmead" by itself, and had represented to customers that one of such pianos was a "Brinsmead" piano. It was held: (1) That the defendant Brinsmead had put his name Stanley on his pianos as prominently as the word "Brinsmead," and had not attempted to imitate the mode in which the plaintiff company's name was used, and that he had not acted dishonestly, notwithstanding that he knew that he was deriving some advantage from the fact that his name was the same as that of a well-known manufacturer; (2) that the charge of conspiracy failed. The action against him was dismissed with costs. Waddington & Sons, Ltd., having submitted to an injunction restraining from passing-off, an order was made against them with the costs of the plaintiff company up to the date of the first offer, except so far as the costs had been increased by the charge of conspiracy, but the plaintiff company was ordered to pay the increased costs and the costs from the date of the offer.

The second case involved an attempt to acquire a monopoly by claiming an exclusive right to the title of a magazine, but it was not always successful. In *Stevens v. Cassell and Co.* (1913), 30 R.P.C., 199, the plaintiffs were the publishers of magazines called "The Magazine of Fiction" and "The Monthly Magazine of Fiction." The defendants, who were also publishers, had for many years issued a magazine called "Cassell's Magazine," and had lately changed the name to "Cassell's Magazine of Fiction and Popular Literature." The price of the plaintiffs' magazine was threepence, and the defendants' fivepence. The plaintiffs brought an action against the defendants claiming an injunction to restrain them from passing off their magazine as and for the plaintiffs' magazine, and gave evidence to show that when, on many occasions, persons had asked for "The Magazine of Fiction" the defendants' magazine had been tendered. At the conclusion of the plaintiff's case, and without calling on the defendants, it was held that the plaintiffs had proved no title to relief; that they had no right to the exclusive use of the words "Magazine of Fiction," which were purely descriptive words; and that there was no evidence of deception. The action was dismissed with costs.

BUSINESS NOTES.

Electrical Trade of Cuba.—A report has been issued by the Department of Commerce (Washington), prepared by a Special Agent of the Department, on the market for electrical goods in Cuba. The various classes of electrical work on the island are discussed in detail, and suggestions are made regarding the possibilities of developing the business in the future. The application of electricity to systems of lighting, power plants, especially in sugar mills, heating devices, and the numerous other miscellaneous uses to which electricity is put in Cuba, have all been studied. The report may be seen by British firms interested at the Department of Commercial Intelligence, 73, Basinghall Street, London, E.C. 2.

Prohibited Exports from Sweden.—The Swedish Government has prohibited the exportation from that country of electrical machines, such as generators, motors, and converters; also transformers and damping rollers, and stators, rotors, current collectors, magnet poles, and brush-holders, when exported separately.

Book Notices. — "Science Abstracts." A and B. Vol. XX. Part 5. May 26th, 1917. London: E. & F. N. Spon, Ltd. Price 1s. 6d. each net.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXVI. No. 5. May, 1917. New York: The Institute. Price $1.

"The Canadian Patent Office Record and Register of Copyrights and Trade Marks." Vol. XLV. No. 1. January 31st, 1917. Ottawa: J. de L. Tache. Price 20 cents.

Catalogues and Lists.—The Power Plant Co., Ltd., West Drayton, Middlesex.—Leaflet relating to flexible couplings in a variety of patterns.

Messrs. W. T. Henley's Telegraph Works, Ltd., Blomfield Street, E.C.—Folder giving details of a few of the Henley terminal boxes, wall type, stocked ready for delivery; also the Henley lead-cone gland and porcelain terminal ends. Revised list No. U104 (fifth edition) consists of 108 pages of well illustrated particulars, with tabulated sizes, reference numbers, and prices of a variety of Henley terminal boxes. The several sections deal with the following manufactures:—Lead cone and standard wiping glands, terminal boxes for indoor use, ditto for outdoor use, terminal boxes for telephone and multicore cables, colliery terminal boxes, porcelain terminal ends, miscellaneous boxes, and accessories. Since the last edition appeared, several additions have been made, and in the telephone terminal box section large reductions in prices have been made.

British Thomson-Houston Co., Ltd., 77, Upper Thames Street, London, E.C.—New 44-page list (No. 10,555A), containing very full information, with illustrations, prices, &c., of "Eye-Rest" indirect lighting fittings. Several new types of fittings are included. The contents show the extent to which the "Eye-Rest" equipment is now adapted for use with half-watt type lamps. The new list also contains complete details and illustrations of lighting installations, giving full illumination data and tables of values, thus permitting the ready solution of lighting problems with this form of lighting equipment. Special attention is drawn to the new "Eye-Rest" Portables, employing the indirect lighting equipment with half-watt type lamps with floor and table standards, thus giving an equipment which is independent of a ceiling fitting and can be used in any part of the room or removed from room to room as conditions require. The list is being distributed to all holders of B.T.H. Lamp and Wiring Supplies Handbook Binders, and copies can be obtained on application to the Lamp and Wiring Supplies Department at the address given.

Light Electric Motor Co., Baltic Street, Dundee.—A set of illustrated leaflets dealing briefly with various portable electric tools—electric drilling machines, electric grinders, motor-driven pumps, and grinding and polishing machines—and giving prices of same.

Spain.—A new company has lately been formed at Palma de Mallorca with a capital of £20,000 and the title La Sociedad Electro-Mecanico Industrial, to carry on an electrical and engineering business.

Bankruptcy Proceedings. — Brown, Frederick, electrician, Llanelly. First and final dividend, 8s. in the £, payable at Official Receiver's Office, 4, Queen Street, Carmarthen.

Excess Profits Duty. — The Board of Referees has ordered, in response to an application by the Victoria Falls and Transvaal Power Co., Ltd., for an increase of the statutory percentage as respects "the business of supplying in bulk electrical power and power in the shape of compressed air in the Transvaal Province of the Union of South Africa," that the statutory percentage be increased to 9 per cent. in the case of companies or other bodies corporate and to 10 per cent. in the case of any other trade or business.

Liquidations.—Isaria, Ltd.—The controller, Mr. G. S. 140, Leadenhall Street, E.C., has applied for his release.

Trade Announcement.—Mr. F. Evill, who represents the Klein Engineering Co. (1908), Ltd., and the Timbrell and Wright Machine Tool and Engineering Co., Ltd., has removed to 159, Victoria Street, Westminster. Telephone: "Victoria 4561."

For Sale.—Messrs. C. A. Tricks & Son will offer for sale by auction, at Bristol, on June 12th and 13th, the electrical stock in trade, fittings, &c., of Mr. C. M. Simpson. Particulars are given in our advertisement pages to-day.

LIGHTING AND POWER NOTES.

Belfast.—Strike.—On the 1st inst. 72 semi-skilled and unskilled labourers employed at the Corporation electricity works went on strike for higher wages. The men contended that they should have had a rise of 5s. per week when that advance was given some weeks ago by the Committee on Production to the engineers and the members of certain Federated Unions in the employment of the Corporation Tramways. An arbitrator is to be appointed by Sir George Askwith, with a view towards an adjustment of the question. On the two days of the strike the services of light and power were carried on as usual.

Birmingham.—Year's Working.—The annual report of the Corporation electricity department for the year ended March 31st last, shows that the total number of units sold was 149,724,637 as compared with 117,016,321 units in the previous year, representing a revenue of £717,831, as compared with £498,962; over 29,000,000 of the 32,718,316 increase in the units sold was for extra-high-tension current, the increase in this item alone being over 55 per cent. The output for lighting and power, exclusive of tramways, shows an increase of 35 per cent., while the money value of this supply shows an increase of 50 per cent. After meeting all charges for interest and sinking fund, there is a balance of £67,794, of which sum £40,000 has been transferred to renewals, and the balance it is proposed to pay to the credit of the rate account.

In order to facilitate the handling of coal the Committee recommends the purchase of additional land at Nechells for railway siding accommodation, at a cost of £1,600.

The award of the arbitrator, Mr. W. W. Mackenzie, K.C., appointed by the B. of T. to consider the application of the employés of the gas, electricity supply, tramways, and water departments of the Corporation for an additional 5s. 6d. per week has been received. The grant is of 5s. per week for the first full pay day following the award, which is dated May 22nd.

Bray (Co. Wicklow).—Electric power has been installed in a new hosiery factory opened by the Technical Instruction Committee.

Canada.—The Ontario Hydro-Electric Commission has purchased the Ontario Power Co.'s plant and its transmission lines from the Niagara Falls for $22,000,000, as an addition to the Government-owned electric system of the Province.

Colne.—There has been a loss on the electricity undertaking for the past year of £1,300, due to the increased cost of producing current, price of coal, wages, and diminution of income from lighting.

Continental.—Italy.—H.M. Embassy in Rome reports that the Ministry of War has been authorised to advance the sum of about £800,000 to the Ministry of Public Works, which, in agreement with the railways administration, will undertake the immediate installation of hydro-electric plant for the production of power. The power generated will be placed at the disposal of factories working under Government control, but the installations will eventually pass under the control of the railways administration, and should the railways administration have no immediate use for them the Ministry of Public Works will operate them for account of the railways.—*Board of Trade Journal.*

Dublin.—Considerable discussion recently took place in the Council on the decision of the Special Committee providing for the appointment of Mr. M. Ruddle, city electrical engineer, to control the electrical undertaking for a period. It was complained that the Council had had no opportunity of considering the decision, and eventually it was decided that the matter should be dealt with at a special meeting of the Council.

Exeter.—The City Council has passed a resolution urging that municipal electrical authorities should have greater repretation on the B. of T. Electricity Committee.

Folkestone.—E.L. Purchase Deferred.—The T.C. has decided not at present to give notice to purchase the undertaking of the Electricity Co. The next period which gives the Council the option is six months before July 2nd, 1918.

Greenock. — The Harbour Trustees have recently brought into use a fitting-out crane of the electric cantilever type, made by Sir William Arrol & Co. It deals with 150 tons at a maximum radius of 85 ft., and reduced loads at greater radii up to 132 ft. The overall length of jib is 230 ft., and a hook lift of 150 ft. above the quay is possible.

Hebden Bridge. — Bulk Supply Proposals. — The U.D.C. has decided to consider a report in Committee as to the purchase of a bulk supply of electricity from the Halifax Corporation.

London. — Hackney. — The recommendations of the Electricity Committee for a general increase in the price of electricity having been referred back for further consideration, the Council considering the present not an opportune time to determine upon a comprehensive revision of the scale of charges, the Committee recommended that the rates for lighting, cooking, and other domestic purposes and for power and charging batteries should be increased by a further 10 per cent., and the Council agreed.

Nottingham. — Year's Working. — A preliminary announcement regarding the past year's working of the Corporation electrical undertaking states that 14,717,000 units were sold, being 862,000 more than in 1915-16, the increase being due to the growing power load, in connection with which 2,155 motors of 9,420 H.P. are in use. New connections during the year reached a record; there are now 5,007 consumers and three generating stations—viz., Talbot Street, 6,810 H.P.; St. Ann's, 9,500 H.P.; and Eastcroft destructor station, 720 H.P.; making a total of 17,030 H.P.

Salford.—Year's Working.—The annual report of the Corporation electricity department for the year ended March 31st last shows that the total output sold amounted to 29,572,331 units, as against 24,856,435 units in 1916. The revenue increased from £133,764 to £156,953, and after meeting operating expenses, the gross profit was £70,924; the net profit, after the payment of interest and sinking fund charges, was £21,354 as compared with £16,598 in the previous year. The average working cost per unit sold was:—·538d., as compared with ·504d. in 1916 and ·561d. in 1915, the cost of coal per ton being 12s. 2½d. for 1915, 15s. 1¾d. for 1916, and 17s. 6½d. for 1917.

Shipley.—The U.D.C.'s electricity accounts for the year ended March 31st show an income of £16,347, as compared with £15,497 in the previous year, the increase being chiefly due to enhanced sales for power. The cost of coal and labour increased by £1,680, and loan charges increased by £440. It was chiefly due to the increased cost of coal that there was a loss on the year's working of £341. Mr. E. Reynolds, chairman of the Electricity Committee, said they had considered how to meet the debit balance and future increased charges, and recommended no alteration of charges for lighting, but a flat rate of 1¾d. per unit for power purposes, and that the previous two advances of 10 per cent. each should be increased to 25 per cent. on the scale of charges for power, the increases to date from July 1st. This recommendation was adopted by the Council.

Slaithwaite.—The B. of T. has extended the 1914 Electric Lighting Order for one year.

South Africa.—According to the *British S.A. Export Gazette*, the new municipal tailoring department at Johannesburg is being equipped with electrical sewing machines, irons, and other appliances.

Southport.—War Bonus.—The war bonus recently granted to the Corporation employés will increase the amount paid under this head by £6,000, bringing the total to over £10,000. Including other bonuses and war allowances, the total additional expenditure owing to the war is over £20,000, and nearly equal to a rate of 10d. in the £.

Spenborough.—Wages.—The employés at the Council's electricity and destructor works have made application for an advance in wages. The Electricity Committee has appointed Messrs. Blackburn and Heywood to discuss the matter with representatives of the men.

Todmorden.—During the past year the Corporation electricity undertaking sold 422,000 units, of which 321,536 were for power, the maximum load being 290 KW., and load factor 16·6 per cent. The total connections to the mains were 785 KW., made up of lighting, 359 KW.; power, 362 KW.; and heating, 63 KW. The average works cost was 2·19d. per unit sold; the average price for lighting was 4·85d., and for power, 1·15d. per unit. The question of increasing the price of energy is now before a Sub-Committee.

Worcester.—Year's Working.—The accounts of the Corporation electricity undertaking for the year ended March 31st show a profit of £812, but new plant to the value of £986 having been provided out of revenue, there is a deficit of £173. A record output had been obtained from the hydro-electric plant on the Tame at Powick, and the engineer, Mr. C. M. Shaw, suggests that the water power at Diglis Weir, on the Severn, should be utilised, as he considers that 1½ million units per annum can be generated thereby, and a substantial margin of profit, at a selling cost of a ½d. per unit, obtained.—*Birmingham Daily Post.*

Yeovil.—The B. of T. has extended the Yeovil Electric Lighting Order of 1914 for a year.

TRAMWAY and RAILWAY NOTES.

Accrington.—Fares.—The Tramways Committee has recommended that the recently-revised workmen's fares be modified as follows:—That the original workmen's 1d. fares be fixed at 1½d., in lieu of 2d. recently charged, and the original 2d. fares be increased to 2½d.

Birmingham.—Fares.—The Tramways Committee is of opinion that it is necessary (1) that all existing stages be increased so as to allow passengers to ride approximately two miles for 1d.; (2) that all return tickets be abolished, with the exception of those on the 2d. and 2½d. stages; and (3) that the return tickets on these stages be issued to passengers riding before 8 a.m., at 3½d. and 4d. respectively.

Bolton.—In view of the arbitration proceedings pending on the men's applications for a 10s. war bonus, the amount of the rate contribution from the Corporation tramway department has not been announced, but it is stated that it will exceed the estimate of £15,500. Last year the sum was £17,000. The Finance Committee of the Council, it is stated, is asking for a much larger rate aid next year, and if this demand is met it will mean increased fares.

Burnley.—Wages.—The threatened strike of tramway workers in Burnley and 20 other centres has for the time being been averted, the B. of T. having intervened. The men and women workers asked for 10s. per week advance, but the various Corporations affected declined the application. The Burnley Tramways Committee has agreed to refer the matter to the Committee on Production, and to join the Lancashire and Cheshire tramway authorities, who are preparing for arbitration upon the same application.

Eccles.—The *London Gazette* for June 5th contains the full notice of the intention of the Eccles Corporation to lease the tramways within the Borough of Eccles to the Salford Corporation for 35 years from 1904, with particulars of annual and other payments to be made by the latter in respect thereof.

Glasgow.—Year's Working.—As was anticipated by earlier paragraphs in the Review, the statistics just issued for the financial year of the T.C.'s tramways department show that both the traffic and revenue have been greater than ever before—the records easily eclipsing the previous best. The revenue amounted to £1,245,508, an increase of £96,243 compared with the previous year, while the passengers carried totalled 388,294,876, an increase of 25,923,412. The record year is attributed to the fact that the suburban train service has been considerably curtailed and also to the vast increase in the number of women factory workers. One of the features in the returns is, while the number of passengers carried at each of the several fare denominations—½d. to 4d.—was greater than in the preceding year, the increase in the number of passengers carried for the ½d. worked out at over 15,000,000. About 248,000,000 ½d. fares and over 100,000,000 1d. fares were taken. The average track mileage (single) open during the year was 196¼—the same as in the corresponding period of 1915-16, and the car-mileage was 25,786,047—increase 822,738. The receipts per car-mile worked out at 11·592d.—increase ·543d.—and the receipts per passenger at ·769d., increase ·008d.

Lottery Tickets: Legal Position.—Public interest in the position of the prize drawing promoted by the Tramways Department to raise money for war charities, is extending. About 10 days ago the Lord Advocate declared that the "draw" was of the nature of a lottery, and stated that he would be glad to hear what the T.C. had to say in the matter, while the General Assemblies of the Scottish Churches condemned the movement as an incentive to public gambling. The Committee suggested that the Lord Advocate should receive a deputation, and hear the case stated, but the Chief Crown Officer for Scotland asked that the communications be confined to writing. At a meeting of the Committee, this week, the whole position was discussed, and several letters were submitted from representative bodies and public men throughout the country, strongly supporting the "draw," and urging its extension to other large tramway systems. The question of the relation of the Art Union to this "draw" was discussed, and while it was recognised that probably the tramway's efforts would not meet the precise terms of the Art Union Act of 1846 which recognised associations having for their object the distribution by ballot of works of art, or of money prizes to be expended on the purchase of works of art, it was thought that, either by an extension of the statute referred to, or by the passing of a special Act authorising the tramway prize-drawing, and such like, but confining the working thereof to public authorities, there might be legalised what was regarded as a technical breach of the statute. The Lord Advocate is again to be written to for an interview.

Hull.—Year's Working.—The annual accounts of the Corporation tramways for the year ended March 31st show total receipts amounting to £170,175 and a total expenditure of £172,624, leaving a deficit of £2,449, which has been taken from the reserve fund. During the year, 24,686,045 passengers were carried at 1d. fares and 29,439,168 at ½d. fares, the total fares showing an increased value of £2,245 on the previous year.

Keighley.—It is understood that intimation has been made by the Chief Industrial Commissioner's Department of the B. of T. to the Corporation tramway employés, recently on strike for a higher war bonus for the women, that the dispute has been referred to arbitration, which will be heard locally at an early date.

The Tramways Committee has recommended the discontinuance of the issue of cheap prepaid tickets, and the establishment of a uniform fare of 1d. for passengers over 15 years of age for a continuous journey of any distance between any two termini on the local service.

Lancaster.—Year's Working.—At last week's meeting of the T.C. it was reported that there was an actual deficit on the tramway undertaking for the past year of £69, but this was unusually small, and the chairman of the Tramways Committee expressed confidence that they were getting near the day when the tramways would pay.

TELEGRAPH and TELEPHONE NOTES.

Church Telephones.—The worshippers in the St. George's Road Congregational Church, Bolton, have had an installation of electric church telephones put in to enable partially deaf people to participate fully in the services. Fixed in front of the pulpit is the transmitting instrument, with wires to the pews connected, where worshippers will use inconspicuous receivers.

Edinburgh-Glasgow Telephone Service.—According to the *Telegraph and Telephone Journal*, a new underground cable between Edinburgh and Glasgow has enabled a service of junction quality to be provided between a large number of telephone exchanges on the east and west of Scotland respectively.

Hull.—An arbitration award gives concessions as follows to employés of the Hull Corporation telephone service:—5s. to men and 4s. a week to women earning under 30s.; 4s. and 3s. to those exceeding 30s. and under 60s.; and 5s. and 3s. 6d. to those exceeding 60s. a week and not exceeding £250 a year. As a consequence, the Corporation is considering whether it will be necessary to increase the tariffs.

Post Office Revenue and Expenditure.—When the House of Commons on Tuesday went into Committee on the vote of £1,400,000 for the Post Office, Mr. Illingworth, in his statement as Postmaster-General on the work of the Post Office, said it had been rendered specially difficult by reason of the fact that 75,000 of the younger men had been called up for military service, of whom, he regretted to say, 3,829 had been killed. Decorations had been bestowed in 755 cases.

The net revenue for 1916-17 was	...	£2,320,000
As against, in 1915-16	...	£4,430,000
And in 1913-14	...	£6,077,000

The explanation was that an enormous amount of work was done for other departments for which the Post Office had not been paid. As to the telephones, the estimated additional revenue from the alteration of the flat rate was £280,000; the actual additional revenue for 1916-17 only amounted to £120,000. By the end of the present financial year the revenue from this source would probably amount to £230,000. The actual additional revenue from increased trunk fees for 1916-17 was £220,000. Capital expenditure had been kept down as much as possible. The London capital expenditure for 1915-16 was £370,000, and for 1916-17 £93,000. In the Provinces in 1915-16 the expenditure was £882,000, and in 1916-17 £196,000. The number of paid telegrams was still declining. It was 16 per cent. lower in 1916-17 than in 1913-14, and 13 per cent. lower than in 1915-16. The ordinary traffic had fallen from 72,199,000 in 1914-15 to 54,249,000 in 1916-17. The number of Government telegrams dispatched free had increased from 617,000 in 1913-14 to 8,012,000 in 1916-17. The net receipts, however, were only £50,000 less than last year, and more than £300,000 over the receipts of 1913, attributable to the increase of the rate from 6d. to 9d.—*Daily Telegraph.*

The Coming-of-Age of Wireless Telegraphy.—In the *Wireless World* for June, Dr. J. A. Fleming points out that this month marks the completion of 21 years from the date of Senatore Marconi's first British patent, embodying the use of the aerial wire and the earth connection, which provided the key to success in etheric telegraphy. Dr. E. W. Marchant also writes in the same issue on the remarkable achievements of the period. A biographical note sketches the career of the distinguished inventor himself, and an historical *résumé* describes the progress of the Marconi system from the commencement. As a proof that wireless signals could now be sent round the earth with only two relays, it is stated that the San Francisco Marconi station is easily readable at Clifden (Co. Galway), the station at Nauen, near Berlin, at Funabashi, Japan; and Funabashi at San Francisco.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—August 22nd. N.S.W. Government Railways and Tramways. Thirty-six induction motors (Specification No. 4880). September 19th.—One 225-h.p. synchronous motor (Specification No. 4890). Particulars from Electrical Engineer's Office, 61, Hunter Street, Sydney.

Melbourne.—July 25th. Victorian Railways. Step-down transformer and sub-station equipment for Sandringham-Black Rock electric tramway. Particulars from the Chief Storekeeper, Railway Offices, Spencer Street, Melbourne.

Newport (Mon.).—June 9th. Tramway Department. Construction of the Newport Light Railway, Section No. 2. See "Official Notices" June 1st.

Spain.—The municipal authorities of Berlanga (Province of Badajoz) have lately invited tenders for the concession for the electric lighting of the town during a period of six years. The concession for the electric lighting of the town of Deva (Province of Guipuzcoa) for ten years was also recently put up to tender.

York.—June 11th. Coal for one year for the Corporation electricity works (approximately 17,000 tons). Mr. J. W. Hame, Electrical Engineer.

CLOSED.

Birmingham.—Corporation:—

Vaughan Crane Co.—Electric hoist, £3,095.
British Thomson-Houston Co., Ltd.—Turbo-exhauster, £1,686.

Glasgow.—T.C. Gas Contracts Committee:—

Malcolm & Allan, Ltd.—Work and materials for the electrical installation to benzol plant at Tradeston Gas Works.
Allan, Arthur & Ure.—Electric light installation at the small hall of the Couper Institute, Cathcart, £175.

The Trustees of the Clyde Navigation:—

Carbons.—John T. Cartwright, and General Electric Co., Ltd.
Cab tyre cable.—Johnson & Phillips, Ltd.
Switch, plug, and fuse boxes.—Dorman & Smith, Ltd.

Manchester.—Electricity Committee. Accepted tenders:

Cable.—W. T. Glover & Co., Ltd., Callender's Cable and Construction Co., Ltd.
Steelwork for boiler house.—Morton & Co., Ltd.
Turbine-driven boiler feed pump.—G. & J. Weir, Ltd.

Salford.—T.C. Accepted tenders:—

Albion Clay Co., Ltd.—Stoneware conduits for supply to the Manchester Ship Canal Co.'s Irwell Park Wharf, £419.
British Westinghouse Co.—Switchgear at Irwell Park Wharf, £410; E.T. switchgear in connection with cable to be laid to Trafford sub-station, £368; ditto, at Blackfriars sub-station, £375.
W. T. Glover & Co., Ltd.—Lead-covered feeder cable, £2,474.
Bertram Thomas.—L.T. switchgear at Blackfriars, £492.

Todmorden.—1,000 tons of coal for the municipal electricity department: Mr. James Mitchell.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, June 8th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Ordinary meeting.

Royal Institution of Great Britain.—Friday, June 8th. At 5.30 p.m. At Albemarle Street, W. Lecture on "Industrial Applications of Electrons," by Prof. Sir J. J. Thomson, Pres. R.S.

Saturday, June 9th. At 3 p.m. Lecture VI, on "The Electrical Properties of Gases," by Prof. Sir J. J. Thomson, Pres. R.S.

Salford Technical and Engineering Association.—Saturday, June 9th. Visit to Messrs. Taylor Bros. & Co., Ltd., Trafford Park.

North of England Institute of Mining and Mechanical Engineers.—Saturday, June 9th. At 2 p.m. At the Wood Memorial Hall, Newcastle-on-Tyne. General meeting.

Institution of Mining Engineers.—Friday, June 15th. At 11 a.m. At Burlington House, Piccadilly. General meeting.

OUR HALF-YEARLY INDEX.

As it is necessary to effect every possible economy in paper consumption, the Index to Vol. 80 of the Electrical Review, which will be printed in the course of a few weeks, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d. post free. Any reader or advertiser at Home or Abroad who requires a copy for binding, or for other purposes, is asked to make application therefor promptly to: The Publisher, Electrical Review, 4, Ludgate Hill, London, E.C. 4.

NOTES.

Electrification of the Suburban Lines on the French State Railways. Although hampered by the war, the work of electrification of the suburban lines of the Chemins de fer de l'Etat is being proceeded with, and some interesting details of the equipment are given by A. Soulier in *La Nature* for May 19th.

The supply will be three-phase at 15,000 volts and 25 cycles, and will be derived from two generating stations. The current thus produced will be transformed at sub-stations into continuous current. The generating stations themselves are not yet complete, but one of the largest transformer sub-stations has been finished—viz., the Cardinet sub-station.

This sub-station has been built to deal with the power required by the section over which traffic is heaviest. It is divided into two parts—viz., the traction sub-station, where the three-phase supply is received at 15,000 volts and 25 cycles, and the power and lighting section, where the H.T. three-phase supply is transformed to 5,000 volts. In the latter section, the pressure has had to be reduced to 5,000 volts to permit of using the gear in the old sub-station, which was arranged to work at this pressure.

The current, arriving at these two pressures, is carried to a distributing centre which permits either of its distribution to neighbouring sub-stations or of its use in the Cardinet station itself. Groups of special transformers permit of changing over from one pressure to another. The frequency is the same at all pressures, so that if an accident happens to one supply line, another can be substituted, thanks to a suitable combination of transformers. Section switches, pressure regulators, lightning arresters, &c., are provided where the H.T. current enters the sub-station. Before reaching the transformers the current has to pass through special safety-cooled oil switches.

Traction Section of Sub-Station. In this section the H.T. current is transformed down to 650 volts—*i.e.*, the track pressure. After the voltage of the alternating current has been reduced, the supply is fed to the rotary converters. There are at present four converters installed, each of 1,500 KW., thus giving a total output of 6,000 KW. Two others will be installed of the same power. The section is provided with two large fans, each absorbing 40 H.P. and driven by an asynchronous three-phase motor; they remove the hot air from around the transformers, and keep the temperature within reasonable limits. It is estimated that 5 per cent. of the total energy involved in transforming is lost in the sub-station in the form of heat.

The converters are of the 12-pole six-phase type *i.e.*, having six slip rings connected in pairs to the secondaries of three single-phase transformers, the primaries of which, at 15,000 volts, are star-connected. These machines start up on the three-phase current and come into step automatically.

Lighting and Power Section.—Two groups of converters of 600 KW. have been installed, and there is room for a third. Each group comprises a three-phase 5,000-volt synchronous motor coupled to a 600-KW., 500-volt generator. The motors have squirrel-cage rotors.

Two balancing generators, each of 100 KW., at 250 volts, coupled together, serve to balance the two three-wire distributing bridges which feed the neighbouring stations. Two storage batteries complete the equipment.

Rolling Stock.—The motor coaches each have two drivers' stands (one at each end). They are of the latest type, mounted on triple axle bogies; each of the two end axles of each bogie is provided with a 160-H.P. motor, so that the car has available 640 H.P., *i.e.*, 8 H.P. per ton weight, since the total weight under load is 80 tons. The coaches are coupled up on the Boirault system, which prevents the accidents which so often happen when a man has to pass between the buffers. The third rail of the system is somewhat different from those generally adopted. Contact can be made by the slipper either above or below the rail.

Volunteer Notes. — County of London Engineer Volunteers (Field Companies). Headquarters, Balderton Street, Oxford Street, W.

Orders for the Week. By Lieut.-Colonel C. B. Clay, V.D., Commanding:—

Monday, June 11th. Technical for No. 3 Company, Right Half Company, at Regency Street. Drill, No. 3 Company, Left Half Company. Signalling Class. Recruits' Drill, 6.30.

Tuesday, June 12th. Lecture, 6.30. Sergeant Instructor Higgs, "Pontooning." Physical drill and bayonet fighting, 7.30.

Wednesday, June 13th.—Drill, No. 1 Company, Right Half Company, 6.15.

Thursday, June 14th. Drill, No. 2 Company, Right Half Company. Ambulance Class, 6.30. Signalling.

Friday, June 15th. Technical for No. 3 Company, Left Half Company, at Regency Street. Drill, No. 3 Company, Right Half Company. Recruits' Drill, at 6.30 to 7.30.

Saturday, June 15th.- Commanding Officer's Parade, 3.0, at Putney Bridge Station, for Route March.

Sunday, June 17th.—Parade Clapham Common (Tube Railway), 9.45 a.m., for work at Bombing School. Uniform. Rations to be carried.

Macleod Yearsley, *Adjutant.*

Electricity Works Holidays.—In considering the arrangements to be made for the annual leave of the staff and workmen under its control, the Lighting Committee reported to the Islington Borough Council that with regard to those employés who had not been in the service of the Council for 12 months, and who, under the existing regulations, were not entitled to an annual holiday, it was of opinion that it was in the interest of both the Council and the employés (having regard to the present abnormal conditions), that the latter should be granted some respite during the summer months. The Council agreed with the view put forward, and the electrical engineer was instructed to make arrangements accordingly.—*Morning Advertiser.*

British Engineers' Association.—Mr. Wilfrid Stokes, president of the British Engineers' Association, presided, on Wednesday last, at an extraordinary general meeting held to adopt the new memorandum and articles of association which had been approved by the Board of Trade. The meeting was attended by members from all parts of the country, and after the formal resolutions had been passed, considerable interest was taken in the discussion on the wider programme of the Association. Mr. Stokes explained that the necessity for the new powers contained in the memorandum had arisen from the fusion of the Manchester movement for the organisation of the British engineering industry with the British Engineers' Association. In order to give manufacturing engineers the advantage of close consultation with large buyers, users and others, new classes of membership had been created for the Engineering Departments of Public Services and companies and for individual engineers.

Mr. Harry Allcock stated that the circular letter issued to members with regard to the proposals for the organisation of the Association into Trade Sections had met with a most encouraging response, showing that this action would meet a felt want. It was explained that there was no suggestion of interfering in any way with existing Associations already formed for certain branches of the industry, but that these would be invited to co-operate with the British Engineers' Association.

Mr. Arthur Jacob dealt with the question of engineering education and research, and, on his proposal, it was decided to form a Sub-Committee to formulate a scheme for the co-ordination and extension of the educational and research movements at present in existence.

The President briefly reviewed the history of the Association's operations in China, and referred to the greater interest being taken by the Foreign Office in trade developments in that country, as evidenced by the assistance given by Mr. Archibald Rose, H M. Commercial Attaché at Shanghai, during his visits to the commercial centres of this country. The Association is considering the adoption of an extensive educational and pioneering scheme in China on behalf of the British engineering industry.

Mr. Stokes, in his remarks on the difficult problems of after-the-war reconstruction, which included the relations of Capital and Labour, the future control by the Government of industry, the extension of overseas trade, transport and shipping questions, and research, urged upon manufacturers the importance of co-operating, in order to find some solution of these questions for themselves.

Nickel in Ontario.—In the *Journal of the Royal Society of Arts* an advance summary of the report of a Commission appointed by the Government of Ontario to report on the nickel industry of the province is given. It is stated that the nickel ore deposits of Ontario are much more extensive and available than those of any other country. The electrolytic process of refining is the most suitable for Ontario, where electric power is cheap and abundant. Two large refining plants are being erected in Ontario, one to have an initial output of 15 million lb. per annum, by thermal methods, the other—that of the British-American Nickel Corporation, Ltd., which is controlled, and largely financed, by the British Government—to have an output of 5,000 tons per annum by the Hybinette electrolytic process. The output of these two refineries, added to that of works in England refining Ontario nickel matte, will fully meet the entire requirements of the British Empire. It is anticipated that the uses of nickel will be greatly extended after the war. The electrolytic refining process is employed in Norway, the whole output being taken by Germany. The report is stated to be a "veritable encyclopædia of information" on every phase of the nickel industry and trade.

Electric Steel.—According to the *Iron Age*, during the past three years the electric steel furnace has established its position as an important factor in steel production. The United States possesses 136 furnaces, nearly twice as many as a year ago, and last year their output was more than doubled, amounting to 475,000 tons. The estimated output of electric steel in Germany in 1916 was 225,000 tons. At least 88 furnaces are in use in this country, and the probable output of the world within a year or two after the end of the war is estimated at one million tons per annum. In addition to the countries named above, Italy and France are credited with 29 furnaces each, Sweden with 40, Canada with 19, and Russia with 16, while the world's total is given as 471 furnaces for the refining of steel; of these, 181 are of the Héroult type, 70 Rennerfelt, 50 induction, and the remainder Girod, Stassano, Snyder, Electrometals, Greaves-Etchells, &c. The electrical smelting of iron ore is also progressing, Sweden possessing 17 furnaces of 2,000 to 6,000 H.P., with a probable output last year of 100,000 tons of pig-iron.

X-Ray Equipment.—Ealing Chamber of Commerce has undertaken to raise £750 to provide the Ealing King Edward Memorial Hospital with an X-ray equipment.—*Times*.

Irish Agricultural College and Electricity.—In connection with the establishment of a new Agricultural College at Mount Mellary, near Cappoquin, Co. Waterford, electrical power has been introduced, and electrical training will be one of the branches to which students will be invited to give attention. Electric light in the gardens will be used in the dark of winter mornings or evenings to help in urgent work.

Durban's Electrical Plant.—The *British South African Export Gazette* very justly remarks that what Mr. J. Roberts, borough electrical engineer, Durban, was able to accomplish for the Municipality during his recent visit to England on its behalf, suggests that it would not be a bad plan if more officials occupying similarly responsible positions throughout the Union were sent home now and again for the purpose of investigation and personal consultation with experts at this end. It seems that the armature of a high-speed generator driven by a turbine failed, and on Mr. Roberts's advice, the armature was sent to England for repairs, as the work of re-winding was altogether too technical and difficult a matter to be undertaken locally. On his own suggestion, the Council instructed Mr. Roberts to come to England for the purpose of using every effort to get the repairs executed expeditiously, and of ascertaining what recent developments had taken place in the manufacture of other plant which the Council agreed would presently have to be installed." The visit has, we learn, been entirely justified by results. Thanks to the fact that he was in London, Mr. Roberts was able to buy a spare armature from Messrs. C. A. Parsons & Co., Ltd., and have it promptly shipped out to Durban. As a matter of fact, it was actually placed in service within three months of the original breakdown. With reference to the pushing forward of other plant required by the Municipality, Mr. Roberts was able to secure early delivery from the manufacturers of a large condenser, which was badly needed, as well as of other less important plant long overdue, including 500-KW. transformers. In all, by his energy and foresight, the borough electrician appears to have saved the Council much valuable time, and local business men a vast amount of inconvenience and monetary loss. When we state that the amount estimated to be spent is £18,000, and that the total cost to the Council of Mr. Roberts's visit was £223, it is not too much to say that the expenditure was amply justified, although it was made the subject of some criticism by those worthy people who never quite realise what it is to be penny wise and pound foolish."

Our contemporary's remarks are perfectly correct; it pays, and pays handsomely, to send the engineer home at intervals of a few years, to get into touch with manufacturers, and to study the latest developments in electricity supply, which is never at a standstill. We have repeatedly observed the beneficial results of such visits, and cordially commend this policy to electrical authorities in the Dominions and Colonies.

Nitrogen from the Air.—The National Efficiency Board has invited Mr. J. Orchiston, chief electrical engineer to the Post and Telegraph Department, to report on his proposal for establishing an industry in New Zealand for producing nitrates from the air. Mr. Orchiston has acquired data dealing with the cost of hydro-electric schemes in Germany, Norway, and Italy; and in no case, he said, can electricity be generated as cheaply as it could be done by utilising any of the large falls in the south-western sounds of New Zealand. One of the simplest propositions is that presented in utilising the Bowen Falls, in the Milford Sound. He estimates that after making full allowances for all contingencies, energy could be produced for one-fiftieth part of a penny per unit, or 1 H.P. at at a cost of £1 per annum. For nitrogen fixing from the air, Mr. Orchiston doubts if there is a more favoured spot in the world, for at the Bowen Falls there is deep water close to the side of the sound, and perfect shelter in all kinds of weather.—*Auckland Weekly News*.

The B.A. Meeting.—As already stated here, the meeting of the British Association, which was to have taken place at Bournemouth in the autumn, has been cancelled. Annual and other members are asked to maintain their subscriptions as usual, as it would be regrettable if the research work of the Committees, some of which is of great importance, in connection with circumstances arising out of the war, had to be curtailed. A meeting of the General Committee will take place at Burlington House on Friday, July 6th, at 12 noon.

U.S. Electrical Exports.—The electrical exports of the United States in 1916 exceeded in value eight million pounds sterling, compared with less than four millions in 1914 and less than five millions in 1915.

Electric Furnaces for Ferro-Alloys.—The Priestman Collieries, Ltd., made experiments in the manufacture of ferro-silicon at Rowlands Gill in a small electric furnace. On the strength of the results of these experiments they erected larger furnaces, until now they have a 2,000-KW. furnace producing from 10 to 15 tons of ferro-silicon per day. During the last four or five years they have successfully produced 25 per cent., 50 per cent., 75 per cent., and a short time ago 95 per cent. ferro-silicon, the latter of which was of exceptional purity. They have now under consideration a scheme for the production of from 1,000 to 2,000 tons of this material per year. The next alloy they took in hand was ferro-molybdenum. They experienced considerable difficulty in making this alloy, on account of its very high melting point and the difficulty of getting rid of objectional impurities, but are now producing an alloy of excellent quality, testing over 80 per cent. of molybdenum. At the beginning of the war it was discovered that there were practically no stocks of ferro-chrome in the country. They were asked to make that alloy, and within three or four weeks of the outbreak of the war were in a position to supply their customers. Since then they have made large quantities of all grades of ferro-chrome, with carbon content ranging from ½ per cent. to 10 per cent. Two or three months after the outbreak of the war a large demand for ferro-tungsten for the manufacture of high-speed steel set in. To make that material they erected a special furnace house filled with furnaces suitable for the manufacture, and are now producing between 300 and 400 tons of ferro-tungsten a year.—*Iron and Coal Trades Review*.

Ice on Transmission Line.—During a severe sleet storm, Mr. Stuart Van Buren successfully prevented ice forming in dangerous quantities on the conductors of a transmission line, by using the heating effect of the current. This line was of double-circuit construction, connecting a large power house with a sub-station 50 miles away. Under normal conditions, the two circuits were operated in parallel at 60,000 volts. As the storm occurred during light-load operation, the line current was not sufficient to produce the desired heating effect. It was therefore decided to use wattless current.

In order to do this, the two lines were first separated at the power house with one generator on each line, but were left in parallel at the sub-station end. Next, the field excitation was raised to the limit on one machine, and was lowered as much as possible on the other. This set up a heavy wattless current between machines, which was forced to flow over the transmission lines through the sub-station loop. This scheme proved effective in keeping the ice on the wires within safe limits.—*Electrical World*.

Society for Electrical Development.—At the annual meeting of the Society, which was held on May 8th, at New York, resolutions were passed unanimously pledging the Society to support the President in all measures necessary to maintain the honour of the country and the rights of its citizens, and to keep business moving, including the preparation of all electrical systems for the added demands that might be made upon them. Mr. Henry L. Doherty was re-elected president for the ensuing year, and Mr. W. H. Johnson chairman of the Executive Committee. A Committee was appointed to deal with the "Organisation of the Industry," with Mr. J. H. McGraw as chairman, and two representatives of each of the four sections—manufacturers, contractors, central stations, and jobbers—each pair forming a Sub-Committee, whose duty it is to ascertain what their particular branch of the industry wishes the Society for Electrical Development to do for them. The "Organisation of the Industry" Committee will then discuss the various suggestions, and formulate plans to be submitted at a meeting of the board of directors of the Society. The Society points out that electricity in every walk of life conserves time, labour, energy, and money, and thus can lend powerful aid to the country during this time of stress.

Appointment Vacant.—Assistant telegraph engineer (£360), for the Post and Telegraph Department, Federated Malay States. See our advertisement pages to-day.

Fatality.—At an inquest at Bakewell into the death of Joseph Burrows (50), employed at the D.P. Accumulator Works, a verdict of "Nephritis," brought about by the absorption of lead, was returned.

Legal.—London United Tramways, Ltd.—In the Chancery Court on Tuesday, Mr. Justice Eve granted a motion for the appointment of a Receiver for the London United Tramways Co., Ltd. The company, it was stated by counsel, submitted to the appointment. Originally £825,000 debenture stock was issued, and there had been further issues of stock totalling almost another £825,000. The reason for the appointment was stated to be the company's announcement of its inability to pay interest on the debenture stock due on July 1st. (The matter is referred to in the directors' report, which is abstracted in our "City Notes" to-day.)

Prohibited Exports.—The Supplement to the *Board of Trade Journal* of June 7th contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported from Norway, Portugal, Russia, Spain, and Sweden. The Supplement also contains a reprint of the United Kingdom Contraband List in its present form.

The Work of the Central Electrical Laboratory at Paris.—Interesting particulars are given of the above institution in the current number of the *Bulletin* of the Société d'Encouragement pour l'Industrie National. The laboratory, whose director, M. Paul Janet, is responsible for the article in question, is governed by the Société Internationale des Electriciens, under an arrangement with the French Government. Its main activities are two: (1) Tests and measurements on instruments and materials carried out for the public; and (2) research work.

As regards (1), the majority of Government departments depend on the laboratory for the very varied test work which they require carried out.

The Ministry of Marine entrusts that institution with the tests on new types of storage batteries for submarines and acceptance tests on lamps for the Fleet. The tests made for the War Ministry include the measurements on instruments used for acceptance tests of electrical material, and acceptance tests on electrical material used in powder factories.

Another department entrusts the laboratory with the testing of lightning arrester, &c., installations on public buildings. For the Public Works Department investigations are made into the types of meters used by municipalities, &c., for electric supply.

The laboratory has also carried out important experiments on the physiological effects of electricity for a Commission appointed by the last-named Ministry.

The research work has been of a very varied nature, and comprises:—An extensive investigation into the various qualities of carbon used for dynamo brushes; researches by M. Jouaust on the magnetism of iron, its magnetic viscosity, and its permeability at high frequencies; MM. Laporte and de la Gorce's researches on the dielectric strength of insulating materials under alternating and continuous pressures and varying frequencies; and, finally, the very considerable work by M. H. Bureau (now deceased) on insulated wires and cables and on insulating cloths.

With regard to the transmission of energy, M. David has carried out oscillographic researches on one of the most extensive networks in France, *i.e.*, that on the Mediterranean coast, which are very valuable and important in that they were made on an actual supply system, and not in the restricted area of a laboratory.

In photometry reference may be made to M. Laporte's investigations on Violle's platinum light standard—the first experiments to be made in France on this subject since the classical memoirs of M. Violle.

Messrs. Broca and Laporte have studied the action on the human eye of various artificial sources of light, while Dr. Weiss and M. Ch. David have carried out a research on the mechanism of death by H.T. alternating currents.

The laboratory has worthily represented France at various international conferences, in which connection mention may be made of the international experiments carried out at Washington as the result of the International Conference on Electrical Units and Standards, held in London in 1908.

Various papers have been published on this question of electrical units.

Irish Peat Utilisation.—Among various suggestions recently advanced for Irish industrial development, one that has received a good deal of attention is the utilisation of the vast peat bogs of the country for electrical purposes. At the annual Congress in Dublin, last week, of the Irish Technical Association, Dr. J. H. Grindley read a paper on the peat resources, entering a strong plea that the Government and the newly-established Research Council should have impressed upon them the urgent need for assisting in this direction by research work on the basis of nationalisation; and Dr. J. F. Crowley submitted a paper dealing with the cheap distribution of power. Sir Thos. W. Russell, Bart., Vice-President of the Technical and Agricultural Department, said that the peat question had got into the worst possible hands, and warned the Congress that if scientists were going to deal with it, they should remember that they could not take the peat bogs out of the hands of the peasants, to whom they were a necessity, without considerable trouble. The president (Sir Bertram Windle) said one of the misfortunes of Ireland was that the people never really got a grip of the value of research.

A leading authority on electricity has written to the Dublin Press in protest against Sir Thos. Russell's attitude as closing the door to investigation. He points out that there are in Ireland 3,000,000 acres of fuel bog—a supply that would last for 1,000 years—and urges that if science could utilise these deposits it would not fail to provide a less primitive method of supplying the heat requirements of the peasant, who would readily understand that any great development of the country on commercial lines would develop him as well.

Electric Vehicles in Demand.—In view of the restricted supply of petrol, as a result of which a large number of motor-cars have had to be laid up, it is interesting to note that a demand is arising for electric vehicles, both new and second-hand. Thus, in one of the daily papers the other day, there appeared an announcement to the following effect:—"Electric vehicles; good prices given for modern cars in good condition, with or without batteries."

"Electric" Freemasonry.—On May 26th, at the installation meeting of the Electric Lodge, No. 2,087, at the Mitre Hotel, Hampton Court, Mr. W. E. Reid was installed in the chair as Worshipful Master by his predecessor, Mr. E. J. Willcock. Mr. Reid is the son of Mr. E. J. Reid (Reid Bros., Engineers, Ltd.), who celebrated the occasion by presenting the Lodge with a banner, bearing the names of all the Past Masters of the Lodge.

REVIEWS.

The Two-Stroke Engine. By A. M. Low, D.Sc. London: Temple Press, Ltd. Price 1s. 6d. net.

As a scientific investigator who cares nothing for established practice, Dr. Low's views on the subject of two-stroke engines are naturally of considerable interest. We do not expect any work of his to be a mere catalogue of what others have done. Rather do we look for originality and bold forecasting, as when he calls this type of engine "the coming form of internal-combustion engine." This statement of the author would seem to relate particularly to automobile engines, there being little or no reference made to stationary engines; thus he sketches out a fascinating design for a three-cylinder two-stroke light car which certainly ought to be given a trial, as such an engine would be as smooth running as a four-stroke six-cylinder. Whether it would be so efficient Dr. Low does not venture to say. It is true that the efficiency of the two-stroke engine can be raised until it almost equals that of the four-stroke, but this is achieved at the expense of that simplicity which is one of the greatest charms of the two-stroke design, necessitating the introduction of pumps and valves. The author blames prejudice for hindering the more rapid adoption of the two-stroke engine for motor work, but as long as the fuel consumption—a vital matter in these severely rationed days—of the simpler engine is proportionately so much greater that prejudice cannot possibly be dispelled. Here, and in other directions, is work for the designer. Admittedly the latter has been handicapped; thus we agree that "the vast majority of two-stroke engines would have been improved by a knowledge of indicator work on the part of their designers." Such knowledge, however, has been difficult to obtain, owing to the fact that with the exception of the magnetic and oscillating manograph—for the introduction of which we have to thank the ingenuity of Dr. Low—it is not practicable to obtain indicator diagrams at high speeds with any ordinary form of indicator. We can imagine how hopeless would be a card resulting from a run of a two-stroke engine doing its 6,000-8,000 revs. per minute! The mention of such speeds, which have actually been obtained, shows how nearly we are approaching to the internal-combustion turbine, as regards frequency of impulses, in the two-stroke engine; and this is one of the most interesting possibilities in front of the two-stroke engine.—G. S. S.

Gas, Oil, and Petrol Engines. By A. Garrard, Wh. Ex. London: Whittaker & Co. Price 5s. net.

To condense into 221 pages a "description of the construction and operation of the various types of internal-combustion engines" is a large order, bearing in mind the enormous advances that have been made in these engines of recent years. Clearly, there cannot be given in a work on these lines that perfection of detail that would appeal to the expert; nevertheless, the author has succeeded admirably in his main endeavour, which has been to enlighten not the cognoscenti, but the engineering student or apprentice and others engaged in engineering works or concerned in the running of internal-combustion engines. The account, inevitable in works of this class, of the "history and development" of these engines precedes chapters on general principles and fuel and combustion, all being commendably brief and to the point. This clears the way to a consideration, first, of gas engines, then of petrol engines, and finally of Diesel and oil engines. The general scheme of the author is, after giving a brief "introduction" to each class of prime mover, to describe a series of representative engines and fittings. Thus we are told taking the first example from each class, so as to make no invidious distinction—about the Crossley engine, the Rudge-Whitworth motor-cycle engine, the four-stroke Diesel, and the Ruston-Proctor petroleum engine. The accounts of these and numerous other engines are quite well done, and are clearly illustrated by half-tone and line blocks. Chapters on gas producers, Humphrey explosion pumps and ignition complete a very useful little handbook.—G. S. S.

Elementary Strength of Materials. By Ewart S. Andrews. London: Chapman & Hall, Ltd. Price 4s. 6d. net.

Of works on strength of materials a fine assortment exists, but, generally speaking, they are of a costly, elaborate, and highly mathematical kind. Mr. Andrews's book is none of these. It is intelligible, thanks to the adoption of graphical methods, to all of average mathematical ability. Not merely students, but those engaged in practical designing work, will find the book of considerable service. The chapters on testing of materials are very helpful, giving as they do an outline of most of the well known machines for testing materials. We miss, however, any reference to Prof. Dalby's work on this subject, though the automatic load-indicating machine devised by Profs. Dixon and Hummel is described and illustrated. The testing of concrete is interestingly dealt with by the author, who is well known to building and architectural students. The book as a whole is one that we can heartily recommend to those desirous of investigating the elements of the subject, but for fuller treatment we must look to some more ambitious work, as, for example, the same author's larger work on strength of materials, of which the present is in the nature of an abridged edition.—G. S. S.

Engineering Workshop Drawing: First Steps in Engineering Drawing. By Henry J. Spooner. London: Longmans, Green & Co. Price 1s. 6d. net.

Prof. Spooner has given us a cheap and workmanlike book that cannot fail to be of value to all engaged in learning the elements of their profession in the engineering workshop courses of our technical institutes. Photographs are freely and wisely used to show how the various instruments should be handled, and these, combined with the 600 odd other illustrations, go to make up a really strikingly effective little handbook.—G. S. S.

A National System of Economics. By J. T. Peddie. University of London Press. Published by Hodder & Stoughton. Price 5s. net.

It goes without saying that a well-defined and preconceived system of economics is a national necessity—the difficulty is to say precisely what the system shall be. The present volume sets forth the results of the author's study of the problem, and this, in common with many other works on present and future economic problems, affords much food for thought. The whole question of national economics is, however, so broad and so involved that it is immensely difficult to make definite propositions. Yet these it is which are required, and probably to a greater extent now than at any previous time in our history, and we are not sure that at the present juncture the author would not have done better to start off with a statement of the 10 aims (which he now states on the last pages of the book), and base thereon definite proposals as to how they may best be attained—expressing his personal views as briefly as might be, and without copious quotations from the works of other writers.

We do not wish to belittle the present work, for it represents the fruit of much thought and labour, but we believe such a book as we suggest would be of greater national value. What we wish to do is to get our employers and our intelligent workpeople to formulate definite ideas on national economics as relating to their own work, and for the attainment of this end, the more concise and definite the proposals placed in their hands, the better. So much for our personal views, after expressing which it is only fair to outline the treatment which the author has given to his subject.

The first two chapters deal with considerations arising out of the Paris Economic Resolutions, and the conditions required to make those resolutions effective. Much useful matter is presented concerning the theory of free trade and protection and concerning enemy, allied, and neutral trade after the war. The inflation and manipulation of prices is next considered, together with the question as to whether, and how, London may remain the gold market of the world. The author's speculations are interesting and (so far as can be judged) sound, but fresh problems have been raised by America's entry into the war. In discussing the co-operation of Labour in production and politics, the author refutes the Marxian fallacies which have consciously or unconsciously been adopted by organised Labour in the past. The problem of securing sounder relations between Labour and Capital is one of the most serious with which we are faced, and the author's essay on the subject should contribute appreciably towards its solution. The same remark applies to the next chapter, on the economic aspect and problems of modern machinery. Here, again, the author upsets many Marxian views, and exposes facts which are all too often neglected by those who regard machinery as an instrument for robbing Labour of its just reward.

The author regards the minimum wage as the only solution to the Labour problem in general, and the best means of overcoming "restricted output" in particular. In the past it has unfortunately been the case that workers have demanded the proverbial yard when given an inch. However, the author's arguments are sound, and agree in principle with (though they perhaps exceed in optimism!) the views which we have expressed for years past. Chapter VII consists of a powerful plea for agricultural "revival," and an excellent explanation of the importance of agriculture; since these pages were written much has been done perforce which ought to have been done long ago, and surely the main lessons of national food production have now been driven home to us all. Chapter VIII deals with the equally important problem of reform in our transportation rates and methods. The advantages of a "clearing house" system are well explained. The final chapter deals with relative systems of political economy and national economics, and consists largely of an appreciation of List's work and the benefit derived therefrom by Germany. By the way, it is curious to find a statement in the preface that the author felt that his system of economics "rested upon a sure and solid foundation" only after he had read List's "National System of Political Economy."

We believe that this is the best book the author has yet produced. It deserves to be widely read and will amply repay careful study, and we hope that in due course the author will bring out a volume presenting exclusively his own constructive views in crystallised form.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Birthday Honours.—In the list of Birthday Honours conferred by the King, the following appear:—

Mr. H. Pike Pease, M.P., Assistant Postmaster-General, is made a Privy Councillor.

Sir Philip Magnus and Sir Robert Hadfield become baronets.

Mr. F. H. Barker, who has been interested in the development of the Parsons turbine; Mr. T. Gregory Foster, Provost of University College, London; Mr. J. A. F. Aspinall, general manager of the L. & Y. Rly.; and Dr. R. T. Glazebrook, C.B., of the National Physical Laboratory, and a Past-President of the I.E.E., receive the honour of Knighthood.

Central Station and Tramway Officials.—Mr. Fayle, tramway traffic superintendent at Leyton, on leaving for a similar position at Southend-on-Sea, has been presented by the staff and employés of the Leyton U.D.C. tramways with a gold watch and chain.

Mr. R. Allan Brown, who was appointed interim electrical engineer to Falkirk T.C. in September, 1915—on the occasion of the chief electrical engineer, Mr. Harold Ransom, joining the Inns of Court O.T.C.—and was later appointed to the charge post, has received a commission in the R.N.A.S., and leaves shortly for the Royal Naval College, at Greenwich. The vacancy, it is understood, will be temporarily filled.

The Glasgow T.C. is to consider the following increases of salaries recommended by the Tramways Committee:—Messrs. F. W. Christall, mains superintendent, from £365 to £380; J. Grierson, civil engineer, from £305 to £320; D. J. Liddell, outdoor traffic superintendent, from £325 to £340; R. F. Smith, accountant, £295 to £310; G. B. Masterton, chief draughtsman, from £295 to £310; John Crichton, cashier, from £270 to £285; and Miss J. Muir, lady superintendent, £230 to £245.

Mr. J. B. Feltham, electrical engineer to the Mexborough Urban Council, has been appointed engineer-in-charge of the waterworks recently acquired by the Council.

Belfast Corporation Tramways and Electricity Committee has appointed Mr. W. G. Moffat, chief engineer of the Belfast Rope Works Co., mechanical engineer at the Corporation electricity works.

Leek U.D.C. has appointed Mr. Fredk. Swarbrick, of Minehead (Somerset), as chief electrical engineer, at £250 a year.

The services of Mr. Tapper, borough electrical engineer, Stepney, have been requisitioned by the Government Coal Controller for assisting him in the apportioning of coal to electricity undertakings and other large users throughout the country. The Government will pay two-thirds salary, and Mr. Tapper will devote whatever time can be spared to the conduct of the Stepney undertaking.

General.—We regret to state that Mr. J. J. Inglis, chief electrical engineer for Messrs. D. Colville & Sons, has just undergone an operation for appendicitis. We are glad to learn that the operation was very successful, and that Mr. Inglis is progressing favourably.

Mr. W. Hakes has been elected Chairman of the Hull Corporation Tramways Committee, and Mr. Charles Raine has been elected deputy-chairman.

Colonel A. S. Cooper, C.M.G., has been appointed Director of Inland Waterways and Docks at the War Office, in succession to Major-General A. S. Collard, C.B., now Deputy Controller of Auxiliary Shipping at the Admiralty.

Roll of Honour.—Gunner E. Bawcutt, R.F.A., formerly in the cable testing department of the India-Rubber Co., Silvertown, has been wounded in France.

Captain Frederic Hands, R.E., formerly in the electric light department of the same company, was recently killed in France. He was son of Mr. Albert C. Hands, of Snow Hill, E.C. Captain Hands joined the Territorials as a sapper in the Electrical Engineers about 12 years ago. He went to France in October, 1914, with a Wireless Section, and remained there for about eight months, first as sergeant, and afterwards as sergeant-major. He then obtained his commission, and towards the end of 1915 was attached to the Air Lines, and last March obtained his captaincy. Captain Hands was Officer Commanding a Signal Constructional Corps, and he met his death returning late at night from an advanced post.

Private J. Barker, Loyal North Lancashire Regiment, missing since October last, now officially reported killed in action, was employed by Messrs. Dick, Kerr & Co., Ltd., Preston.

Lieutenant I. J. Clarke, of the Canadian Forces, who was killed in action on May 19th, aged 24, was in partnership with his brother in the Prince Albert Electrical Co. He emigrated to Canada several years ago.

Second-Lieutenant Harold Ransom, Argyle and Sutherland Highlanders, formerly chief electrical engineer under the Falkirk T.C., has been wounded in action, and is in a Manchester Hospital.

Lieutenant C. Maurice Down, 1st Hertfordshire Regiment, now attached R.F.C., has been awarded the Croix de Guerre. He has also been recommended for the Military Cross.

Sergeant John Dixon, who was employed in the tramways department of the Hull Corporation, has been awarded the Military Medal.

Staff-Sergeant George Marshall, R.E., who, prior to the war, was in the employment of the Dundee Electricity Works, has been mentioned in dispatches for good work done in France.

Wireless Operator Alfred Barrett Harwood is missing, and presumed drowned in the recent sinking of the *Arcadian*.

Lieutenant J. A. O'Sullivan, R.F.C., killed in action on May 27th, aged 20, was the only son of Mr. P. F. O'Sullivan, chief engineer of the Dublin United Tramways Co.

Corporal G. Cook, Essex Regiment, who has fallen in action, was with Messrs. Crompton & Co., Ltd., Chelmsford.

The Military Medal for bravery in action has been awarded to Private A. Shacklady, King's Liverpool Regiment, who was formerly on the staff of the St. Helens tramways.

Sergeant R. Greatorex, Chief Signaller, Border Regiment, formerly a driver on the Corporation tramways at Stockport, who gained the Military Medal for gallantry in action, has been presented with a lever watch by the Bredbury and Romiley Soldiers' and Sailors' Recognition Committee.

Private Colledge, formerly at the Rugby works of the B.T.H. Co., has been killed whilst dressing a wounded comrade in the open.

Corporal I. B. Lockhart, Cheshire Field Co., R.E., killed in action, was in the electrical engineering department of Lever Bros., Ltd., of Port Sunlight.

Sergeants J. Jackson and G. W. Jackson, brothers, who were both formerly inspectors in the Leeds Corporation electric lighting department, have died in hospital of wounds received in action on May 14th and 15th respectively.

Second-Lieutenant J. D. Ferguson, who was formerly on the staff of the Glasgow Corporation tramways department, after being officially reported missing on April 28th, is now announced to be a prisoner of war.

Private A. C. Pugh, aged 19, who was employed by the Kidderminster Electric Tramway Co., has been missing since April 28th.

Lance-Corporal R. Clifford, Sherwood Foresters, who was employed by the Electric Construction Co., Ltd., at Wolverhampton, has been killed in action.

Sergeant J. T. Deans, Army Cyclist Corps, who was killed in Palestine on April 19th, aged 23, was employed by Messrs. Chalmers, Ltd., electrical engineers, of Glasgow.

Private F. Walker, Canadian Mounted Rifles, previously missing, now reported killed, was employed at the British Westinghouse Co.'s works, Trafford Park.

Obituary.—Mr. Wm. Harpur.—We regret to record the death, at the age of 65 years, of Mr. William Harpur, city engineer of Cardiff.

NEW COMPANIES REGISTERED.

Cathodes, Ltd. (147,620).—Private company. Registered June 1st. Capital, £10,000 in £1 shares. Manufacturers and repairers of copper water jackets for internal-combustion engines, fuses, and other parts of shells, and similar articles, by electrolytic deposition, engineers, metallurgists, &c. Agreements (1) with C. F. Peczenik, (2) with N. Bosanquet, and (3) between Alastair-Houston-Boswall-Preston and T. Hamilton-Adams. The subscribers (each with one share) are: F. W. Darch, 20, Eastcheap, E.C. 3, solicitor; A. Taylor, Thames House, Queen Street Place, E.C., chartered accountant. The first directors are: T. Hamilton-Adams, N. Bosanquet, Sherard Cowper-Coles, Alastair-Houston-Boswall-Preston, and G. Houston-Boswall-Preston. Registered office: 11, Arundel Street, W.C. 2.

Renew Electric Lamp Co., Ltd. (147,598).—Private company. Registered May 31st. Capital, £10,000 in 10s. shares (10,000 5 per per cent. cum pref.). To take over the business carried on at 83, New Street, Kennington, S.E., as the Renew Electric Lamp Co., with F. Harrison and others. The subscribers (each with one pref. share) are: W. A. Ward-Jones, 7, Queen Street, E.C. 4, solicitor; T. J. M. Hume, 124, North View Road, Hornsey, N. 8, clerk. The first directors are: R. G. M. Delpech, one other to be nominated by him, and F. Harrison. Qualification, £100. Solicitors: Mawby, Mawby & Morris, 7, Queen Street, E.C. 4.

Geo. W. Baker, Ltd. (9,866).—Private company. Registered in Edinburgh on May 30th. Capital, £2,000 in £1 shares. Electrical engineers and manufacturers, &c. The subscribers (each with one share) are: G. W. Baker, 29, Kengrew Street, Glasgow; J. Smith, Machrihanish, hotel proprietor. The first directors are: G. W. Baker and J. Smith. Registered office: 19, Blythswood Square, Glasgow.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Tyne Electric Steel Foundries, Ltd.—Issue on May 10th, 1917, of £1,500 debentures, part of a series of which particulars have already been filed.

Tuke & Bell, Ltd.—Mortgage on proceeds of 16 munitions contracts, dated May 14th, 1917, to secure all moneys due or to become due from company to London City & Midland Bank.

Alert Electrical Co., Ltd. (78,971).—Capital, £2,000 in £1 shares. Return dated February 28th (filed May 5th), 1917. 708 shares taken up, £708 paid. Mortgages and charges, Nil.

CITY NOTES.

Metropolitan Electric Tramways, Ltd.

Revenue for 1916, £558,866. After including the balance brought forward from 1915, and deducting all expenses chargeable to revenue, including a provision of £22,158 for future reconstruction and renewels, £37,796 remains, out of which £11,015 is put to reserve, £25,000 is required for preference dividend, and £1,781 is to be carried forward. The traffic receipts, after adjustment of accounts with the L.C.C. in regard to through running services, amounted to £504,338, showing an increase of £43,515. This increase is more than swallowed up by the increase in working expenses. Passengers carried: 1916, 105,109,403; 1915, 89,656,054. Average receipt per passenger: 1916, 1.16d.; 1915, 1.23d. The units sold by the North Metropolitan Electrical Power Supply Co. were 53,352,819, as against 39,457,712 in the previous year. As a result of the abnormal cost of fuel, the gross profits of the Power Co. show a decrease of £4,081. Meeting: June 11th.

Electric Construction Co., Ltd.

Mr. P. E. Beachcroft presided at the annual meeting on May 31st. He said that the accounts again showed considerable improvement. The gross profit from manufacturing and contracting was £103,000, against £88,500, an increase of £14,500, and the net profit £51,500, against £43,200, an increase of £8,300. The increase in net profit was about 20 per cent., which, having regard to constantly increasing prices of all materials and higher rates of wages, was very satisfactory. Increases in wages were regulated by the Ministry of Munitions, and were generally put into operation with only short notice, but under existing conditions this might be unavoidable. As no corresponding increase, however, could be obtained on current contracts, they would realise how difficult it was nowadays to frame accurate estimates. For example, on April 1st an increase of 5s. per week was granted to all workmen, and a war bonus of 10 per cent. to the weekly staff. The work in progress on March 31st (which was greatly in excess of any previous year) would have to bear the full increase, and the estimated profit accruing for the new financial year would be somewhat reduced. It was to be hoped, therefore, that if and when further increases were granted, some opportunity would be afforded employers of completing current contracts on the old basis, or of being granted an increase in prices by Government departments on such contracts. For their improved results they were again indebted to a larger turnover. This having been obtained from substantially the same equipment as in pre-war times, very special exertions had been made by both the staff and workmen, for which they could not be too highly commended. The recent unrest in the engineering trade was non-existent in the company's shops, and their interest in the welfare of the men had been reciprocated by loyal and unremitting efforts on their part. The speaker said he concurred in the views expressed by many chairmen of public companies on the danger of appropriating so large a proportion of excess profits. The simplicity of the tax was of itself, of course, a great temptation, and to get as much as possible out of the taxpayer was presumed to be the duty of those who administered the Acts. Moreover, no corresponding duty had been imposed by Germany, where large sums were being accumulated by manufacturers, which would be utilised in capturing neutral markets. If any great expansion was to be made in the trade of this country, there must be a corresponding accumulation of capital, but how this was to be accomplished with so large a proportion of profits taxed at the source it was difficult to see. Regarding the business generally, their position gathered strength year by year, and he saw no reason why this should not continue. Much of their success was due to the amicable relations which had existed between the workpeople and themselves. They had endeavoured in every reasonable way to do what they could to contribute to their well-being and comfort, and many of the recommendations made by the Ministry had been in operation at Bushbury for some years. They had provided up-to-date recreation rooms, and ground for tennis and bowls.

and such facilities, he considered, were essential for the health and well-being of employés of all industrial concerns. Their clubs were well managed and controlled by the employés themselves, and were almost entirely self-supporting. The future of industrial development after the war was occupying the minds of all who had the welfare of the country at heart, and legislation must take account of future generations. The proper education and training of the young to take their part in that development were all important, and technical school training should be compulsory. Wolverhampton, where their works were situated, had recognised its duty in this matter, and had provided excellent classes. For many years they had encouraged their boys to attend these technical classes, and successful students had been awarded prizes, and had been given promotion in the workshops. They had reintroduced the system of indentures, under which they hoped to turn out journeymen possessed of a greater degree of skill and knowledge of their trade, and in other respects were doing what they could to encourage and help the boys. Personally, he would like to see it made compulsory for factory boys to attend classes until they were, say, 18 years of age, and compulsory upon employers to give boys these facilities during business hours. This might somewhat disarrange the routine of workshops, but it would only be temporary; and would anyone deny that the advantage to the nation would not far outweigh any inconvenience or additional expense to the employer? The chairman expressed appreciation of the work of the managing director, Mr. Gray, the joint director and secretary, Mr. Willock, and the manager at the works, Mr. Furniss.

London and Suburban Traction Co., Ltd.

Revenue for 1916, £120,586, against £122,430 for 1915. Out of the total available balance of £84,857, the full dividend of 5 per cent. on the cum. pref. shares is paid, leaving £4,684 to be carried forward. The continuance of the war has adversely affected all the subsidiary companies owing to the large increase in the cost of labour and materials, but in the case of some of the companies the increased cost of operation has been largely met by an expansion of revenue. The position of the London United Tramways, Ltd., is referred to. Since the commencement of 1917 it has become evident that the net results for the year will be even less favourable. In these circumstances, and in view of the fact that a large sum will be required to put the undertaking into a proper condition of repair, a reorganisation of the capital of the L.U.T. appears unavoidable. Pending the formulation of a scheme for this purpose, proceedings have been commenced by a debenture stockholder of the L.U.T. for the appointment of a receiver. Until that scheme was settled, it was impossible to state how far the London & Suburban Co.'s interests in the company might be affected. No dividends have been paid by the L.U.T. since July, 1914, when ½ per cent. was paid on the preference shares. Meeting: June 13th.

Delhi Electric Tramways and Lighting Co., Ltd.

Gross receipts of tramway undertaking for 1916, £11,135; electricity supply undertaking, £22,934. These figures represent increases of 16 per cent. and 13½ per cent. respectively. Combined undertakings show a net revenue of £11,593, against £10,300 in 1915, and £8,163 in 1914. After charging general expenditure in London and Delhi, debenture and loan interest, Indian income-tax, and depreciation of profit and loss account, £3,194 remains, plus £896 brought forward. There is put to renewals reserve £1,000, 2 per cent. (less income-tax) is to be paid on the preferred shares, and £1,089 carried forward. Plant, equipment, and rolling stock have been overhauled, and are in good condition. Cost of upkeep will probably continue to be heavy for some time. Additions to plant during 1916 cost £1,856. The allocation from profits to meet depreciation of plant and equipment has been increased to £4,000, making the total £10,000. Further plant is imperatively necessary, and a contract for a third Diesel engine has been made. Arrangements have been made locally for the temporary use of an old machine. The provision of other necessary plant, equipment, and mains remains in abeyance for the present. Owing to these difficulties, and owing to the high prices of all materials, connections to new consumers are temporarily restricted, and charges for supply are increased.

London United Tramways, Ltd.

Gross receipts for 1916, £336,335 (increase £2,190). Increased cost of material and labour increased the expenses by £34,010. After including the balance brought forward, and deducting interest and all expenses chargeable to revenue, there is an adverse balance of £2,583 to carry forward to 1917. The report says:—"It has now become evident that the net results of operation in the current year will be even less favourable. In these circumstances, and in view of the fact that a large sum of money will be required for the purpose of placing the company's undertaking in a proper condition of repair, proceedings have been commenced by a debenture stockholder for the appointment of a receiver pending the preparation of a scheme for the reorganisation of the company's capital." As a result of further negotiations between the directors and the L.C.C., the litigation arising out of the arbitrator's award in the matter of the purchase of the company's tramways in Hammersmith, which form part of the security of the 4 per cent. first mortgage debenture stock, has been settled on terms which are set forth in the report, the purchase price being £235,000, completion to be postponed until the end of the war, and £12,000 towards the company's costs. The company may discontinue forthwith the generation of electricity at the Chiswick power station, and purchase the energy required for the Middlesex and London lines from the Lot's Road generating station, Chelsea, from which the current for the Surrey lines is already taken. The company may convert a portion of the power station into a transforming station, of which they will retain possession for 21 years in consideration of their giving the Council a free supply of electricity for a like period to the tramways to be taken over by the Council. Passengers carried were 65,734,446, as against 63,145,226 for 1915; car miles run 7,494,898, against 7,744,894 for 1915; average receipt per passenger 1.17d., against 1.21d. for 1915. Annual meeting: June 12th.

Callender's Cable and Construction Co., Ltd.

Presiding at the annual meeting, on Friday last, Sir J. Fortescue Flannery, Bart., M.P., said that during the war the course of all manufactures had been changed from the making of goods for the benefit of man to the making of implements for his destruction. Their manufactures had followed that unhappy downward course in an increasing degree each year since the war began. Whilst sparing no effort to serve the State, they had struggled hard to keep together their old and valued business connection which existed at home, in the Dominions, and in neutral foreign countries. They had had some success in that endeavour, and they had taken every precaution to enable them to open out again in their commercial connections when the war was over. In the meantime, the Minister of Munitions had imposed such restrictions as completely to change the ordinary course of their business. They had forbidden the use of copper for the making of cables, excepting those specially sanctioned for the war and for special purposes. The Minister of Shipping had restricted their export even of goods already made, and their foreign and colonial orders, the satisfactory execution of which would have redounded to the credit of the company, were now in a state of indefinite suspension. They had, however, not been without plenty of occupation, and the variety of the war munitions which they had taken in hand at the request both of the War Department and the Admiralty had been very great, and formed a monument to the mechanical ingenuity and the business adaptability of the managing director, Mr. T. O. Callender, and to his large and highly competent staff. Last year he mentioned how largely they had adopted the services of women, especially in their works in Lancashire. During the past year they had more women actually, and more in proportion than they ever had, and they were becoming more competent, capable, and satisfactory. They had had several substantial increases in the cost of labour as well as in the cost of materials. Since the last meeting they had opened a building which was intended for, and which was splendidly adapted to, every social and recreative use to which the employés could put it. It cost several thousands of pounds, and it had accommodation for seating nearly the whole of the employés at one time at meals, and at other times affording an opportunity for social meetings and recreation. They were constructing somewhat similar accommodation at the Erith works, while at Belvedere, quite close to their works on the Thames, they had a hostel which was intended for the living and sleeping of the female employés. They had already organised a system of "first aid" in case of accident or sudden illness, and they were endeavouring to extend that so as to have something more in the nature of hospital accommodation. The increase in wear and tear of plant had been considerable, because the plant had been working at high pressure all the time. They had enormously increased their output, and they had worked long hours. They had made such provision as seemed to be reasonable for depreciation. At both their Anchor works in Lancashire and their Erith factory they had put in quite a quantity of new and improved machinery. They had also increased the buildings very considerably, and at the moment they were constructing practically new works upon a portion of the land that the forethought of the directors had provided in years gone by. Having referred to the strengthening of the board by the election of Mr. A. W. Tait, the chairman proceeded to refer to the accounts. There was, he said, no change in the capital and the liabilities, in the reserve, or in the machinery renewal, but bills payable were £75,000 less than they were a year ago. That was one reflection of the shortage of commercial trade to which he had already referred. Their trade creditors and other liabilities were something like £159,000 more than they were last year; that was a reflection also of the change in regard to higher prices. On the other side of the balance sheet, the item for depreciation was £17,000—£7,000 more than a year ago, that being the very moderate assessment which they had put upon the extra depreciation to which he had drawn their attention. Cable drums, contract plant, &c., stood at £36,917, which was £4,000 less than a year ago, due to the fact that they had also depreciated those particular items on account of the extra service to which they had been put. The profits amounted to £190,000, as compared with £177,000 last year.

an increase of £13,000. That extra £13,000 profit was a very small increase in proportion to the labour and trouble required to earn it. They proposed to pay a dividend, which amounted with bonus and special bonus to a rate of 20 per cent., which would leave £249,000 to be carried forward. The 20 per cent. distribution, absorbing £35,000, was just one seventh of the carry forward; in other words, they were being advised to carry forward an amount equivalent to a dividend of 20 per cent. for seven succeeding years. He did not promise them that dividend, and he did not know what to say about the future, which was very doubtful in all commercial enterprises, but it was a very fair, and even satisfactory, opening for the accounts for the new year. He would like to remind them that those very gratifying results had not been obtained by profiteering. They had not been paid excessive prices; they had made no unfair bargain out of the needs of the nation. They had changed their form of manufacture at the bidding of the State, and they had served the State for a reasonable and moderate remuneration. There had been no sensational increase in their profits; it was an honest profit largely based upon the accumulated savings of past years. If anybody should say that 20 per cent. was a high profit, the answer was that that profit had not all been earned in the year just closed, but that it was the result of the thrift, savings, and accumulations of many years past.

Mr. T. O. Callender, in seconding the motion, referred to the men who had joined the Forces, and to those who had laid down their lives. 678 men who formerly worked for them were now serving either in the Army or in the Navy. Under ordinary circumstances it was his custom to give them some information as to the new lines on which the business was progressing, and the new developments which were taking place. He was sorry that owing to the special nature of that business, and owing in many cases to the extremely confidential work they were doing, he could tell them but little. Most interesting work in various directions had been undertaken, but it was impossible in any way to specify what it had been. The ordinary run of their business in connection with the making of cables had practically ceased. It was impossible to obtain the necessary materials, copper being only one of them, and even if they could make cables it would be almost out of the question to get them to their destination. They recognised that when the war came to an end a good deal of work would be required to win back for the company the trade which had been lost through the necessary closing down of many of those old connections. Only a few days ago they received intimation that one of their friends in Scandinavia, who had been in the habit of making use of large quantities of their cables, had found it necessary to place their orders with a neighbouring country, and for the present, and, he was afraid, for some time to come, that market would be closed to them. While they recognised that those difficulties would arise, they were ready, when the war came to an end, to hold their own with any of their competitors, and to win back any part of their business which might have passed into other hands. They considered that although the success of the company had been considerable in the past, it was probable they would have a much larger and greater work to do in the future in the new England which would arise after the war. It was unquestionable that electricity would play a greater part in the daily life of man, and a much greater part in the manufacturing life of this country, than it had ever played in the past, and it was equally certain that, when that time came, Callender's would not be behind in obtaining a share of the orders which would result. They therefore anticipated a good deal of worry and a great deal of labour, but they hoped with satisfactory results, when the happy day arrived. They had spent large sums of money in the upkeep of the works; maintenance and depreciation had of necessity to be increased, for not only were the prices which they had to pay for materials infinitely greater than in past years, but the class of labour which they had to make use of was nearly always less experienced, and often less careful, than of yore and as a result their plant and machinery, and tools and fittings suffered from the handling which they got. It was for those reasons that they had added so largely to depreciation.

The report was adopted.

United River Plate Telephone Co., Ltd. Gross earnings for 1916, £709,226; gross maintenance and other charges in Argentina and London, £477,371; profit £231,855, plus £6,234 brought forward. After paying debenture interest, preference dividend, and 8 per cent., free of income-tax, on the ordinary shares, and putting £2,000 to staff provident fund, £50,000 to reserve, and £26,000 to war contingencies reserve fund, £6,990 remains to be carried forward. To fill vacancies caused by the death of Sir G. Franklin and Mr. G. Keith, Sir John Gavey has been elected chairman, and Messrs. J. E. Kingsbury and A. Anns directors.

Anderston Foundry Co., Ltd.—The report shows that the profit, after providing for depreciation, excess profits duty, and income-tax, was £32,767, against £30,329, before providing excess profits duty. Dividend for the year 22s. per share, putting £5,000 to reserve, and carrying forward £8,720.

Brazilian Traction, Light & Power Co., Ltd.—Quarterly dividend, 1½ per cent. on the fully-paid cumulative preference shares.

Calcutta Electric Supply Corporation, Ltd.—The units sold to consumers during the five weeks ended March 30th were 2,591,258, compared with 2,122,507 units last year.

Canadian General Electric Co., Ltd.—The directors have declared a quarterly dividend of 2 per cent. for the three months to June 30th, being at the rate of 8 per cent. per annum, on the common stock.

STOCKS AND SHARES.

Tuesday Evening.

The main feature of the markets throughout the House is the continued quietude of business. Russia has become something of a thorn in the financial flesh which threatens to be permanent; and with the rate of exchange daily moving against Petrograd, the investor, even in first-class British securities, is disposed to go slowly in the way of investing his money.

Meanwhile, authorities in high places are roundly rating us for our extravagance—and not us alone, but the Government also, for not taking away, by taxation, the means whereby extravagance is maintained. In spite, however, of this, with its appeal for more taxes, coupled with the quietude of business, prices of most investment issues are extremely well held. The electrical and the telegraph departments are excellent illustrations of this; and if proprietors of stocks and shares are tempted to complain that values do not improve, they have at least the consolation of seeing them keep remarkably steady.

Metropolitan Consolidated is ½ better at 23¼, and Underground incomes are good at 83. This strength is shown in the face of weakness in most of the Steam stocks, the latter being unmoved by the fact that present prices include the greater part of the first half year's dividends. Labour troubles—present and to come—are still the deterrent factors in the situation. Metropolitan surplus land stock is better at 19, and Districts are unchanged at 16. With the recent rearrangement of fares on the L.C.C. trams, the expectation is revived that fares on the Tube lines may be similarly treated before long.

Mexicans are mostly dull and heavy; the 5 per cent. bonds of the Tramway Co. have shed 2 points. Inquiries have been made during the last day or two on behalf of Amsterdam capitalists who appear to be anxious to take a hand once more in these ventures. The market, however, has drifted into such a limited condition that, while there is difficulty in getting a bid for stock one day, on the day following it may be just as hard to find a seller, so much are demand and supply governed by the immediate sentiment of the moment in regard to Mexico. If the Dutch started to buy Mexican industrials in earnest, prices would probably go bounding ahead; and holders of the stock on this side might welcome the opportunity for getting out, even at the big loss which most sales would entail.

Rio de Janeiro Tramway bonds are better, in consequence of a further rise in the Brazilian exchange, and for most of the Brazilian issues there is an increased demand, in which, however, Brazilian Tractions have not yet participated. The British Columbia group is still flat. Buyers want the offer of good-class Canadian industrials, more particularly those connected with the electrical industry; and the prospective purchasers announce that they are not out for high dividends, but that they are content with a comparatively low return on their money. Yet, so contrary are Stock Exchange currents nowadays, there is scarcely any stock to be bought; and whatever shares do come into the market are snapped up by people who have been waiting for weeks.

Anglo-Argentine Trams are dullish on the issue of the report, a document which shows that the undertaking is still struggling against adverse conditions. The second preference shares again go without their dividend. The Lisbon Electric Tramways increased its passengers by 10 millions but working expenses rose still more heavily, and the ordinary shareholders go dividendless, against the 1½ per cent. they received in the previous year.

Changes in the telegraph and telephone market are few and far between. West India and Panama Ordinary are left unchanged at 22s. 6d. ex the dividend of 6d., deducted last week, while Orientals at 2¼ show a nominal fall of 1/16, accounted for by the dividend of like amount. Amongst the stocks not quoted in our list Amazon Telegraph were done the other day at 4 and 4 1/16. Cuba Submarine Preference changed hands at 14¼, and the last business done in Direct Spanish Preference was at 7½. A little demand has arisen for the debenture stocks in this section. Eastern Extension Fours being a point better at 74, while Eastern 4 per cent Debenture is 73, the difference arising from the fact that the former stock carries about 10 weeks' more interest than the latter. West India and Panama first Preference were done at 7⅝ at the end of last week, but the Seconds have lain dormant since the beginning of April, the nominal price being 6, ex the recently-paid dividend. Monte Video Telephones are a little better at 17s 6d., and the 5 per cent Preference shares can be bought about 15s. 3d. The company pays 6 per cent. on the Ordinary shares.

The most active section is once more the Marconi market. The price spurted 3/16 to 3¼, upon another wave of rumours in respect of the amount which the company is likely to receive from the Government. The dividend announcement is due almost immediately, and the report is eagerly anticipated in the hope that something will be said on the compensation question. With the parent shares the subsidiaries are also firmer, Marconi Marines being 2⅜ and the Americans 16s. 3d., although Canadians still languish at 9s. Marconi Preference have risen ¼ to 2½.

India-Rubber shares are 5s. up, British Insulated 2s. 6d., and Telegraph Constructions 10s. British Aluminium ordinary rose 6d., and Castner Kellner 1/16; in fact, the industrial market shows up much better than any other section of the House at present. Strong demand for shares in companies connected with explosives is explained by reports of a coming combine of the principal undertakings. Iron, coal, and steel shares have advanced substantially; armaments are better, and these various activities have diverted attention to some extent from rubber shares, where business has been further restricted by a slight fall in the price of the produce, which has taken it a shade below 3s per lb.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend 1915.	Dividend 1916.	Price June 5, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	9	6½	—	£6 18 6
Charing Cross Ordinary	5	5	8½	—	7 2 10
do. do. do. 4½ Pref.	4½	4½	8¼	—	6 18 6
Chelsea	4	3	2⅞	—	5 4 4
City of London	8	8	12	+ ¼	6 13 4
do. do. 6 per cent. Pref.	6	6	10		6 0 0
County of London	7	7	10⅝	-	6 11 9
do. 6 per cent. Pref.	6	6	10	-	6 0 0
Kensington Ordinary	7	10	5¼	—	5 11 7
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	8¾	—	5 6 8
Metropolitan	8	8	2¼	—	6 0 0
do. 4½ per cent. Pref.	4½	4½	8¼	—	7 4 0
St. James' and Pall Mall	8	8	6¾	+ ⅛	6 5 6
South London	5	5	2¾	—	7 5 6
South Metropolitan Pref.	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	5¾	—	6 1 9

TELEGRAPHS AND TELEPHONES.

	Dividend 1915.	Dividend 1916.	Price June 5, 1917.	Rise or fall this week.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	98	+ ½	6 2 0
do. Def.	33,6	1½	22½	—	6 13 4
Chile Telephone	8	8	6 15/16	—	6 15 4
Cuba Sub. Ord.	5	5	8	—	6 5 0
Eastern Extension	8	8	13⅝	—	*5 17 6
Eastern Tel. Ord.	8	8	139	—	*5 15 1
Globe Tel. and T. Ord.	7	7	12½	—	*5 12 0
do. Pref.	6	6	10⅛	—	5 18 5
Great Northern Tel.	22	22	86½	—	6 0 7
Indo-European	13	13	49½	—	6 11 4
Marconi	10	10	3⅛	+ 3/16	8 4 0
New York Tel. 4½	4½	4½	99	—	4 11 0
Oriental Telephone Ord.	10	10	2⅛xd	—	4 14 1
United R. Plate Tel.	8	8	6⅝	—	*6 0 9
West India and Pan.	6d.	6d.	1⅛xd	+6d.	2 4 5
Western Telegraph	8	8	14	—	*5 14 4

HOME RAILS.

	Dividend 1915.	Dividend 1916.	Price June 5, 1917.	Rise or fall this week.	Yield p.c.
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	23¾	+ ½	4 4 3
do. District	Nil	Nil	16	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A"	Nil	Nil	5/6	—	Nil
do. do. Income	6	5	83	+1	*6 0 6

FOREIGN TRAMS, &c.

	Dividend 1915.	Dividend 1916.	Price	Rise or fall	Yield
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	3	− 1/16	9 3 4
do. 2nd Pref.	5½	—	2⅝	—	—
do. 5 Deb.	5	5	66xd	—	7 5 0
Brazil Tractions	4	4	47	—	Nil
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	60	—	8 6 8
do. do. Preferred	Nil	Nil	37½	—	Nil
do. do. Deferred	Nil	Nil	32½	—	Nil
do. do. Deb.	4½	4½	58½	−1½	7 1 8
Mexico Trams 5 per cent. Bonds	Nil	Nil	38	−2	Nil
do. 6 per cent. Bonds	Nil	Nil	30	—	Nil
Mexican Light Common	Nil	Nil	14½	—	Nil
do. Pref.	Nil	Nil	23½	—	Nil
do. 1st Bonds	Nil	Nil	37½	—	—

MANUFACTURING COMPANIES.

	Dividend 1915.	Dividend 1916.	Price	Rise or fall	Yield
Babcock & Wilcox	15	15	2 31/32xd	—	4 18 0
British Aluminium Ord.	7	10	27/6	+6d.	7 6 10
British Insulated Ord.	17½	20	12⅝	+ ⅛	7 18 5
British Westinghouse Pref.	7½	7½	2 7/16	—	6 3 0
Callenders	20	20	13⅝	—	7 6 10
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	22	22	3⅜xd	+ 1/16	6 10 2
Edison Swan, £3 paid	—	—	½	—	Nil
do. do. fully paid	—	—	1⅝	—	Nil
do. do. 4 per cent. Deb.	4	4	70½	—	5 13 6
Electric Construction	7½	—	1	—	7 10 0
Gen. Elec. Pref.	6	6	9¾	—	6 3 1
do. Ord.	10	10	15	—	6 13 4
Henley	25	25	15½	—	8 1 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12⅛	+ ¼	*8 5 0
Telegraph Con	20	20	87½	+ ½	*6 8 2

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, June 6th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	,,	£54	..
a Bisulphide of Carbon	,,	£23	..
a Borax	,,	£38	..
a Copper Sulphate	,,	£61 10	..
a Potash, Chlorate	per lb.	2/6	..
a ,, Perchlorate	,,	2/-	..
a Shellac	per cwt.	215/-	..
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers	,,	£35	..
a ,, Lump	,,	£25	..
a Soda, Chlorate	per lb.	10½d.	1½d. dec.
a ,, Crystals	per ton	120/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c ,, Tubes (solid drawn)	,,	..	..
c ,, Wire, basis	,,	..	..
c Copper Tubes (solid drawn)	,,	1/8½ to 1/9	..
g ,, Bars (best selected)	per ton	£165	..
g ,, Sheet	,,	£165	..
g ,, Rod	,,	£165	..
d ,, (Electrolytic) Bars	,,	£142	..
d ,, ,, Sheets	,,	£167	..
d ,, ,, Wire Rods	,,	£150	..
d ,, ,, H.C. Wire	per lb.	1/5⅞	..
f Ebonite Rod	,,	3/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/3	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	3/2	1d. inc.
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
l ,, Wire, galv. No. 8, P.O. qual.	,,	£40	..
g Lead, English Pig	,,	..	..
g Mercury	per bot.	Nom.	..
e Mica (in original cases) small	per lb.	6d. to 3/-	..
e ,, ,, ,, medium	,,	3/6 to 6/-	..
e ,, ,, ,, large	,,	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/9½	..
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	,,	..	..
n ,, Wire, Nos. 1 to 16	per lb.	3/6	..

Quotations supplied by—

a G. Boor & Co.	*g* James & Shakespeare.
c Thos. Bolton & Sons, Ltd.	*h* Edward Till & Co.
d Frederick Smith & Co.	*i* Bolling & Lowe.
e F. Wiggins & Sons.	*l* Richard Johnson & Nephew, Ltd.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.	*n* P. Ormiston & Sons.
	r W. F. Dennis & Co.

Ministry of Munitions and Insulated Wires and Cables.—Revised regulations have been issued by the Ministry of Munitions as to the manufacture and supply of insulated electric wires and cables. Under these regulations, dated June 1st, 1917, the exemption from the terms of the Copper Order, dated December 8th, 1916, under which wires and cables of small size used for interior wiring could be manufactured and supplied outside of the terms of the order has been withdrawn. As from the above-mentioned date consumers not entitled to Priority Certificates Class A and Class B (P5) may obtain supplies of insulated copper wire without a priority certificate, provided that they are able to satisfy the manufacturer or supplier that the goods are to be used solely for the purposes of repairs and maintenance. The Cable Makers' Association, Sardinia House, Sardinia Street, Kingsway, W.C. 2, has been granted permission to obtain a limited monthly supply of copper for distribution among manufacturers, whether they be members of the Association or not, for the purpose of manufacturing insulated wires required for repairs or maintenance. The Association has been appointed the controlling authority, and is held responsible for the distribution of this monthly ration of copper.

Manufacturers requiring copper for this purpose should apply to the Cable Makers' Association at the address given above. The regulations provide that in respect of new orders, existing stocks of insulated copper wire may be used only for repairs and maintenance, unless required for a Government contract, or for work covered by a Class A or P5 Priority Permit. Copies of the regulations may be obtained from the Ministry of Munitions, Priority Department, 1, Caxton Street, Westminster, S.W. 1.

Platinum Production in the Urals.—In spite of the present high prices for platinum, the production of the metal in the Urals during 1916 showed a further decrease. The total output, according to a report from H.M. Consul at Ekaterinburg, amounted to 86,508 oz., as compared with 118,709 oz. in 1915, and 156,755 oz. in 1914. The chief causes of this decline are the shortage of labour, the difficulty in obtaining spare parts for dredgers, and the exhaustion of the richer alluvial deposits. It is confidently expected that new alluvia will be found when extensive prospecting is resumed, but there is no prospect of an improvement in platinum production in the near future, at any rate, as long as the war lasts; on the contrary, it is probable that the output for 1917 will be lower than that of last year.—*Journal of the Royal Society of Arts.*

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING MARCH AND APRIL, 1917.

For reasons which we must leave to the imagination of our readers, the usual Customs returns on which our monthly table of electrical exports from and imports into the United Kingdom are based are no longer available, and it has been necessary to consider the question of publishing such data as can be obtained, with a view to preserving what has undoubtedly been a much appreciated feature of the Electrical Review for many years past.

Although interesting at the moment, no doubt, to commercial men, the comprehensive data published by us since the commencement of the war, and especially in recent months, in view of present overseas trade conditions, are probably not representative of what may be anticipated after the war when trade conditions resume more normal channels, and the condensed returns, obtained from official sources, which we are now able to publish, although not entirely comparable with our previous returns, will, no doubt, serve the purpose of keeping our readers to some extent informed on this branch of industry under war conditions.

The last complete return of electrical exports and imports, for February, appeared in our issue of March 30th last, the totals for the month as computed from Customs statistics being as follows:— Exports, £394,062; imports, £183,192; re-exports, £31,445.

The returns for March and April, which are compiled on a slightly different basis, are given below.

It should be noted that the values of electrical wire and cable include for insulated varieties only; it may also be observed that our previous returns have almost always shown a value of machinery exported in excess of that imported, and the departure from this in the above returns may be due to differences of classification, of which, of course, we have no details.

It will be noted that while the value of the March electrical exports was rather in excess of that of the previous month, the April total shows a marked decrease; also that both the March and April imports totals were considerably in advance of the February figures, though the later month showed a decrease of £50.000 on the March return.

Electrical goods and apparatus unenumerated.	Insulated wire and cable (not telegraphic or telephonic).	Electric glow lamps.	Arc lamps and parts (not carbons).	Meters and instruments.	Electrical machinery (including switchboards and transformers).	Batteries.	Carbons.	Telegraph and telephone wire and apparatus.
Exports of Electrical Goods and Machinery, March, 1917.								
£67.328	£68.256	£16.110	£7.004	£11.973	£117.877	£16.071	£1.942	£98.025
			Total		£404.586.			
Imports of Electrical Goods and Machinery, March, 1917.								
£53.041	£7.504	£24.356	£8,568	£2,131	£151.527	£24,919	£9.244	£5,631
			Total		£286.921.			
Exports of Electrical Goods and Machinery, April, 1917.								
£52.574	£18.403	£8.843	£4.591	£6,349	£92.068	£10.611	£1,312	£113,763
			Total		£308.514.			
Imports of Electrical Goods and Machinery, April, 1917.								
£48.090	£2.266	£4.674	£10.645	£596	£129.808	£27.071	£9.128	£3.707
			Total		£235.985.			

A CONCENTRIC STANDARD DYNAMOMETER WATTMETER AND NON-INDUCTIVE STANDARDS OF LOW RESISTANCE.

By A. E. MOORE, A.M.I.E.E.

(*Abstract; from the "Journal" of the* Institution of Electrical Engineers.)

The object of much of the work outlined in this paper was to provide, in the Standardising Laboratory at the School of Technology, Manchester, a precision watt standard for dealing with load currents of upwards of 1,000 amperes. The instrument was to be suitable for the verification of sub-standard and other wattmeters and watt-hour meters, and for any other refined measurements where accuracy is of first importance. A Duddell-Mather standard was installed in the Laboratory originally, but an instrument of this type was not, at that time, made for currents higher than 100 amperes. The requirements of the Laboratory frequently called for an instrument capable of dealing with currents much higher than 100 amperes, and a Kelvin watt balance for currents up to 1,000 amperes was afterwards obtained. Previous to the installation of the 1,000-ampere balance, a composite balance was used as the watt standard for currents of from 100 to 500 amperes, but investigation showed that neither of these balances fulfilled the necessary requirements.

It is now fairly well known that many of the so-called standard dynamometer wattmeters of the straight-through type designed for currents exceeding 100 amperes are unsatisfactory except for use on circuits of approximately unity power factor. The defects are mainly due to eddy currents and skin effect. Eddy currents in the metal forming the main conductors, and in any other metal-work used in the construction of the instruments, cause the active part of the flux in the main-current coil to be out of phase with the main current, while the skin-effect may cause variations in the distribution of the current over the cross-section of the main conductors with changes in frequency, and this may consequently affect both the magnitude and the phase of the active part of the main-coil flux. It should be remembered that the active conductors of the pressure coil cannot be made to embrace more than a small portion of the main-coil flux, and for successful working this portion must always be a definite fraction of, and in the same phase as, the whole flux. It is not very difficult to eliminate eddy-currents by avoiding the use of metal supports, &c., and having the main coils formed of stranded conductors, each strand being insulated; but in order that the current distribution may be maintained constant independently of changes in the frequency of the current, it is necessary that every strand of the conductor have the same time-constant (L/R). In the ordinary form of dynamometer wattmeter the main-current conductor is in the form of a coil of one or more turns, and there are many difficulties in the way of the satisfactory stranding of the conductor, if it is intended for currents of upwards of 1,000 amperes.

The present contribution deals with a form of wattmeter in which the theoretical conditions are maintained in instruments for currents of upwards of 1,000 amperes.

In the wattmeter now to be described the author has made use of the concentric magnetic field which is formed between two concentric conductors when a current is maintained in them in opposite directions.

If a wire be wound uniformly over the surface of a ring as shown in fig. 1, the magnetic field produced when a current is maintained in the wire is symmetrical about the principal axis of the ring, so that every turn of the wire encloses the same magnetic flux, and, presumably, has the same ohmic resistance, and therefore the same time-constant. If all the turns are cut and their ends securely connected to copper end-plates (fig. 2), the turns will be connected in parallel instead of in series, and the time-constant of any one turn will still remain the same as that of every other turn, since each will be of the same resistance and will embrace the same flux. Therefore, if an alternating current be maintained in the coil thus formed it will be uniformly distributed over the turns, and the uniform distribution of the current will be unaffected by changes in the frequency. It is imperative that the winding be perfectly symmetrical, and in making up an actual coil many difficulties had to be overcome before a satisfactory construction was obtained.

Fig. 3 illustrates how the pressure coils may be arranged within the current coil. Two coils are used in order to render the system astatic to uniform stray magnetic fields. The magnetic axes of the pressure coils are nominally perpendicular to the direction of the flux produced in the main coil, and the result is a turning moment about a vertical axis.

The difficulties met with in the production of a concentric-field wattmeter are:—

1. The construction of a current coil in which the phase difference between the flux and the current that produces it is negligibly small.

2. The making of a mechanical joint in the current coil.

which permits of the easy insertion of the pressure coils, but does not introduce a phase error in the current coil.

3. The design and construction of the most suitable form of pressure coils.

In the paper are given descriptions of the various models with which the author experimented, and the defects found in them.

Difficulty was experienced in eliminating the phase difference between the flux and the current. Slight inequalities in resistance, especially at soldered and brazed joints, were ultimately found to be responsible for this trouble, and by adopting a design in which the current element takes the form of a cage consisting of wires soldered into heavy brass end-plates ½ in. thick, connected to concentric tubular conductors, the phase error was reduced to less than one minute of arc (actually 0.0002 radian).

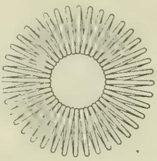


Fig. 1.—Closed Ring Winding

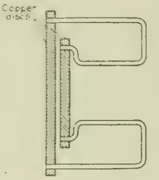


Fig. 2.—Sectional View showing how Turns of Ring Winding may be arranged in Parallel. Two Turns only shown.

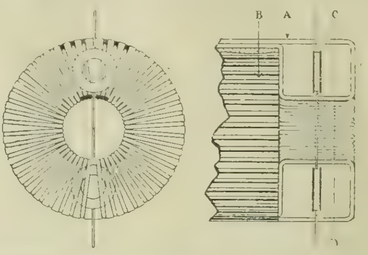
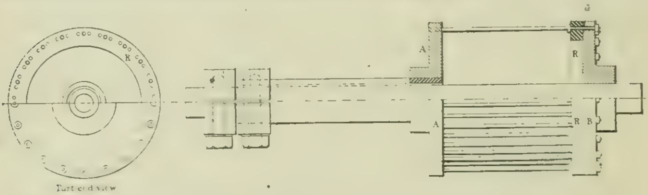


Fig. 3.—Current Element for Concentric Wattmeter, made up of Formed Coils A mounted on a Slotted Wooden Cylinder B.

The heating of the inner conductor limits the current-carrying capacity of the coil; the element described will carry 1,500 amperes for a short time without undue heating, but in the reflecting type of instrument, to prevent trouble due to convection currents of air, a stream of water is passed through the inner tube. Fig. 4 shows an element made on this principle, with a mechanical joint at G, which enables access to be obtained to the interior of the cage.



A, B, end-plates; R, brass ring; G, machined joint.
Fig. 4.—Improved Cage Form of Current Element, with Mechanical Joint.

In a future construction it is intended to make the joint in the middle of the cage, as shown in fig. 5. In this case it is not necessary to have the pressure coils of a form which can be passed between the wires of the case or through the ring R. This being so, a continuous tube or "shell" may be substituted for the "cage."

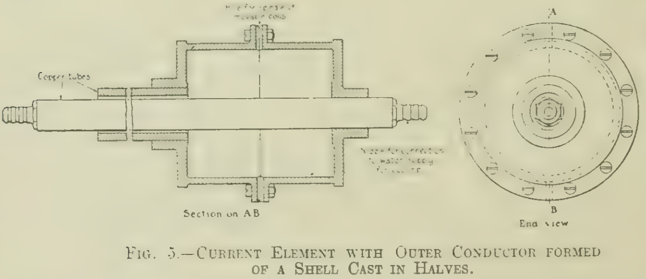


Fig. 5.—Current Element with Outer Conductor formed of a Shell Cast in Halves.

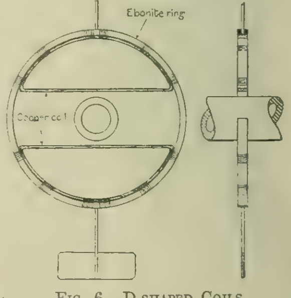


Fig. 6.—D-shaped Coils in Ebonite Ring.

The pressure coils were at first mounted on ebonite bobbins, but after the jointed cage was made they were mounted on a mica disk, which was found lacking in rigidity. The form of coil finally adopted is shown in fig. 6. It consists of two D-shaped coils, each of 100 turns of No. 36 S.W.G. silk-covered copper wire, mounted in an ebonite ring; the movement weighs 36.5 gm., and the inductance of the two coils in series is 2.3 millihenries. An oil-damping vane is provided.

By modifying the ratio of the width of space between the coils (a) to the length of the straight side of the coil (l), it was found that when $l = 1.73\ a$, the torque was almost independent of the angular relation between the magnetic axes of the main and movable coils over a range of 80 deg. to 90 deg.

Comparative tests made between the concentric wattmeter and a Duddell-Mather standard wattmeter show that the phases of the fluxes in the two instruments are in exact agreement when the watts are zero and the volt-amperes 10,000, at 50 cycles. Observations were also made at various power factors, leading and lagging, and when corrections were made for lag in the pressure coils the two instruments agreed as nearly as they could be read, the ratio of the deflections remaining constant and independent of the power factor. On increasing the resistances of the pressure-coil circuits so that the error due to lag was negligible, and making comparisons from 0.95 to zero power factor, the indications of the instruments without corrections agreed at all power factors as nearly as they could be read.

As at present used, the reflecting concentric instrument is calibrated with a single D.C. current measurement at or near a fixed deflection, the resistance in the pressure-coil circuit being varied to give the desired deflection. By adopting this method of constant deflection the necessity for drawing out a correctly divided scale is avoided, the accuracy of reading is constant, the work entailed in verifying the constant of the instrument is reduced to a minimum, and, in the event of its being necessary to disturb the position of the instrument or the scale, the new constant is readily determined.

The instrument is arranged with a standard resistance of 0.001 ohm, as a shunted-type dynamometer ammeter, the connections being as indicated in fig. 7. The pressure coil is connected in series with a non-inductive resistance so that the total resistance r of the pressure-coil circuit is 500 ohms. A continuous current is maintained in the main circuit, and is adjusted until the required deflection d is obtained on the wattmeter scale. The current is measured by means of a potentiometer connected to the 0.001-ohm resistance strip.

Then if k = the watts per division of the scale for a pressure-coil resistance of 1 ohm, watts indicated by instrument = $k\,r\,d$. If the resistance r is chosen so that the desired deflection is produced with a potential difference at the terminals of the resistance R about equal to that of a standard cadmium cell (*i.e.*, a current of 1,000 amperes if R = 0.001 ohm), certain possible errors in the potentiometer are eliminated. The potentiometer, as such, is in fact quite unnecessary when the above conditions obtain, and the author is arranging the testing circuit as indicated by the dotted lines in fig. 7. In this case the main current is adjusted until the potential difference on the resistance R exactly balances the electromotive force of the standard cell. The resistance r is then varied until the required deflection is obtained.

With r = 500 ohms the temperature coefficient of resistance of the pressure-coil circuit is less than 0.02 per cent. per deg. C.

In good dynamometer wattmeters designed to give a full-scale deflection with full-load volts, full-load amperes, and unity power factor, it is generally hardly necessary to make corrections for the phase lag in the pressure coils, even when the instrument is used on low power factors.

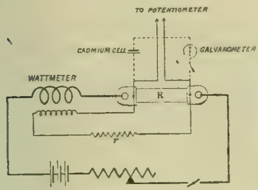


Fig. 7.—Connections for Calibration of Dynamometer.

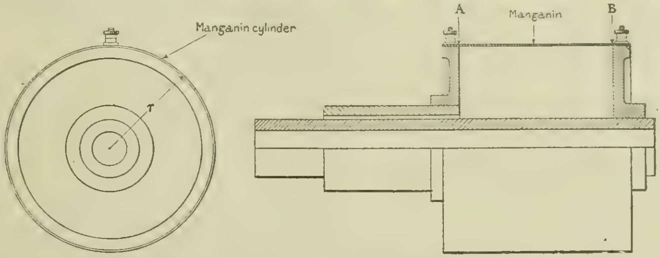


Fig. 8.—Non-inductive Low-resistance Standard.

It must not be assumed, however, that all the instruments so calibrated are free from measurable errors at low power factors. There are, in some types, serious errors due, not to the phase lag in the pressure coil, but to the other disturbances referred to in this paper.

When the wattmeter is connected up for calibration as described above, it becomes a shunted type dynamometer ammeter, and can be used as such, the current in amperes being

$$\sqrt{(kdr/R)}.$$

If a cylinder of resistance alloy be substituted for the wires forming the outer conductor of the wattmeter cage as in fig. 8, a non-inductive, low-resistance tube is obtained. If the thickness of the resistance alloy were indefinitely small the inductance of the tube would be zero whatever the length of the tube. For finite thicknesses of the material the inductance is calculable, and may be made very small.

An evenly distributed entry of the current into the resistance material is essential in standard resistances, and particularly so in non-inductive types, and the arrangement of the concentric connections shown in fig. 8 appears to be the most effective way of ensuring this.

The author gives details of tests made with a view to the construction of a polyphase standard wattmeter, a scheme of connection for testing such instruments, and an accurate method of measuring small differences of phase by comparing both of the currents whose phase difference is under examination with a third current of the same frequency. In an appendix the torque obtainable with different shapes of pressure coils is analytically discussed.

REINFORCED CONCRETE TRANSMISSION POLES.

A recent issue of *Indian Industries and Power* contained a contributed article describing the experimental ferro-concrete poles which have been produced by the Military Works Services at Lahore. Both solid and hollow poles were tried, of varying mixture and percentage reinforcement, a fairly rich aggregate being ultimately adopted. The best results for ballast were obtained with limestone broken to pass through a ½-in. sieve; good results were also obtained with a mixture of crushed pebbles. The reinforcement comprised ½-in. square rods braced laterally at 1-ft. intervals with ¼-in. diam. rods, which were welded to make them continuous.

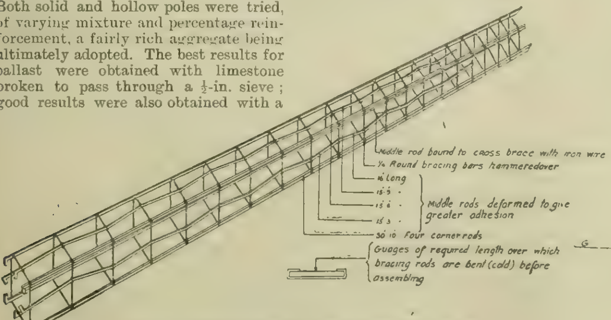

Middle rod bound to cross brace with iron wire
¼ Round bracing bars hammeredover
16' Long
15' 9"
15' 6"
15' 3"
Middle rods deformed to give greater adhesion
30' 10" Four corner rods
Guages of required length over which bracing rods are bent (cold) before assembling
End turned

Fig. 1.—Reinforcement for Concrete Pole.

All ironwork was cut to gauge, and ends of cross-braces bent over the gauge, thus ensuring correct spacing and rapid assembling.

Most poles have four full-length corner rods and four intermediate side rods to a point about half way up the pole, these rods terminating at intervals of 3 in. to avoid a sudden change in the percentage of reinforcement, and being deformed to give greater adhesion; the ends were also turned in to avoid any movement when under tension. An earthing wire was carried down inside the concrete, and bound to each vertical rod to obviate any chance of electrolysis, tails being left out to earth cross-arms, &c. The street poles are 31 ft. long, 10 in. sq. at the bottom, and 6 in. sq. at the top: the 29-ft. poles are 9 in. and 5 in. sq. respectively. Both these poles have been used in pairs as H poles.

The method of casting the poles is as follows:—A number of sleepers are laid in the ground, tops flush with the ground level, six rows parallel with each other at 5 ft. apart. Across each sleeper three bottoms are securely fastened, wooden chocks being fixed to each sleeper 3 in. clear of the bottom boards, against which the sides are wedged when required for casting. To each set of three bottoms one pair of sides are provided, and this constitutes a unit for turning out one pole a day. The first day the sides are wedged up to No. 1 bottom and the pole cast; the following day the sides are taken off and put up to the second bottom, and that pole cast, and similarly for the third day; on the fourth day the pole on No. 1 bottom is pulled off endwise on to level ground, and the cycle of operations repeated.

This system was adopted for both solid and hollow poles, though the extra labour involved in the hollow poles made their advantage over the solid ones rather doubtful, except as regards weight.

To obtain a hollow core, if desired, a hollow tapering steel tube, flush riveted, is placed inside the mould, small concrete saddles supporting it at each end and the middle; this protrudes at the small end 2 ft., and, after the concrete has been in six hours, is tapped back flush at the small end to relieve it from the concrete. It is soft-soaped prior to casting, and withdrawn the next day. The moulds are smooth inside and whitewashed; fillets are inserted at the corners to bevel the poles.

The constituents, including the water in the concrete, were carefully measured, and it was made slightly wet to facilitate casting; with solid poles, 2 in. of concrete was first laid in, and the reinforcement laid on that, the mould being then filled up.

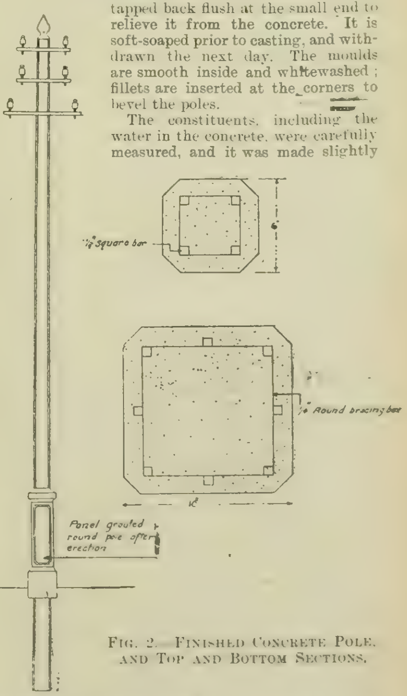


Fig. 2.—Finished Concrete Pole, and Top and Bottom Sections.

After casting the poles were kept covered with damp straw and gunny bags for three weeks, dried out for a week, and erected when a month old. Ordinary methods of carrying and erecting were employed; the root of the pole was set 5 ft. in the ground on 6 in. of lime concrete with another foot of concrete rammed round the end after erection.

Ordinary methods of staying were adopted in line construction: in some cases the sizes of feeders ranged up to 3/0 B & S.

No cement was used having an initial setting time under 60 min., the casting of one pole taking about 45 min. The poles have been made both departmentally and by contract, the cost at the present time being Rs. 50, including cement at Rs. 81 per ton and steel rods at Rs. 28 per cwt. At pre-war prices the costs might be reduced to Rs. 20 per pole.

THE IMPORTANCE OF HYGIENIC FACTORY CONDITIONS.

It is not possible with any degree of exactness to calculate the influence that hygienic conditions have with regard to output. That they have a great influence is generally acknowledged. There is a growing conciousness that the hours of labour and the rate of wages paid are not the only factors that determine the amount of production. More than food and rest are necessary to make the worker physically healthy, and unless he is healthy in body his thinking capacity will be diminished, and he will be a less valuable asset to the State and to his employer than he ought to be. The amount of lost time is usually attributable, in a lesser or greater degree, to the effect of working in a germ-laden atmosphere, and it is to the mutual benefit of both man and master if the factory is wholesome. It is obviously unfair, as is sometimes done, to blame the factory-owner altogether for the conditions of the shop. The workman must share the blame. Most men are dual personalities. It is a curious psychological fact that men spend about equal time at work and at home, yet, unless in rare cases, the habits of the one life do not influence the other. The customs that are considered common decency in the home are not observed at work. The laws of cleanliness are neglected. Workmen expectorate freely on the shop floor, or wherever is most convenient, tea dregs are thrown about, oil is spilt carelessly and dirt of all kinds is left lying about the machine or the bench. Of course, the habits of the men are influenced to a considerable degree by the conditions for which the employer is responsible. A new building may be always healthier than an old one, and a great many works want rebuilding; but a clean old building is a preferable place to a dirty new one. If floors are not swept daily, or several times a day, depending upon the operations performed in the shop, it seems futile to be careful of them. There is always a greater inducement to be clean in a parlour than in a stable. A great deal depends upon shop discipline. It is a fact that many foremen are so much interested in the skilled workers' efforts that they have not time to look after the labourers. The labourers are thus allowed a free hand, and it appears to be human that unless a man is subject to supervision he gets lazy. Dust is allowed to accumulate in corners and on girders for a whole 12 months. The annual shop cleaning is quite a customary affair, but in some cases the dust and filth of all kinds are allowed to lie for years. It is admittedly difficult in machine shops with continually revolving shafts to clean in working hours. Some provision, however, ought to be made for having it done after the ordinary working hours or at the week-end. In many shops the windows get literally blocked up with dirt, and are never opened either in winter or summer. The work is carried on in a nauseous, unhealthy atmosphere, and towards the close of the day there is a general state of fatigue, and work slackens. Good ventilation is necessary to big output.

Many workmen do not leave the shops even during meal hours. They sit on dirty benches or on machine tables and eat their meals. It is quite a common sight to see a group of men huddled round a smithy fire, or in a foundry stove, eating breakfast or dinner, and drinking black tea out of blacker cans. Even when dining-halls are provided, they are not universally used. One cause of this is probably that there is not the same privacy sitting at a long table in a crowded dining-hall; but the chief cause, perhaps, is that the workman cannot be bothered with going out of his shop. It is an attitude of mind based on habit, and not easily broken. Most of us are conservative at heart, and do not like to be deprived of what we have come to regard as rights, and not privileges. The only way to get workmen into the dining-hall habit is to close the shops during meal hours. It would well repay all employers to have dining-rooms, where the workers could either have meals at a nominal price, or have their own food cooked.

It is a pity that some workmen so often spoil a beneficent employer's endeavours by loitering, and in other ways slacking. In many industries wash-hand basins are now enforced by law, and employers generally would, no doubt, provide better facilities for washing and dressing if it were not for the precautions they find it necessary to take against unprincipled workmen. These are not in the majority, however, and the man and the master ought to recognise a mutual interest in raising the level of the factory to that of the home.—*Mechanical World.*

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

7,329. "Electrodes." A. B. Pescatore. May 21st.
7,337. "Loading coils for telephone circuits." G. E. Bairsto, British Insulated & Helsby Cables, Ltd., and H. H. Harrison. May 21st.
7,354. "Self-regulating dynamo-electric machines." B. Brooks & W. Holt. May 22nd.
7,360. "Electrical accumulators." J. [illegible]. May 22nd.
7,368. "Electric couplings." H. F. C[illegible] & Sopwith Aviation Co. May 22nd.
7,372 and 7,373. "Electric controllers, &c." J. Anderson & G. Ellison. May 22nd.
7,388. "Detachable watertight terminals for electric cables." G. F. Cooke. May 22nd.
7,400. "Anodes for electro-deposition." A. S. Lucas. May 23rd.
7,403. "Insulators for supporting overhead electric conductors." H. R. Lamb. May 23rd.
7,427. "Wireless telegraphic apparatus." British Thomson-Houston Co. (General Electric Co., U.S.A.). May 23rd.
7,430. "[illegible] apparatus for internal-combustion motors with [illegible] apparatus." [illegible] A. Hill & O. W. Hill. May 23rd.
7,431. "Apparatus for electric light and power distribution." W. J. F[illegible] & Co. and R. W. Wills. May 23rd.
7,432. "Manufacture of glass bulbs for electric lamps, &c." T. Davidson. May 23rd.
7,442. "E[illegible] working [illegible]." R. Kronenberg. May 23rd.
7,444. "Magnetometers for measuring weak magnetic fields." J. L. [illegible]. May 23rd.
7,449. "Sparking plugs for internal-combustion engines." T. H. R. Key. May 23rd.
7,459. "Incandescent lamp sockets." J. S. Withers Levy. May 23rd.
7,461. "E[illegible] apparatus." J. F. Bark. May 24th.
7,484. "[illegible] gas, electric, &c., lamps." T. W. Styles. May 24th.
7,487. "Electric [illegible]." A. [illegible]. May 24th.
7,499. "Electric ignition systems for internal-combustion engines." E. H[illegible]. May 24th.
7,505. "Electric generators." E. C. [illegible]. May 24th. (France, May 23rd, 1914.)
7,510. "Electric [illegible]." C. S. Palmer & D. Palmer. May 24th.
7,519. "Means for preventing oxidation or wasting of electrodes in electric furnaces." W. B. H[illegible] & J. Holland. May 25th.
7,547. "Electric switches." British Thomson-Houston Co. (General Electric Co., U.S.A.). May 25th.
7,548. "[illegible] motors, applicable to electric propulsion of ships." British Thomson-Houston Co. (General Electric Co., U.S.A.). May 25th.
7,557. "[illegible]." F. I. Jensen. May 25th.
7,558. "[illegible] electric currents [illegible]." [illegible] Electrical Syndicate. May 25th. (U.S.A., August 15th, 1916.)
7,563. "Electrical [illegible]." L. C. Bygrave & Relay Automatic Telephone Co. May 25th.
7,571. "[illegible]." Cutler-Hammer Manufacturing Co. and [illegible] Co. May 25th.
7,592. "[illegible]." [illegible]. May 25th. (U.S.A., May 26th, 1916.)
7,606. "[illegible] for Pupin loading coils, magnets, &c." Western Electric Co. May 26th. (U.S.A., May 26th, 1916.)
7,627. "Telegraphs." F. C. R. Marks and United Telegraph & Cable Co. May 26th.
7,629. "Sparking plugs for internal-combustion engines." R. L. A. [illegible]. May 26th.
7,6[illegible]. "[illegible] installations." G. Giles. May 26th. ([illegible] May 27th, 1916.)

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1,271. Carbon Filament Electric Glow Lamps. C. O. Bastian. January 26th, 1916. (105,929.)
2,077. Electric Heaters. F. C. R. Marks (Landers, Frary & Clark). February 28th, 1916. (105,930.)
4,759. Device for Recording Musical Improvisations. C. E. Pritchard and A. E. Wi[illegible]. September 9th, 1916. (105,938.)
4,788. Dynamo-electric Machines. H. C[illegible]. March 31st, 1916. (105,942.)
4,948. Apparatus for Automatically Igniting and Extinguishing Electric Lamps. F. C. Fargo. July 10th, 1915. Addition to 24,223/12 and 4,825/16. (100,886.)
6,124. Method of Operating Electrodes for Projectors. E. A. Sperry. April 28th, 1916. (100,781.)
6,131. Electrical Resistances. A. H. Curtis. April 28th, 1916. (105,946.)
6,150. Method of Automatically taking up Shrinkage of Coils of Electric Transformers and other Electric Apparatus. J. Hall & J. R. Kirk. April 29th, 1916. (105,947.)
6,229. Apparatus for Effecting Endothermic Gas Reactions by an Electric Arc. J. A. Currie. May 1st, 1916. (105,953.)
6,249. Reversing Controller for Electric Motors used on Petrol-electric Cars and for other Purposes. W. A. Stephens. May 2nd, 1916. (105,956.)
6,255. Electrical Transformers. W. H. Wilson. May 2nd, 1916. (105,957.)
6,269. Electrical Selectors or Impulse Responders. Relay Automatic Telephone Co. & L. C. Bygrave. May 2nd, 1916. (Addition to 9,345/15.) (105,959.)
6,328. Automatic Telephone Systems. W. A. Burrell. May 3rd, 1916. (105,960.)
6,378. Timers or Interruptors for Magnetos. C. Messerschmidt. October 12th 1915. (101,783.)
6,518. Indicators and Recording Instruments. S. R. Fletcher and A. Speight. May 6th, 1916. (105,986.)
6,771. Incandescent Electric Lamps. O. R. Sell. May 11th, 1916. (105,994.)
6,859. Carbon Holders for Electric Arc Lamps. J. White. May 13th, 1916. (105,996.)
7,712. Sparking Plugs. A. E. White (Wolverine Spark Plug Co.). May 31st, 1916. (106,006.)
7,796. Electric Conversion. S. Cabot. June 1st, 1916. (106,008.)
8,433. Electric Heaters. Cable Accessories Co. & F. H. Reeves. June 15th, 1916. (106,011.)
8,960. Means for Printing Identifying Marks on Individual Cores of Multicore Electric Cables. R. Wood and Callender's Cable & Construction Co. June 26th, 1916. (106,016.)

THE
ELECTRICAL REVIEW.

VOL. LXXX. JUNE 15, 1917. No. 2,064.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: June 15, 1917. [No. 2,064.

	Page
Speed the Plough Electrically	641
The Conditions of Labour	642
Recent Developments in Electricity Supply at Keighley, by H. Webber (*illus.*)	643
Anthracite Coal, by W. H. Booth	646
New Electrical Devices, Fittings and Plant (*illus.*)	647
Legal	648
Correspondence—	
Business Man or Engineer?	649
News from Ruhleben	650
Association of Consulting Engineers (Inc.)	650
War Items	650
Business Notes	652
Notes	655
City Notes	658
Stocks and Shares	660
Induction Methods of Fault Localisation, by H. E. Blake (*illus.*)	661
The more Recent Applications of Electricity in the Present War, especially in the Treatment of Diseases and Wounds arising therefrom, by W. Leeming (*illus.*)	661
An A.C. Bridge Method of Comparing Inductances, by T. Parnell (*illus.*)	664
New Patents Applied for, 1917	664
Abstracts of Published Specifications	664
Contractors' Column ... ... Advertisement page	xxii

THE ELECTRICAL REVIEW.
Published every FRIDAY, Price 4d.
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OFFICE 1—4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.
Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

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PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto 1 307.
SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.
WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE "ELECTRICAL REVIEW'S"
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1917 EDITION

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SPEED THE PLOUGH ELECTRICALLY.

No apologies are needed at the present time, even in the case of an electrical paper, for referring to the subject of ploughing, which is a matter not only of domestic, but of very real national concern. The country had been led to expect much from the influx of petrol-motor operated tractors and ploughs on our farms, and in view of the eulogistic forecasts of their friends and admirers it is rather a shock to learn from the *Commercial Motor*, which is naturally an ardent supporter of the movement, that the "initial" experiments in their use under official auspices have proved rather disappointing; "the troubles have much exceeded anticipations" . . . "the average ploughing per month per agrimotor has been very much below the most conservative estimates of the promoters," and that "the figures . . . are startling by reason of their disclosure of low average performance per agrimotor."

Putting aside the questionable suggestion of novelty—the manufacture of farm tractors has been proceeding for some years—we must express our regret that the expectations as regards the assistance to be obtained from these internal-combustion-engined farm appliances in extending our home food production in the emergency conditions of the moment are unlikely to be realised. Private issues are beside the question, and had the motor-tractor and plough come through victoriously criticism would have been ungenerous. When, however, the Editor of the *Commercial Motor* contents himself by taking the view that the bringing under the plough of an additional three million acres of land, which it is sought to accomplish during the next 12 months, will largely be aided by the employment of additional steam ploughing sets, assisted by motor tractors, &c., and suggests that 100 such sets might be constructed between now and the end of the year, although he would be glad to see even 50 additional ones, which would represent at least 150,000 acres of new ploughing and cultivating per annum—for which work not fewer than 400 independent agrimotors were be required, based on an annual average per machine, with double shift working, of 375 acres—we begin to realise how very far from providing a solution to the ploughing difficulty the present types of motor-tractor and plough really are.

Assuming that we must revert to some form of cable ploughing to attain our object, we would suggest that much of the constructive difficulty and first expense (over £4,000 per steam set) would be obviated by adopting electricity as a power agent wherever a suitable supply of electricity is practicable, instead of building independent steam engines, with their attendant fuel and water carrying difficulties. Standard electrical motors and apparatus can be used for haulage gears, costing far less than engine-driven gears, and extremely light pole line construction would meet the conditions on private property, the power required being comparatively insignificant from a transmission point of view. In addition, a supply of electricity means good lighting at night, thus allowing of continuous day and night ploughing, and as one cannot overlook the favourable prospects of increasing crop production on the same land, or alternatively utilising less land and fewer ploughs, by employing electro-cultural methods, it appears that a strong case can be made out for the electric plough plus electroculture.

The greatest obstacle in the way of such a scheme to the non-technical mind is lack of electricity supply on the spot; yet anyone who has visited large reservoir and dock works in progress, covering square miles of land, must have been struck with the facility with which temporary transmission lines are erected or moved at a few hours' notice, and no engineer who is practically familiar with such work would doubt the possibility of developing a suitable system for ploughing purposes.

We are not advocating an untried novelty; readers who are interested will find many references to electrical ploughing results in past volumes of the Review, including an illustrated article on the use of the electric plough on a farm in Nottinghamshire,* but apart from this, we have the electric ploughing experience of the German firms, Eckert, Siemens, A.E.G., &c., the Italian firms, such as the Societé Electrotechnique of Turin, and Morelli, and again of the French Société de Constructions Electriques (Jeumont), and of M. Fillet to draw upon, the latter in particular having developed a portable field transmission system employing light tubular poles which are screwed into the ground, and easily packed into a wagon for removal.

The electric plough was tried out before the oil tractor and plough had emerged from the nursery, and it is very evident that had the electrical fraternity in this country displayed a quarter of the energy shown by the internal-combustion engine enthusiasts, the possibilities of electrical ploughing in some districts, at least, would have received official recognition, and the costly coal-burning steam tackles could be relegated to less favoured localities. The circumstances of the moment have left the electrical industry with trump cards in the shape of the electric plough and electroculture. But with an industry which is apathetic and casual in matters affecting organised development work, and a Government agricultural department which has only recently emerged from a prolonged state of coma, it will probably require something of the nature of T.N.T., suitably applied, to awaken either to a realisation of the economic future before electric ploughing.

The Conditions of Labour.

Those of our readers who are interesting themselves in after-the-war conditions of Labour, and who recognise the importance of doing everything possible to avoid causes of future friction, may be advised to obtain a copy of a pamphlet just issued by the Labour Co-Partnership Association (6, Bloomsbury Square, London, W.C.) on the subject of "Industrial Fatigue in its relation to Maximum Output." Brief introductory messages are contributed by Sir Robt. A. Hadfield and Mr. J. R. Clynes, M.P., the former quoting his own experience in proof of the inadvisability of employing non-stop and overtime methods, and showing that by knocking off Sunday work output was not reduced. Sir Robert does not care for Taylorism because of its tendency to make the workman into a machine, when, after all, he is a human being. Mr. Clynes states three outstanding impressions which are in the minds of workmen. When changes have been made to secure increased output, the men have felt certain that such changes would mean reduced wage rates, "and their certainty rested upon experience." "They were confident that the more they produced the sooner they would be unemployed, and they found results in some occupations to support this view." "They had a natural objection to being made the mere instruments for certain unknown material ends which would give greater gain to others than they themselves derived." He holds that there will be difficulty in getting rid of these deeply-rooted impressions which have been engendered as the result of generations of industrial experience, and in his opinion it will not do to try and reduce the conditions of fatigue purely "in order that workmen should be able to produce more." That would be one of the results, but to set it up as an object would be fatal. Though he recognises that increased production is all-important, he feels that it should be secured with two other conditions: (*a*) A fair share of the increased rewards should go to the producer; (*b*) the producer himself must be regarded as a man first, and a workman afterwards. These are merely the introductions to the pamphlet, in which very thoughtful views on the subject of fatigue and output are expressed by Prof. Henry J. Spooner. The conditions of industrial life, in Government-owned and controlled factories and yards, during war-time have taught us more than we ever knew in practice before concerning the matter. Prof. Spooner deals with the subject in the light of this and other valuable experience, and he handles it sympathetically, setting forth a collection of notes which form as comprehensive a study of the whole matter as one could reasonably hope for in a pamphlet of 50 or 60 small pages, and one which can very appropriately be studied at the present time. The causes of fatigue are many, and Prof. Spooner discusses a variety of means which may be employed, without any appearance of "fussiness" or coddling, to remove these causes. The points touched upon include the need for healthy environment in the works, the provision for periodical rest breaks, avoidance of overtime and Sunday work, reduction of working hours, simplification of operations and lightening of labour as the result of motion study, the scrapping of antiquated machinery and methods, the re-classification of certain trades, education respecting the worker's fallacy concerning the benefits to himself of restriction of output, study of the conveniences and conditions of the workers, both within and outside the factory, the need for better housing accommodation, especially in crowded industrial centres, &c. The worker calls for greater security of employment, and if this can be secured it will benefit the employer by obviating the wasteful turn-over of trained labour from one works to another, which the unwisdom of the hasty discharge of labour is bound to encourage. The author is under no delusion as to the urgency of our industrial problems, nor is he blind to the unlimited industrial expansion that lies awaiting us. He obviously attaches great importance to the question of Welfare Work, and urges the cultivation of the long vision. In his opinion, some of our great statesmen, engineers, and industrials, who are not now fully employed on matters of national interest, should be appointed to carefully examine the problems of the kind indicated above while there is time. The Government Labour Unrest Commissioners who are now getting to work in different areas of the Kingdom have a very large subject to investigate. Their task has arisen directly from war conditions, and what they are to suggest in their recommendations relates, we believe, more particularly to the measures necessary for removing the special causes of unrest for the further period of the war. Prof. Spooner's method of dealing with the subject, as well as the Labour Unrest Commissioners' study, both have a direct bearing upon the after-the-war industrial situation. It is on that ground that we commend them to the attention of serious students of our industrial problems.

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* Electrical Review, February 11th, 1916.

RECENT DEVELOPMENTS IN ELECTRICITY SUPPLY AT KEIGHLEY.

By HARRY WEBBER, A.M.I.E.E., Borough Electrical Engineer and Tramways Manager.

The following article is intended, not only to give particulars of the extensions to the Keighley electricity works, which were officially opened by the Mayor of Keighley (F. W. L. Butterfield, Esq., J.P.) on May 31st, 1917, but also to illustrate the effect that the present European war has had on the supply of electricity in the town generally.

My excuse for preparing the article is that I believe many of the particulars and the special information given will be of use to a great number of readers.

The Keighley electricity undertaking was inaugurated in 1901, and a supply was commenced on March 30th of that year. The plant consisted of two Lancashire boilers, with a total heating surface of 1,932 sq. ft.; three Allen engines of 730 I.H.P. direct-coupled to three Allen dynamos with 440-KW. output, with a small Tudor battery.

The capital expended was £39,300, detailed as follows:—Buildings, £7,000; generating plant, £12,000; motors and instruments, £21,000; mains, £14,100; accumulators, £2,000; public lamps, £1,556.

The station was originally intended for supplying power for the tramways, which had just been electrified, and also any lighting developments which might occur.

Nothing of a very exceptional character was done in the way of expanding the business until the latter end of 1909, when the plant capacity had then increased to 740 KW.

Seeing that more plant had to be installed, the question of a complete change in the methods of generation was fully discussed by the Electricity Committee, with the result that application was eventually made to the Local Government Board for permission to borrow £21,000 in order that a three-phase, E.H.T., alternating-current system of supply could be commenced for the power users in the town of Keighley. Since this time the undertaking has forged ahead.

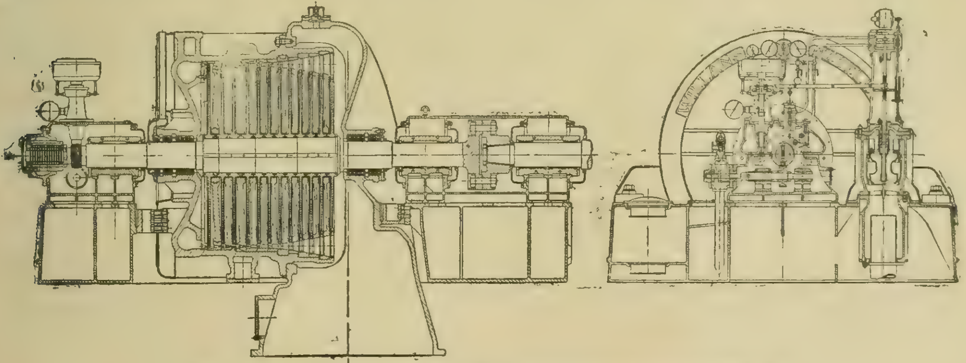

Fig. 1.—Section through 5,000-KW. Willans-Zoelly Turbine at Keighley.

There was a steady increase in the output of units from 1910, when the total sale was only just over 100,000 units, until 1914, the year when the present war commenced, of just over 4,000,000 units.

To show the effect the war has had on the output, the total sale at the present time is at the rate of just over 8,000,000 units per annum, or double what was being sold when the war first broke out.

The original turbine units installed were only of 1,000-KW. capacity, whereas the latest installation is of 5,000-KW. capacity, the total plant capacity at the present time being, in round figures, 10,000 KW.

The capital either spent or pledged up to March 31st, 1917, amounted to about £146,000; this figure includes the cost of the latest new plant and also £9,300 for land, as well as all the mains, meters, motors on hire, engine-room and boiler-house plant. Working this out on the kilowatt capacity, it only amounts to £15·38 per KW., which is an exceptionally low figure; moreover, there is very little plant of an obsolete nature left, as all the Lancashire boilers and two out of three of the original generators have been sold, and the balance of cost paid for out of revenue.

No doubt one of the primary reasons why the Keighley undertaking has developed very rapidly since the installation of the three-phase system, is that in conjunction with this system a very moderate charge was made for the supply of energy in bulk—namely, £3 per KW. of maximum demand, plus ¼d. for every Board of Trade unit consumed. This has brought the average price obtained to ·86d. per unit, which is lower than in many large towns and cities with a much greater output in units sold.

I believe, however, that the policy of offering this low price has been justified, as it was not until the year 1912 that the department first began to make a profit, and this profit, which was only small at the commencement, has gradually increased, until the exceptional cost of materials, &c., for the last two years has brought it slightly lower again.

In the initial stages it was obvious that although pretty heavy prices were being charged, the current was being sold at a loss; thus in the year 1902 the total costs were 10·1d., while the average price obtained was only 3·1d.; that is to say, a loss of 7d. resulted on every unit that was sold. In 1903, 4d. was lost on every unit sold, and the third year 2½d., and so on until 1912, when the costs of production were exactly equal to the average price obtained.

Low prices could not be maintained unless the working costs and capital expenditure were kept at a very low figure. To illustrate what these figures have been, in 1914, just before the war commenced, the total working costs averaged only ·47d. and the total capital charges ·32d. per unit.

The demand is created by a very diversified class of manufactures, and this has a beneficial effect on the power station, as it results in a very steady load throughout the majority of the working day, thus enabling boilers and prime movers to be worked at their most efficient output.

The following is a selection of power consumers connected to the mains:—Small wood turners, wringing machine manufacturers, tape manufacturers, machine tool makers, corn millers, saw mills, weaving sheds, spinning mills, steel founders, malleable iron founders, brass founders, dyers, coopers, cabinet makers, manufacturers of spinning machinery, loom makers, paper tube manufacturers, tanners and curriers, laundries, automobile works, manufacturers of electrical plant, stone yards, brewers and maltsters, wagon works, hosiery manufacturers, bakeries, &c.

The following examples of power consumers on the Keighley supply may be of interest to readers:—

Malleable Iron Founder.—D.C. supply. £21 per month: seven motors installed, total 76 H.P.

Iron Works.—D.C. supply. £26 11s. 4d. per month. Principal manufactures, washing machines and bedsteads: 11 motors installed, total 97 H.P.

Wagon Builder.—D.C. supply. £2 8s. per month: six motors installed, total 36 H.P.

Sand Merchant.—D.C. supply. £2 13s. 8d. per month: two motors installed, total 23 H.P.

Corn Miller.—A.C. supply. £9 5s. per month: two motors installed, total 50 H.P.

Timber Merchant and Sawyard.—D.C. supply. £3 13s. per month: six motors installed, total 46 H.P.

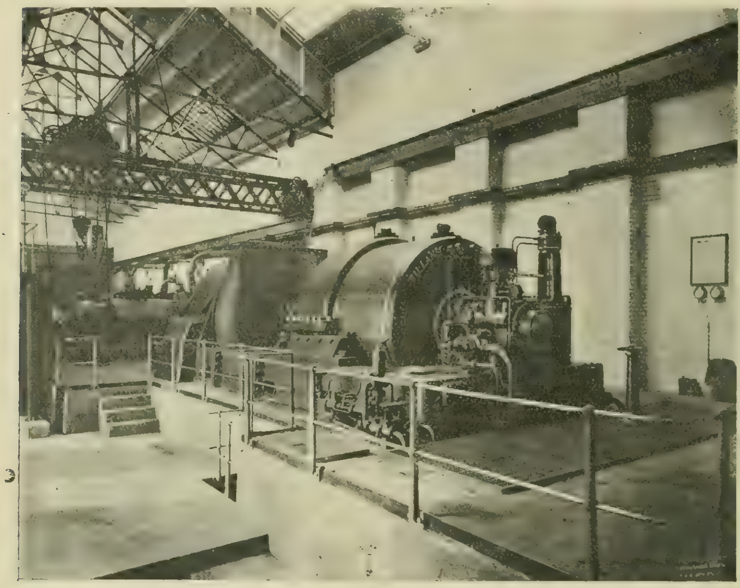

Fig. 2.—Willans-Zoelly G.E.C. Turbo-alternator installed at Keighley.

Machine Tool Maker.—A.C. supply. £21 17s. per month: 14 motors installed, total 175 H.P.

Brass Finishing, including Foundry.—D.C. supply. £12 7s. per month: five motors installed, total 41½ H.P.

Weaving Sheds.—A.C. supply. £39 per month: 275 looms and one winding frame; five motors installed, total 130 H.P.

A.C. supply, £16 9s. per month; 130 looms and one hoist: five motors installed, total 100 H.P.

A.C. supply. £9 per month: 22—86-in. broad looms: one motor installed of 25 H.P.

A.C. supply, £25 per month; 480 tape weaving machines and 10 beaming and winding machines: three motors installed, total 90 H.P.

Hosiery Manufacturer. D.C. supply. £4 9s. per month. 20 hosiery machines and 28 sewing machines; two motors installed, total 14½ H.P.

Spinning and Twisting Machines.—A.C. supply. £13 per month: 144 cap spindles, 700 fly spindles, 132 ring twisting spindles, and 96 fly twisting spindles; one motor installed of 35 H.P.

Foundry.—D.C. supply. £8 2s. per month: five motors installed, total 56½ H.P.

During the year 1914, powers were obtained to supply a large area surrounding the borough on all sides, but a clause was inserted restricting the Corporation from commencing the work of laying mains, &c., until six months after the declaration of peace. With these additional districts, practically the whole of the Valley of the Worth and a good portion of the Aire Valley will be included in the supply area, and I estimate that at least 30,000 steam H.P. is being produced in those districts at the present time by private concerns, which in the natural course of events may reasonably be expected to take a supply eventually from the Corporation.

One of the districts which obtained its own provisional order is already taking a supply in bulk, and transforming it for tramway and general distribution purposes.

I now propose to give a detailed description of the recent extensions.

The prime mover is a 5,000-KW. Willans-Zoelly steam turbine, which is direct coupled to an alternator made by the General Electric Co.

The turbine is of rather special interest, as it is practically the first Zoelly-type steam turbine made by Messrs. Willans and Robinson, and is similar to the sets which have been installed at the Glasgow Corporation electricity works and Salford Corporation electricity works.

The surface condensing plant, which was also supplied by Messrs. Willans & Robinson, has a special feature, which is of interest—namely, that the air, instead of being extracted by some form of rotary or reciprocating plant, is carried away by passing the whole of the circulating water through ejectors, before entering the condenser proper. This system does away with one piece of moving plant, thus saving the usual upkeep, and also the power which is always required for driving the ordinary types of air pumps; moreover, it is not so liable as machinery in motion to give trouble whilst in operation.

The governor is of the oil relay type, and is fitted with a small motor, which can be controlled from the switchboard gallery, so that in the event of the attendant on the engine-room floor not being available at the moment, the speed can be brought up or down by the switchboard staff. In Keighley, however, this has not been coupled up, as once the load is on after meal hours, it is so steady that the set very seldom varies in speed at all.

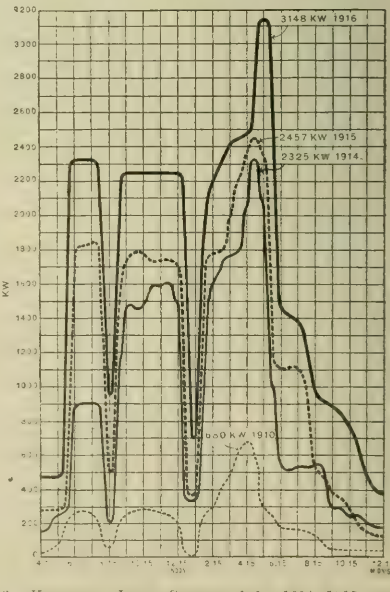

Fig. 3.—Keighley Load Curves, 1910, 1914, 1915 and 1916.

With the majority of steam turbines running at high speeds there is always the possibility that the bearings become dry after the plant has been standing for some time. Some makers provide oil rings, which operate by friction on the shaft; other makers provide a small hand semi-rotary pump, which the engine driver is supposed to work before starting the set up, and thus flush the bearings by hand, but I think the arrangement adopted on the set described is preferable to either of these methods. A small steam oil pump is coupled in with the rotary pump driven from the turbine itself, and immediately steam is turned on to the main stop valve, this steam pump starts automatically to flush the bearings with oil. When the turbine is fairly up to speed a diaphragm device cuts out the steam pump, and leaves the oil circulation entirely to the rotary pump.

The steam pump also comes into operation again whilst the set is gradually slowing down.

All so-called flexible couplings have been eliminated in the designing of this set, the alternator rotor being rigidly coupled to the steam rotor, and the exciter armature is built on to the end of the main shaft.

The modifications eliminate a lot of the minor troubles which are generally experienced some time or other with flexible couplings, and small bearings for the exciter when flexible couplings are used.

The turbine proper is of the multi-cellular impulse type, consisting of a rotor, on which is mounted the required number of impulse wheels, each of these wheels rotating in a separate chamber formed by means of division or diaphragm plates.

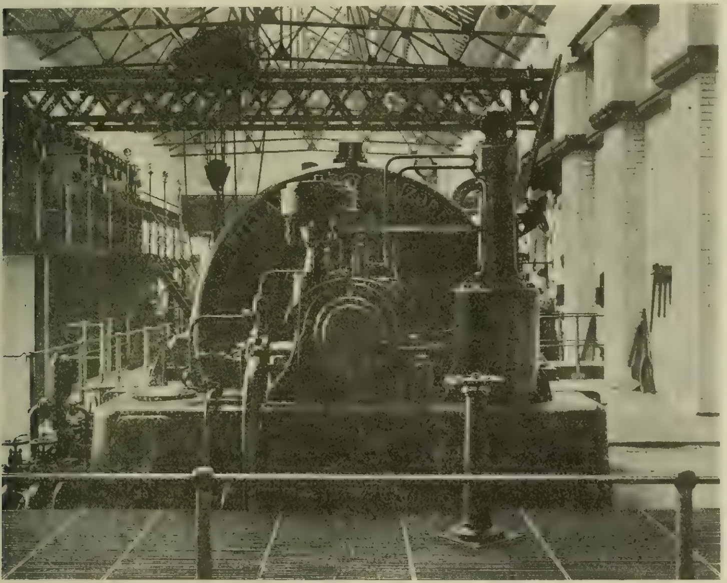

Fig. 4.—Steam End. 5,000-kw. Willans-Zoelly Turbine Set, Keighley.

The body is built up of ring sections permanently bolted together, but divided into upper and lower halves. Feet are fitted on to this body, which enable it to slide along the bed plate, and thus allow for unequal expansion. The main pedestals are cast entirely separate from the body, and so arranged that the alignment of the turbine is unaffected by the expansion of any of its parts.

The steam rotor consists of a steel forging which forms the shaft, upon which are mounted the disks, of high-tensile steel, each fitted with one row of nickel steel impulse blading.

The roots of these blades are of T-section fitted into grooves and machined in the disk, and shrouding is fitted round the periphery.

The casing is subdivided by diaphragm plates, fitted with labyrinth packing to prevent leakage of steam from stage to stage. The steam passages are formed at the outer edge of these diaphragms by plates of nickel steel, cast in position.

A set of small thrust collars is provided, which would be capable of taking a heavy end thrust, if necessary, but is really intended to be used only for adjusting the position of the shaft when first setting to work. This thrust block is rigidly attached to the turbine body, and free to slide in the steam-end pedestal.

The oil is cooled by means of two vertical coolers, coupled up in series, but of such a size that it would be possible under emergency circumstances to run the turbine whilst one was being cleaned out.

Besides the ordinary governor, which has already been described, there is an emergency governor, which comes into action when the maximum allowable speed of the turbine has been exceeded.

As far as possible the steam connections, oil pipes, &c., have been fitted to the lower portion of the turbine body, so that when an internal inspection is necessary, there is practically only the cover or top half of the body to lift, without undoing a lot of pipe connections, and other small apparatus.

The condenser is designed to maintain a vacuum of 28½ in. when the turbine is on full load, and the barometer stands at 30 in., the quantity of water required to obtain this vacuum being 5,180 gallons per minute at a temperature not exceeding 60° F.

The cooling surface provided is 7,740 sq. ft. A flooding cock is specially fitted, so that the steam space in the condenser can be filled with water if it is desired to run the turbine non-condensing. This saves installing one of those huge valves, which generally result in a continuous loss of vacuum through slight air leaks.

The condenser itself is erected immediately below the turbine bedplate, with a sufficient gap between the flange of the exhaust end of the turbine and the steam flange of the condenser to allow for a suitable expansion piece.

The electrical end constructed by the General Electric Co. is designed to give an output of 5,000 kw. continuously at 6,600 volts, 50 cycles, with a power factor of ·8 and a speed of 1,500 r.p.m.

The generator stator is in one piece, and consists of a cast-iron box section frame to accommodate the laminations.

No filing or scraping was done after the laminations were assembled, as owing to the length this would cause much higher iron losses, due to eddies, than in ordinary machines. For the same reason, sheets of strong paper are inserted between the plates at suitable intervals.

Stranded copper has been used throughout, not only in the slot, but also in the connections.

The insulating tubes are of micanite, and moulded on to the coil itself.

The ventilation is carried out by means of fans fixed rigidly at each end of the rotor, and the scheme is that the fan at the exciter end of the rotor drives the air into the space enclosed by the guards. After cooling this side of the stator coils, the air passes through a number of axial channels provided in the core for cooling purposes. The outlet for the air is all at one end of the machine: that is to say, the opposite end to the inlet, and in passing through the core to escape, it automatically cools the coil connections. There are two completely separate streams of air, and that air which is used to cool the rotor is not used again to cool any part of the stator; this results in very low even temperature rises all over the machine.

Heavy metal clamps are arranged all round the windings to prevent any moving of the connectors or the projecting ends of the coils.

The rotor is a solid forging, in one piece with the shaft; the slots are milled out of the solid drum.

The fan at the coupling end of the rotor is used for keeping a circulation of air through the rotor for cooling purposes.

The temperature rise guarantee is that it shall not exceed 70° above the surrounding atmosphere after six hours' run on full load. Efficiencies at ·8 power factor full load, 95·75 ; three-quarter load, ·95 ; half-load, 93·25.

With relation to the overall efficiency of the set, as a result of some recent tests taken on site, it was found that the steam consumption per KW.-hour is ·6 lb. better than the maker's guarantee, which was considered most satisfactory.

A Heenan & Froude rotary air filter is installed in connection with the alternator, and this filter has proved very efficient.

The new 5,000-KW. set was named after the Mayor of Keighley (F. W. L. Butterfield, Esq., J.P.), and the opportunity was taken of giving a name to the three other turbo-alternators installed in the station, the next in size being a 2,000-KW. set, which was named after the late Mayor, Councillor W. A. Brigg, J.P., and the two 1,000-KW. sets, one after the present chairman of the Electricity Committee, Councillor Herbert Sellers, and the other after the late chairman, Councillor Henry Whitehead.

ANTHRACITE COAL.*

By W. H. BOOTH, F.G.S.

There are, roughly, four general varieties of coal—lignite, bituminous, semi-bituminous, and anthracite. These are sufficiently distinct to be at once recognised as regards their average members. But there is some difficulty near the lines of demarcation, for while brown coal is at once seen to be a lignite, yet the Kaitangata coal of New Zealand, and the Bulli coal of Australia, though lignites, are very similar to bituminous coal. But Welsh smokeless coal, or semi-anthracite, has an appearance of its own, and anthracite, with its flinty looking bright fracture, its hardness and clean touch, stands very much alone.

Yet all the coals differ only in some hidden secret of their molecular make-up rather than in their bald analytical figures. Typical analyses—No. 1 of a well-known bituminous coal, No. 2 of one of the best Welsh smokeless varieties, and No. 3 of "Gwythien Goch" anthracite, as obtained from the Ammanford and Pontyberem Collieries of South Wales—are appended. Hydrogen is so often regarded as the distinguishing feature of bituminous coal, that these analyses may be a little surprising. They indicate that the influence of oxygen is of greater importance as the factor, in bituminous coal, which enables about one-third of the weight of a coal to pass away in a gaseous form when the coal is heated. Long streams of flaming gas are then set free, and if the flames are checked by contact with cold surfaces, masses of soot are deposited on those surfaces, and the flame is rendered dull and red, or is more or less completely extinguished.

With Welsh smokeless coal it is very different. Any gas in its composition comes off in short flames of easily ignited gas, which are not long enough to reach even to a nearly-placed cold surface, so that, with any reasonable care, a Welsh smokeless coal can readily be burned without showing smoke.

Real anthracite burns just as though it were pure, solid, gasless carbon. The pieces become as hot as the fire into which they are thrown, and just melt gradually away if exposed to a draught of air. There is no smoke. There is, however, a little tarry matter even in an anthracite coal, but it is very small, and only develops, as a rule, in the separator of a gas producer, from which, of course, the gas comes away not too highly heated, and leaves a little tar in the tar separator box.

Welsh anthracite is closely resembled by the anthracite of Pennsylvania, U.S.A., but the latter is harder and more splintery, and requires a keener draught to burn it. It is much used on American locomotives, because of its smokeless quality, and is burned on tubular firebars, on which it is thinly laid. He is a skilful fireman who can fire one of these large American fireboxes thinly and evenly, care being required to fill up the holes before they are fully burned through, for the American article is apt, when burned into holes, to cool rapidly round that hole, so that a blank and spreading patch of non-burning coal may form.

In order to understand the action of anthracite in the process of combustion, it is perhaps best first to describe what happens in a furnace when bituminous coal is burned and when anthracite is burned.

Taking first the case of bituminous coal, let it be assumed that a fire has burned down sufficiently to demand a further charge of coal. The whole fire is brightly incandescent, and giving off merely the short blue flames of carbonic oxide gas, which, especially if the fire is thick, will be produced when the supply of air through the grate is not sufficient completely to burn the carbon, which remains when the hydrocarbon gases have been driven off the last charge of coal. The chemical action with sufficient air is $C + O_2 = CO_2$. In this equation the nitrogen of the air is neglected as neutral. With insufficient air the action is as follows:—$2\ C + O_2 = 2\ CO$, the result being carbonic oxide gas with less than one-third the heat production of perfect combustion. Thus when fires are thick, additional air may be needed over them to burn this gas as well during the period when the hydrocarbon gases are being evolved.

The fire then being brightly incandescent, a fresh charge of coal is sprinkled evenly over its surface. The first effect is to heat the fresh fuel at the expense of the red-hot fire next the grate, and to cause it to pour out volumes of hydrocarbon gas, which bursts into flame, and demands for a short time a very considerable volume of air above the fire. This is usually admitted at the door by grids. A ton of bituminous coal will give out about 10,000 cb. ft. of gas. Assuming a charge of fresh fuel to be 56 lb. per furnace, the gas production will be 250 cb. ft. in a space of two to four minutes. To produce this amount of gas out of solid fuel will require the locking up of heat in a latent form, exactly as when any solid or liquid is vaporised. This heat can only be derived from the fuel on the grate, and since one-third the weight of bituminous coal is thus volatilised, it is clear that the fuel on the grate, now reduced by combustion to less than two-thirds its original weight, will be very sensibly cooled. The gas which has been given off will burn freely if mixed with air and not deprived of its heat of combustion by directing the flames upon too much cooling surface. The mixing with air and subsequent heating is accomplished in properly-formed furnaces by allowing the gas and air to flow together over the length of the fire and by providing an ample combustion space beyond the bridge in which complete combustion may be secured. Is it because of these suddenly produced volumes of gas, to be burned off in a fraction of the total time between stokings, that some mechanical stokers are made to give a constant feed of fresh coal at the furnace mouth, whereby a constant production of gas is secured and the working of the furnace is rendered uniform, and the supply of air above the fire is also constant; indeed, sufficient air usually gets through the thinly burned part of the fire next the bridge. Often, indeed, far too much air gets in through the nearly bare grates.

Since so much of the coal has gone away from the grate as gas, and has cooled the fire in doing so, it follows that little more than half the heat capacity of the coal is actually generated on the grate. The mean temperature of the fire is, therefore, much less than it would be if all the combustion occurred actually on the grate.

Now to take the case of anthracite, any hydrogen in its composition is apparently either free or compounded with carbon in such a manner that the flame is short, and is practically contained within the fuel bed. Almost all the coal is just solid carbon, which burns away completely on the grate. When air passes through the grate and comes into contact with the fuel, this is at once burned to carbon dioxide. The action is as above, $C + O_2 = CO_2$. As this gas passes up through the fire it picks up more carbon and issues at the fire surface if the fire bed is thick, as 2 CO. And this must then be burned again to 2 CO_2 by adding more air above the fire. But if the fire is thin enough, air gets through the bars to burn all to CO_2. And all the heat of combustion is thus generated near the grate surface, and it is not desirable to use grates put together so carelessly as they may be with bituminous coal. The grate bars must not present parts of their sides to the fire. Therefore, no bar should stand up above the rest, or the upstanding part risks being burned. Various methods have been adopted to prolong the life of fire-bars under anthracite fuel. Bars have been made hollow, and a stream of water run through them. Their upper surfaces have been made of trough form, and the trough has filled itself with the ash, which has insulated the bar surface from the direct touch of the hot fuel. Anthracite has been burned on flat plates in which are many holes, each surrounded with a nipple like a flat volcanic hill. The areas between these hills become filled with ash, and this preserves the metal. Some have cast very deep bars, the bellies of which have been immersed in a trough of water in the ashpit, which has kept the bars cool by conduction of the heat from the upper edge, and by the flow of steam between the bars into the fire, where the steam is split up into its constituent gases, and heat is thus abstracted from the fuel bed, and returned later on, when the oxygen and hydrogen recombine, and give up the heat taken up in decomposing them at the grate surface.

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* Memorandum specially prepared for Mr. T. T. Pascoe, of Swansea, to whose courtesy we are indebted for the opportunity to publish it.—Eds. Elec. Rev.

The use of steam in connection with the burning of anthracite fuel is quite general now. The anthracite is better for a little assistance to sharpen the draught, for this helps to clear the surface of the pieces of fuel from the dust left on the burning surfaces, and, by the use of steam-blown inductors, the air is forced into the ashpit, and passes with the steam directly to the furnace, where, as stated above, the steam is decomposed by the red-hot coal, and helps to moderate the intensity of the temperature at the grate surface.

By these means anthracite coal may be burned at a considerably higher rate per square foot of grate surface than if ordinary natural draught is employed, but greater care is necessary in the preservation of an even grate surface and in the maintenance of an even thickness of fire, for at higher rates of combustion the fires burn more quickly into holes, and, moreover, the thin parts of the fire are more keenly attacked by a sharp draught, and so are still more rapidly burned into holes.

The Gas Producer.

The action of anthracite when burned on a thickly-covered grate has been shown above to be imperfect in so far that the gas which results from combustion is a carbon monoxide and the heat of combustion is only 4,415 B.TH.U. per lb. of carbon as compared with 14,647 B.TH.U. for perfect oxidation.

This peculiar property is really very valuable, for by burning anthracite in a thick mass in a firebrick-lined vertical cylinder with an air inlet at the base only, the output above the fuel bed is almost wholly carbon monoxide = CO, plus, of course, the nitrogen, which goes in with the air and is neutral, and acts merely as a diluent. If now this carbon monoxide is burned with a further supply of air, it will give out 10,232 B.TH.U. for each lb. of carbon which it contains, for 14,647 − 4,415 = 10,232. The gas is thus eminently suitable for use in gas engines, and has come very largely into use for power purposes. But experience has shown that the 4,415 B.TH.U., which it is not possible to avoid producing when a gas generator is worked with dry air, are more than sufficient to carry on the proper heat reaction of a gas producer. The gas passes off very hot, and must be cooled. Thus much heat is lost. To reduce this loss, the gas, as it passes from the producer vessel, is made to heat a tank of water which forms the cover of the producer vessel, and it may also heat a vertical cylinder outside which a constant trickle of water is allowed to flow. The air to feed the producer is drawn over the wetted surfaces and over the steaming surface of the water in the cover tank, and enters the base of the producer carrying a considerable load of steam. This steam splits up, when it touches the hot fuel, into oxygen and hydrogen.

The hydrogen helps to quicken the combustion of the final gas in the engine cylinder, and the oxygen combines with the red-hot coal to form carbon monoxide. Thus it takes the place of a portion of air, and the resulting product not only now contains hydrogen, but it contains less nitrogen, and the final gas is much more powerful.

Many producers for small suction gas plants are so very small as to be little more than toys, and the grading of the anthracite to suitable size is very desirable if the gas is to be uniform in quality. Anthracite must always remain, *par excellence*, the fuel of the gas producer, for it is hard and it does not bind or cake, but moves freely down as it burns away, and fills the space of the producer evenly, avoiding empty air channels up which air would travel, and, by aiding to burn the gas above the fuel bed, would greatly reduce efficiency. There are no caves formed by the bridging across of conglomerated fuel. The pieces of anthracite are too free, loose, and dry to hold to each other, and the fuel bed is self-consolidating.

(To be concluded.)

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Simplex Weather-Proof Fitting.

A new porcelain-body watertight lantern brought out by MESSRS SIMPLEX CONDUITS, LTD., of Garrison Lane, Birmingham, is specially made up to resist corrosion and deterioration due to the weather. It consists of a heavy china body into which is cemented a metal threaded nut, to take the suspension fitting or down-drop of the conduit system.

The well glass, which is held by a metal ring with two bolts and fly nuts, completely protects the lamp and prevents corrosion of the contacts, and keeps moisture from entering the system. The ring and the nuts are galvanised for protection. The standard well glasses are used with this fitting, so that in the event of the glass breaking, replacement is quite easily effected. The body of the lantern also has an overhanging projection which acts as a shade. It is a cheap and effective fitting, and is specially useful for garages, stables, yards, factories, and other exposed positions.

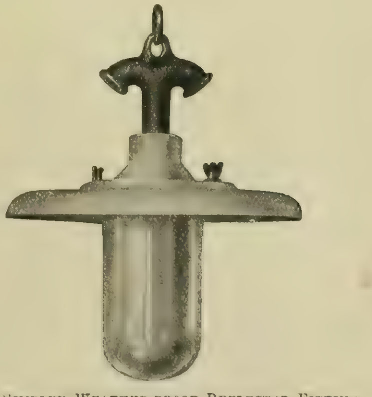

FIG. 1.—SIMPLEX WEATHER-PROOF REFLECTOR FITTING.

The "Depthometer."

Most firms of any magnitude have experienced the need of some method of indicating or recording the depths of liquid in distant tanks—a perfectly safe method when used in conjunction with volatile and inflammable liquids such as benzol, toluol, &c., which will indicate the depths in a continuous curve from "empty" to "full," and combine simplicity with the need for an extreme minimum of attention.

A system having these desirable advantages is obtainable in the Plummer-Burrows Depthometer, made by the Foster Engineering Co., Ltd., of Wimbledon, London, S.W.

This is an electrical device operated by an alternating current at a pressure of about 20 volts, and avoids the employment of moving contacts with consequent oxidation and unreliability. All current-carrying parts are hermetically sealed from tank vapours, the risk of explosion being thereby eliminated. Supply voltage fluctuations are corrected by means of a small automatic regulator, which smooths out irregularities in the supply pressure of 16 per cent., which variation, of course, seldom occurs in practice. There are no wearing parts in the regulator, and as accessibility has not to be provided for, the parts are sealed before leaving the factory.

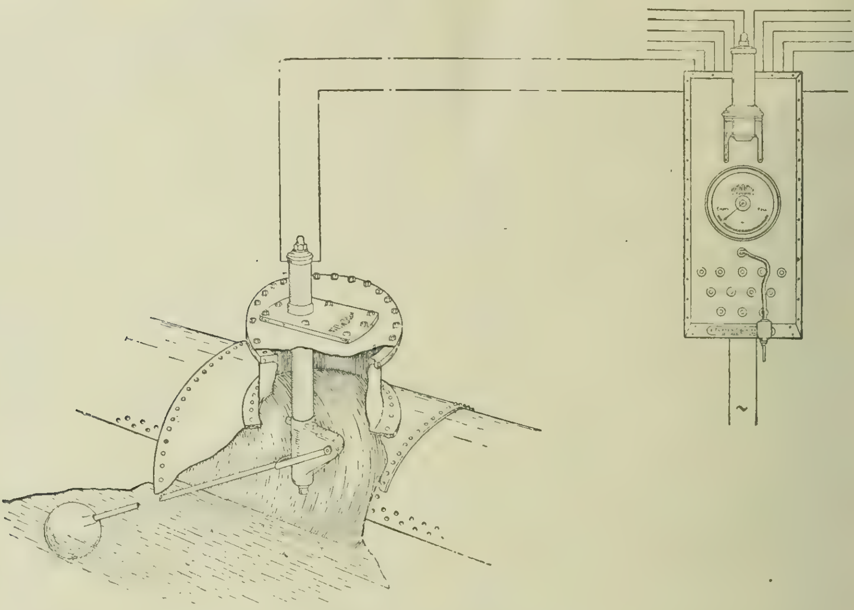

Fig. 2.—Showing Arrangement of Depthometer and Recording Panel.

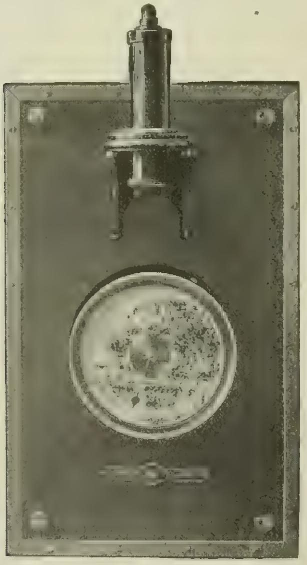

Fig. 3.—Depthometer Recording Panel.

Fig. 2 illustrates the disposition of the various parts in a typical installation, while fig. 3 shows the panel at the recording station, on which are mounted the pressure regulator and the indicating instrument giving direct readings in feet and inches.

The float in the tank actuates the movable core of a choking coil, the coil being connected in series with a millammeter and low-pressure A.C. supply. The millammeter is calibrated at a definite supply voltage, and indicates in feet and inches.

The voltage regulator is a choking coil having two windings—an upper one connected in shunt to the supply, and a lower one across the instrument terminals. An iron core floats in the windings, an increase in pressure tending to draw it into the upper winding, and thus to reduce the choking effect of the lower winding in parallel with the instrument, thus altering the proportion of current flowing through the latter in such a way as to compensate for the increase in total current arising from increased supply pressure.

The appliance can operate over any distance, and the current consumption is only 0·05 unit per hour.

There is only one moving part which might be subject to wear, and this, though extremely light, operates under oil, and when once installed requires no attention.

A Magneto Re-magnetiser.

A simple apparatus for the re-magnetisation of ignition magnetos has lately been brought out by the Runbaken Magneto Co., Ltd., of Campt Street Works, Deansgate, Manchester. The device is normally supplied for 100—150 and 200—250-volt circuits, but as low as 12 volts can be arranged for at a slight extra cost.

LEGAL.

Electric Installation at a Picture Palace.

Mr. Muir Mackenzie, one of the High Courts Official Referees, on Thursday, June 7th, concluded the hearing of an action in which Mr. Joseph Mears, proprietor of the Richmond Cinematograph Theatre, claimed from Messrs. Weston & Sons, electrical engineers, damages for breach of contract in connection with the installation of electric lighting at the theatre, and for money paid under a mistake as to facts.

Mr. C. J. Conway appeared for the plaintiff, and Mr. H. J. Turrell for the defendants.

From Counsel's opening statement, it appeared that by a letter dated October 1st, 1914, the defendants offered to install an electric light and power system for the plaintiff at his then newly-built cinematograph theatre at Richmond for the sum of £473. On October 9th, 1914, the plaintiff orally accepted the offer, provided that the price was reduced by the allowance of a discount of 5 per cent. It was a term of the contract that the defendants should use for the complete power and lighting installation heavy-gauge screwed conduits, enamelled inside and out, of ample size to enable the cables to be drawn in and out after erection, and that they should efficiently connect the whole conduit with the earth, and efficiently drain off any condensed moisture. It was also stipulated that there should be no joints whatever in the wiring, and that the whole of the work should be carried out in accordance with the rules and regulations of the Institution of Electrical Engineers, the fire insurance companies concerned, the supply authorities, the Secretary of State under the Cinematograph Act, and the Surrey County Council. It was a further term of the contract that the whole of the work to be done should be guaranteed by the defendants for a period of 12 months from the date of the last certificate of completion. The breach of contract complained of was that the defendants did not use heavy-gauge screwed steel conduits of sufficient size to enable the cables to be drawn in and out after erection, and that they did not lay the conduits so that the condensed moisture could be successfully drained off. It was also alleged that the wiring was not without joints, and that the work generally was not carried out in accordance with the terms of the contract or in accordance with the rules and regulations of the authorities. The installation, it was alleged, was not, on the whole, efficient, and was not maintained for 12 months in accordance with the guarantee. By reason of these breaches of contract and warranty, the plaintiff had suffered damage, and had been put to the expense of remedying the defects, amounting in all to £109 19s. 6d. It was further stated by counsel that the plaintiff from time to time paid to the defendants sums of money on account for work performed under the contract and for extras amounting in all to £785 15s., the final payments being made on September 6th, 1915, and January 23rd, 1916, under a mistaken impression that the amounts paid were due, whereas an amount of £23 13s. was overpaid, as deduction had not been made on account of 5 per cent. discount on the sum of £473, the contract price.

In their defence, the defendants denied that the contract price was to be reduced by the allowance of discount, and they did not admit any of the allegations as to defective work. The plaintiff, they said, agreed with the defendants to appoint an architect to supervise the work and grant certificates showing, amongst other things, the completion thereof; but this they did not do. They completed the work in accordance with the terms of the contract on December 24th, 1914, and subsequently carried out their 12 months' guarantee. By not appointing an architect, the plaintiff had, said the defendants, himself committed a breach of contract, and was therefore precluded from requiring that the date of completion should be fixed by "the date of the last certificate of completion," as specified in the contract. The defendants further denied that there had been any breach of warranty.

Mr. Tom Lewin Linton, manager for plaintiff, said that after the opening of the theatre for a short time the electric lighting was satisfactory, but early in the year complaints were made that some of the lights were going wrong.

Mr. James Edgcombe, the Kingston borough electrical engineer, in the course of his evidence in support of the plaintiff's case, said that he made a thorough examination of the electric installation at the theatre, and found that while the materials used were quite good, the installation itself was defective. The method of using the materials had not, in his opinion, been in accordance with the specification. Mr. Dewhurst was called in to remedy the defects, which he did at a cost of £109 19s. 6d.

Mr. Dewhurst gave evidence as to the details of the work he had had to do to put the electric lighting of the theatre right. It having been alleged by the defence that some of the alleged defects were to be attributed to the dampness of the building, the witness, in reply to counsel, said that the theatre was a well-built structure, having cost some £3,000, and certainly could not be called damp.

Several witnesses were called for the defence to prove that the work had been properly done, that the complaints as to defects were without foundation, and that if any alleged defects did exist they were due to the dampness of the building.

Counsel for the defence argued that the onus was upon the plaintiff to show want of skill, and this he had not done, and in the result the Referee reserved judgment.

Dundalk Electric Lighting Loans.

In the Chancery Division of the Irish High Court, on Thursday of last week, Mr. Justice Barton gave judgment on the motion of the Dundalk Urban Council for a declaration (see Elec. Rev., June 8th, page 624).

Mr. Justice Barton said that the effect of acceding to the claim of the Council would be to disregard the prohibition of the statute which forbade borrowing for any purpose other than for permanent works, which expression could not include working capital, and to ignore the direction in the Provisional Order that any deficiency in income should be charged on, and payable out of, rates. He had arrived at this conclusion with regret, as he was satisfied that the Council had done everything in a *bonâ fide* and businesslike manner. It occurred to him that undertakings of this kind—municipal undertakings, in fact were at a disadvantage in regard to working capital in comparison with commercial undertakings. He would gladly have acceded to the application if he could have done so. The action taken to obtain a declaration he held to be justified, and he hoped they would find some way out of the difficulty.

Queen Anne's Residential Mansions and Hotel, Ltd., *v.* H.M. Postmaster-General.

In the Chancery Division, before Mr. Justice Eve, last week, Mr. Maugham, K.C., moved on behalf of the plaintiff company for an injunction until judgment or further order to restrain the defendant, his servants, or agents from cutting off or disconnecting the telephone service to the plaintiffs' premises.

According to the *Times*, Mr. Austen-Cartmell, for the Postmaster-General, said that an action would not lie against a Government Department, and certainly not an action for an injunction. The Postmaster-General would, however, be prepared to waive his rights in this respect in order that the rights of the parties might be determined, on the understanding that the action should be set down for hearing at an early date.

Mr. Maugham submitted that the Post Office differed from other Government Departments in that it was carried on for profit, and was thus in the nature of a corporation. He, however, assented to the course proposed by Mr. Austen-Cartmell.

The motion accordingly stood over until the trial of the action.

Tungsten Filament Patent Litigation.

In the House of Lords on Tuesday, the 12th inst., the appeal was opened of the Osram-Robertson Lamp Works, Ltd., from a judgment of the Court of Appeal in favour of Pope's Electric Lamp Co., Ltd.

The House consisted of the Lord Chancellor (Lord Finlay), Viscount Haldane, Lords Atkinson, Parker, and Parmoor.

Counsel for the appellants, Mr. Walter, K.C., Mr. Colefax, K.C., and Mr. Gray; for the respondents, Mr. Thomas Terrell, K.C., Mr. E. M. Kerly, K.C., and Mr. E. Russell Clarke.

The proceedings at the trial of the action and in the Court of Appeal were fully reported in the Electrical Review, July to December, 1915.

In opening the appeal, Mr. Walter, K.C., said that the appellants brought an action in the Chancery Division claiming that the now respondents had infringed their Letters Patent No. 23,899 of 1904. Mr. Justice Joyce found that the respondents had not infringed the patent, and dismissed the action, with costs. That decision was upheld by the Court of Appeal, and from the Order affirming the judgment of Mr. Justice Joyce this appeal was brought.

The patent was granted to Dr. Alexander Just and Franz Hanaman for an invention of improvements relating to the manufacture of incandescent electric lamps, and Letters Patent No. 18,622 of 1906 was granted to Philip Middleton Justice for an invention of an improved method of producing metallic incandescent bodies for electric glow lamps. There was the usual claim for damages and other relief. Prior to the introduction of the appellants' process in 1904 tungsten had never been applied for use under any process for lamp filaments. No method of producing a tungsten filament was known. The appellants found that by mixing finely divided tungsten with a carbon paste material, so as to keep the metal particles together, and heating the compound in moist hydrogen, the oxygen in the water vapour combined with the carbon, and left a coherent mass of tungsten in the form of a paste that could be squirted into threads. The respondents said they employed two methods in the manufacture of their alleged infringing filaments, which were referred to in the Courts below as the "ordinary hydrogen process" and as the "vacuum process." His contention would be that they constituted differences, if they were differences at all, only from the detailed example set out in the appellants' specification. They were not differences from the essence of the appellants' invention as described in the claim, which, on its true construction, covered a process embodying all the alleged differences.

The learned Counsel went on to compare the respondents' process with that detailed in the appellants' specification and claim. He then argued the question of infringement. The hearing was adjourned.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Business Man or Engineer?

Stands Scotland where it did? Or words to that effect. Is there not one among all those who draw the breath of life from engineering to strike a blow for their mistress's fair name? Does no one challenge the insidious attack of the article in your number of May 4th on "Promotion in Electricity Supply Undertakings"? The writer calmly asserts that an accountant may become a chief engineer; that "it is generally agreed that the head of an electricity supply undertaking must be a business man first and an engineer afterwards."

In these days, electricity almost automatically sells itself. The "business" of an electricity undertaking is to produce electricity cheaply and reliably. These are both engineering problems. Given equal reliability, one unit is as good as another. Imagine a given area of supply with two undertakings having equal rights, the one run by a business man devoting most of his energy to rounding up prospective consumers, the other run by an engineer devoting most of his brain work to producing cheaply. The engineer would only want a very "dud" salesman to follow round in his rival's footsteps and simply state that he was selling the identical thing at a farthing a unit less, and perhaps point out that, whereas the other company had had so many failures, his company had had none.

Quite recently I read in an American engineering journal of such a case, only that the "plot" hinged on the fact that one chief hesitated to scrap comparatively new engines in favour of more economical turbines. The slow man, of course, got the sack.

It seems to me that there is only one sense in which the chief of a supply undertaking must be a business man first—and that is, that he must never forget that the aim and object of all his engineering is to produce cheaply. The problems before engineers fall into two classes: Those that may be solved at "any" cost and those that have to be solved at "some" (certain maximum) cost. The power station engineer must not allow himself to be led astray into tackling problems which, when solved, are merely an engineering triumph, not a commercial success. In the past many capable engineers have done this, and so have given rise to certain false impressions and certain cheap sneers from the ignorant about "theorists." I wonder if these very "practical" gentlemen ever heard the familiar appellation of certain ancient sea-going engineers—viz., "shovel engineers" or "shovels"?

To talk about a man being a business man first and an engineer afterwards is surely putting the cart before the horse. I should like to suggest that what is popularly known as "business" is really elementary engineering, or engineering and water. Many years ago, I think at the Oxford meeting of the B.A., Mr. Balfour quoted an American definition of an engineer as "a man who can do for one dollar what any fool can do for two." That, I think, is the essence of "business." Is it too much to suggest that the Americans are such first-class business men because they are such first-class engineers? They have had engineering thrust upon them by the vastness of their country and the rapid growth of its population. Almost everything nowadays resolves itself into terms of engineering: the war, we have been told from the start, is an "engineers' war." Several years ago, at the urgent suggestion of the Electrical Review (in a leader), I sent a half-crown across to New York for a copy of Mr. Salmon's Presidential Address to the American Institution of Civil Engineers, in which he asserted (very emphatically) that an engineering training was the finest business training in the world, and that more and more of the great business corporations of America were being given into the hands of engineers. Surely it would be retrograde for England (the mother of modern engineering) to adopt the policy of "business first and engineering afterwards."

I am afraid this epistle is already far too long (but I could go on for several more pages, and e'en wax violent on the subject), but it amazes me that it should be left to humble individuals like myself to take up the cudgels on such a vital subject at what is really such a vital time; for all things are in more or less of a liquid state just now. Isn't now the time when the engineer, as admittedly the most important citizen, should begin to stake out a claim for his future rights as the most highly-paid citizen? How much longer is the chief engineer going to be satisfied with half the salary of the town clerk? How much longer is he (some of him) going to try to compensate for bad engineering by the "business" subterfuge of starvation salaries to his staff? When is the I.E.E. going to make power station certificates compulsory, and bar the door to "business" chiefs?

Engineer.

News from Ruhleben.

On April 16th I received nine copies of the Electrical Review, addressed to me from your office. The news that copies of the Review had arrived again was greeted with great pleasure by our members, as we had almost given up hope of hearing from Ageekay in the future.

On behalf of the Technical Circle, I beg to express our sincere thanks to you, and to assure you that the 30 odd electrical men, among whom the Review is circulated, keenly appreciate the opportunity thus offered them of keeping in touch with current affairs. The back numbers are constantly being referred to, and have in many instances given invaluable assistance to members preparing papers.

You will be pleased to hear that the work of the "Circle" is going on very satisfactorily, as far as possible on the lines of the Institutions at home.

In spite of the great drawback of being cut off entirely from actual practice, we are able to do a considerable amount of serious work, thanks to the increase of our technical library. Our weekly meetings show a constant increase in attendance, and we are doing our best to keep fit for the time when we can take our places in the ranks once more.

William Eric Swale,
Hon. Sec. to the Committee of the Technical Circle, Ruhleben.

Ruhleben, *April 24th*, 1917.

[We are very glad to hear again from Mr. Swale, whose letter has taken nearly seven weeks to reach us. The difficulties which caused a temporary irregularity in the supply of copies of the Electrical Review were not of our making; they have now been overcome, and we hope that in future the journal will be delivered more promptly. Our cordial sympathies are with our compatriots in their enforced retirement, and we rejoice to learn that they are doing such splendid work, in spite of the disadvantages under which they labour.—Eds. Elec. Rev.]

ASSOCIATION OF CONSULTING ENGINEERS (INC.).

The report of the Committee for the year 1916-17 states that in June last it was resolved, on Mr. Mordey's suggestion, to suggest to members that in preparing specifications and inviting tenders they should require that where possible all goods should be of British manufacture, and that where this was not possible the country of origin should be stated in the tender. The recommendation of the Local Government Board that local authorities should prepare plans and estimates for work to be put in hand at the conclusion of the war without delay is noted. The schedule of protected occupations issued on April 21st provides exemption for mechanical and electrical engineers over the age of 23, but does not mention civil engineers, whose services are often required before the former can proceed with their work, and the Committee has taken up the matter with the Ministry of Munitions. Eleven members of the Association are serving with the Forces.

The accounts show income £119, expenditure £91, leaving a surplus of £28. The assets are valued at £189. Members serving with the Forces are excused from payment of subscriptions, and the subscription for the current year has been reduced to one guinea. The members number 69.

At the annual general meeting, the Chairman (Mr. H. J. Rofe), in moving the adoption of the report, said that they had passed through another year of extreme depression for the consulting engineering profession, and there was little left for them to do but to keep their staffs together in the expectation of being called in to advise on the works which had been held over in this country during the war, and the works of reconstruction which would be necessary in the countries of our Allies on the conclusion of it.

As British capital would no doubt be largely employed in financing the schemes abroad, they trusted that British consulting engineers would to a large extent be employed to advise upon them.

The committee had continued to urge upon the Local Government Board the necessity for undertaking *now* the preliminary work on such schemes as were of urgent necessity, and which should be put in hand as soon as possible after the war. The Board had already in certain cases granted permission for the raising of loans sufficient to cover the fees and expenses incurred in preparing the necessary plans, specifications, schedules of quantities, and estimates, but he thought that the local authorities would hesitate to commit themselves to undertake the work unless the Government guaranteed their loans for such approved schemes at a fixed rate of interest.

Each year greater use was being made of the Association by individuals, local authorities, and also Government departments when requiring the services of a consulting engineer specialising in any particular branch of the profession.

Mr. Spencer Hawes seconded the adoption of the report, and it was carried unanimously; the accounts were also adopted, and the Hon. Secretary (Mr. A. H. Dykes) announced that the following gentlemen had been elected as members of the committee:—

London Members: Mr. J. S. Alford, Mr. H. H. Humphreys, Mr. J. Swinburne, F.R.S., and Mr. G. M. Taylor.

Country Members: Mr. W. Cramp and Mr. J. E. Sayers.

Mr. F. E. Wright was re-elected as honorary solicitor, and Messrs. Cash, Stone & Co. as honorary auditors.

Votes of thanks to the chairman, the hon. treasurer (Mr. S. R. Lowcock), and the hon. secretary (Mr. A. H. Dykes) concluded the proceedings.

WAR ITEMS.

Summer Street Lighting.—Deptford Borough Council has received a letter from the Home Office concerning the Council's proposals for the diminution of street lighting during the summer months. The Home Secretary, after consulting the Commander-in-Chief of the Home Forces and the Commissioner of Police, expresses the opinion that where all lamps are now in lighting, one in three might be dispensed with from now until August 25th, provided that there is a lighted lamp for each 100 yards of street.

Men in Protected Trades and Tribunal Exemptions.—At Southwark Tribunal, the point was raised as to the position of men who previously had exemptions from Tribunals, but are now in possession of certificates of exemption under the Protected Trades' Schedule, as to whether they should surrender their Tribunal exemption certificates. It was held that if they were withdrawn neither the men nor their employers had a right to any further appeal at the Tribunals.—Coun. Weaver said the certificates granted the men under the schedule could be cancelled at any moment by the Recruiting Officer, and unless the men were now protected by the Tribunal they, and their employers, would be deprived of their right to appeal. When a man was previously badged by the Ministry of Munitions and the badge was withdrawn he had the right to lodge an appeal at the Tribunal, and the same privilege should be extended to men receiving these new certificates.—The Military Representative said the latest instructions from the War Office were that in cases like this, when the men had received certificates under the schedule of the protected trades, he was not to press for the withdrawal of the Tribunal exemption certificates, and in future he should not ask for their withdrawal. That would deprive no one of the right to an appeal at any time should the new certificates be withdrawn.—The Chairman said he should not raise any objection to a man coming to the Tribunal for exemption after he had lost his certificate under the schedule. —The Tribunal decided to permit the men to retain their Tribunal certificates when granted certificates under the schedule of the protected trades.

Standardisation of Copper Tubes for Aircraft.—Difficulties having been experienced by aircraft contractors in obtaining supplies of copper tubing, the causes were investigated, and they were found to be (1) the great variety of sizes called for, (2) the fact that tube makers received orders very irregularly and for small quantities. Arising out of the investigation, the Specification Committee of the Air Board has decided that, in future, copper tube for aircraft contracts will be specified in terms of external diameter and legal Standard Wire Gauge. As far as possible tubes of 20 gauge (.036 in.) will be used, to the exclusion of all other thicknesses. Where, for special considerations, it is desirable to use other thicknesses, the choice will, as far as possible, be restricted to gauges 16, 18, and 22. The last-named is difficult to manufacture, and will be avoided as far as possible. A new Air Board specification for copper tube will shortly be issued, and will have as an appendix the following list of sizes and gauges which the Air Board regard as standard:—

20 *Gauge.*—3/16 in., ¼ in., 5/16 in., ⅜ in., 7/16 in., ½ in., ⅝ in., ¾ in., ⅞ in., 1 in., 1⅛ in., 1¼ in., 1⅜ in., 1½ in., 1⅝ in., 1¾ in., 2 in.

18 *Gauge.*—1 in., 1¼ in., 1½ in., 1¾ in., 2 in.

16 *Gauge.*—½ in., ⅝ in., ¾ in., ⅞ in., 1 in., 1¼ in., 1½ in., 1¾ in., 2 in., 2½ in.

22 *Gauge.*—1 in., 1⅛ in., 1¼ in., 1⅜ in., 1½ in., 1¾ in., 2 in.

Trading with the Enemy.—The "London Gazette" for June 8th contains a number of additions to the list of persons and bodies of persons in Argentina, Paraguay, Uruguay, Brazil, Chile, Denmark, Netherlands, Netherlands East Indies, Spain, Sweden, Venezuela, and other countries, with whom trading is prohibited.

Exports to China.—A further list of those in China to whom exports may be consigned is given in the *London Gazette* for June 8th.

Controlled Works.—The number of controlled establishments is now 4,942.

Returning Municipal Employés.—Birmingham City Council has approved a resolution that soldiers, on returning to resume Corporation work, shall be offered employment, even if they are unable to resume their former positions.—*Times.*

Souchez Power Station.—In his dispatch, dated June 5th, Sir Douglas Haig said:—"We gained ground slightly during the night south of the Souchez River. The electric power station in the neighbourhood, for the possession of which fierce fighting took place on the 3rd inst., is now in our hands."

Exemption Applications.—At the Westminster Tribunal, last week, the cases of 163 employés of the London County Council tramways were considered. The Chairman asked Mr. F. W. Brock, who represented the Council, if he intended applying for the exemption of Class A men. Mr. Brock said he had to do so; all men who were not certified had gone. In respect of a man aged 28, single, Class A, he knew it was useless applying. After going through the list in six cases the Tribunal refused exemption, the other cases being those of men in certified occupations.

At Southwark, the Selwyn Electrical Engineering Co., Ltd., appeared, at the request of the Military Representative, to show cause why a certificate of conditional exemption granted the manager, 29 years of age, passed for general service, should not be withdrawn. It was stated that the firm were carrying out installations for the Southwark Borough Council, many of which were very complicated. The manager was mostly engaged on repairs at munition works, his wages being 50s. a week for 50 hours. The conditional exemption certificate was withdrawn.

At Fleetwood Tribunal, on June 8th, an electrical engineer, who had been granted six months' exemption, had his certificate reviewed. Captain Dixie said at the last hearing it was stated that the man was the only qualified electrician in Fleetwood, and on that ground he consented to exempt him. A local electrical firm, however, had written protesting against this, stating that they were qualified electrical engineers, and had received Government protection badges. Another electrical firm had written in the same strain. He had raised the matter to give public satisfaction. The respondent said there were other electrical firms, but they were not qualified electrical engineers. A qualified man was one who had served his time. The exemption was allow to remain.

Mr. John F. Cameron, tramway manager to Northampton Corporation, was recently again before the Local Tribunal on behalf of various members of the tramways staff. The following exemptions were given:—Three motormen, one month final; traffic inspector, controller fitter, carpenter, and six motormen, three months open. The chief clerk having been granted three months' exemption some time ago by the Local Tribunal, the Military lodged an objection, which they successfully sustained before the Appeals Tribunal; the chief clerk has since joined the R.G.A.

At the Lanarkshire Appeal Tribunal, the Military appealed against the continued exemption of a man, 26 years of age, employed as an electrician in a picture theatre. Major Rounsfell Brown stated that the man passed with honours in electricity at the Technical College, and he urged that his skill could be put to a better use in the Army than in a kinema house.—Temporary exemption for three months was granted, and the Military were accorded leave to appeal to the Central Tribunal.

At the Sheffield Tribunal, last week, there were the names of 149 employés of the Corporation electricity supply department to be dealt with. They represented a variety of occupations, from the engineers downwards. Mr. E. B. Gibson, of the town clerk's department, said that 183 men in the department had been either exempted or scheduled, but there were 84 men who were neither one nor the other. They could not give up voluntarily any of their 267 men, but, in fact, could do with more. In a pre-war year they produced 26½ million units, but the present output was 220 millions. Applications were now in hand for an increase of 40,000 H.P., and there was also another scheme on hand. The department did not wish to retain the young single men, but if they lost any of those men efficient substitutes must be forthcoming. In view of negotiations in regard to substitution, the Tribunal agreed to the adjournment of all the cases for 14 days on the understanding that appeals could be made in all cases not covered by certificates or exemptions, or in which any hitch might occur.—*Sheffield Independent.*

Renewed exemption for four motormen was sought at Brighton by Mr. Marsh, manager of the Corporation tramways, and also for a timekeeper. One of the motormen, in Class C 2, was given a final month, and the others were each allowed until October 27th.

A review was made at Oxford of the cases of F. Chatwin (34), fitter, and H. Holmes (29), chief engineer, both with the Electric Tramways Co., and both passed for general service. It was intimated that the latter was leaving for the Army at once, and was applying for a commission, a substitute over military age having been secured. Chatwin, it was stated, was the only fitter the company had for day work, and they had no one to replace him, substitutes sent having been men of no experience. The Tribunal granted Chatwin a month's temporary exemption, with a view to substitution.

Conditional exemption, granted on May 29th, 1916, to C. Howard (34), electric fitter and wireman with Messrs. Hill, Upton & Co., electrical engineers, Oxford, was reviewed. The firm produced a certificate showing that Howard was in a reserved occupation, and was not liable for military service until he had had his calling-up notice. The Tribunal withdrew the certificate, as Howard is in the hands of the dilution authorities.

At Oxford, renewed exemption was sought by H. G. Watson (29), electrical engineer and fitter, of Turl Street. He stated that 11 years ago he took over his late father's business; he did all the managing and the electrical part of it, was electrician to eight colleges, at some of which cadets were billeted, and was also engaged on Government work in the city, and had a direct contract with the Admiralty. The appeal was respited for appellant to communicate with the dilution officer.

The Military appealed to the County Tribunal against temporary exemption to September 1st held by R. Lerwill (18, in Class B 2), charge engineer with the Ilfracombe Electric Light Co. Lieutenant Stirling pointed out that the company had two engineers to work two shifts, which covered 18 hours, and he asked what prevented the manager from taking the place of one of the engineers, who would then be released for service. The manager replied that his duties as manager would prevent him from doing as Lieutenant Stirling suggested. If he took over one of the shifts, say the night shift, and the cables went wrong, he would not be able to leave the works, and the town would be plunged into darkness. The appeal was disallowed, and the exemption confirmed.

On a military appeal, the Southend-on-Sea Tribunal has withdrawn the exemption certificate held by a switchboard attendant (28), engaged at the Corporation electricity works. A tram-driver (36), for 13 years with the Corporation, was given final exemption until August 1st.

At Colchester, the Tribunal appealed against exemption held by a stoker at the Corporation electricity works. The electrical engineer said that the stoker was also exempted under a protection certificate. Lieutenant Payne ascertained that others possessing such certificates included the switchboard attendant, aged 20, unmarried, and passed for general service, and said that he thought it was scandalous that these certificates should be given, and he would bring the matter before the proper authority; this would probably be the means of their losing their protection. The appeal was assented to.

At Carlisle, Messrs. Morton applied for exemption for Mr. A. Munro (22, in Class B 1), assistant electrician, and stated that they had 70 electrical machines, and owing to shortage of skilled labour they had to do their own new wiring, repairs, and installation of electrical power. Conditional exemption was granted.

The Corporation applied at Carlisle for exemption for W. Lindsay (18), apprentice in the electricity department. The town clerk said that Lindsay, who had rupture, was not fit for Class A, in which he was placed. It was decided that he should go before the Central Medical Board if he could not get a position as mechanic in the Flying Corps.

Before the Cornwall Appeal Court, the Military appealed against conditional exemption allowed to H. Jenkins (39, in Class B 1), electrician and electrical fitter with the Hotel Victoria, Ltd., of Newquay. He was directed to report for service on June 30th.

At Bexley, an appeal for W. H. Charley (30, in Class C 3), armature winder, with Dickinson's Electrical Manufacturing Co., Ltd., was respited until he is called up. The same Tribunal withdrew conditional exemption held by six motormen on the U.D.C. tramways, and exempted them until efficient substitutes are obtained.

An appeal at Bedford by the Igranic Electric Co., for the retention of F. Morris (41), a time-expired man, was adjourned until he is called up.

The Military appealed to the Northants Tribunal against exemption held by Mr. F. L. Perrin, electrician, Northampton. Respondent, who was one day short of the age which placed him in a certified occupation, said that he was constantly engaged on electrical work at factories in the town and district, and in the winter worked almost night and day, and on Sundays. The appeal was disallowed, and the exemption confirmed.

BUSINESS NOTES.

Italy.—A new company has lately been formed in Turin, with a capital of £800,000, and the title La Società del Alluminio Italiano, to carry on the manufacture of aluminium and other electrochemical products, to establish hydro-electric power plants, &c., in Italy. The Società Idroelettrica di Villanueva e Burgofranco, the Société des Tréfileries du Havre, and the Società Trafileri e Laminatoi di Metalli are interested in the new undertaking.

Patents and Alien Enemies.—A licence has been granted to the United Flexible Metallic Tubing Co., Ltd., to use Patent No. 3,822/09, granted to Witzenmann.

Bankruptcy Proceedings.—George A. Smith, 61, Pall Mall, and George A. Smith & Co., 61a, Pall Mall, S.W., consulting engineers.—The first meeting of creditors was held on June 8th, at the London Bankruptcy Court, the proceedings having been consolidated by order of the Court on May 17th. Mr. J. B. Knight, Official Receiver, reported that the debtor had stated that prior to 1914 he was in business as a consulting engineer. Six months before the outbreak of war, with the object of carrying out hydro-electrical enterprises, he promoted the Pall Mall Development Corporation, Ltd., of which he was appointed managing director. That company never did any business, and the debtor returned his loss over it at £400. Later he promoted other companies. Two years ago the debtor patented an indicator buoy for drifter patrol; it had been taken over by the Government, and the debtor was now attached to the Admiralty as an electrical engineer. He claimed that he had no personal debts of any kind, and that he was perfectly solvent, his present position being due to his having financed the Swindon Engineering Works, Ltd., and to his having made himself liable for the debts of that company. Proofs to the amount of £1,760 were dealt with by the chairman, and a resolution was passed for Mr. E. H. Hawkins, chartered accountant, 4, Charterhouse Square, E.C., to act as trustee, and administer the estate in bankruptcy. The chairman declined to adjourn the meeting, but intimated that notice would be given to the debtor of the application for the adjudication order, and he could then place the position before the Registrar.

Canadian Exhibition. — The thirty-ninth Canadian National Exhibition is to take place in Toronto, from August 25th to September 10th, 1917, and an attendance of a million visitors is looked for. Exhibits relating to agriculture will be important, including a large display of tractors, and there will be farming and other like demonstrations and competitions. British firms who may be desiring to take space should apply at once to Dr. J. O. Orr, general manager of the Exhibition, 36, King Street East, Toronto. There will be a Machinery Hall and Electrical Building. Fuller particulars will be found in last week's *Board of Trade Journal*.

Mr. Dudley Docker and the Electrical Industry.—In the course of his recent speech as chairman of the Metropolitan Carriage, Wagon, and Finance Co., Ltd., Mr. F. Dudley Docker referred to the steady growth in the membership of the Federation of British Industries, alluded in unmistakeable terms to the hostility which had been displayed in Parliament to the British Trade Corporation, and finally devoted his attention to the British electrical industry. He said that in the judgment of the board of the Metropolitan Co. the electrical industry had remained too long in foreign hands. "There is no doubt that the work of electrical construction will play an essential part in British trade development, and, continuing the policy your directors have always pursued, anticipating rather than following, we have acquired a controlling interest in the British Westinghouse Co. It is a considerable event in itself, and we may perhaps be pardoned if we are somewhat proud that this control should be in British hands, and more particularly in ours. We may not stop here. Chapter 3 is only beginning. . . . Your board and your staff . . . are alive to the tremendous call the future will make upon their energies as well as their abilities."

Trade Announcements.—The New Switchgear Construction Co., Ltd., of Sutton, Surrey, announce the following appointments :—

Messrs. Plunket & Abbott, of Lynwood, Llanishen, Cardiff, as their representatives in South Wales district, including Glamorgan and Monmouth.

Mr. R. H. Willis, M.I.E.E., of 211, Produce Exchange, Cathedral Street, Manchester, as representative in Manchester district.

Messrs. Woolfall & Rimmer, of 71, London Street, Southport, have purchased the business of Messrs. John Boyd & Son, electricians, Hoghton Street and Chapel Street, and will conduct it in future.

Book Notices.—"Electrical Engineering Practice." By J. W. Meares. London : E. & F. N. Spon. 25s. net.

"Year Book of Wireless Telegraphy and Telephony for 1917." London : The Wireless Press. Price 3s. 6d. net.

"Industrial Fatigue in its Relation to Maximum Output." By H. J. Spooner. London : Co-Partnership Publishers. Price 6d.

Practical Dynamo and Motor Management. London : S. Rentell and Co., Ltd. Price 6d. net.—While the text in this new edition shows little alteration, a considerable number of new illustrations has been introduced ; these include a useful set of clear diagrams of connections for D.C. motors and generators of various types, which should prove useful.

The June issue of the *Faraday House Journal* contains a portrait of Dr. Alex. Russell, obituary notices of old Faradians killed in action, abstracts of papers by Mr. L. Kettle and Mr. S. E. T. Ewing, and supplementary lists of past and present students and members of the staff who are serving with the Forces.

Liquidations. — Steel's Electric & Engineering Co., Ltd.—A petition for winding up this company has been presented to the Courts by C. S. Milne & Co., Ltd., of Millwall, judgment creditors, and is to be heard on June 19th.

British Graetzin Light, Ltd.—The Controller, Mr. Thos. Wise, has applied for his release.

Colston Electrical Works, Ltd., Bristol.—June 22nd is the last day for receipt of proofs for dividend by the liquidator, Mr. C. H. King, 26, Balwin Street, Bristol.

British Manufactures in Australasia.—*New Zealand Shipping and Commerce* for April 19th publishes an appeal from Mr. R. H. Butler, the secretary of the B.E.A.M.A. in Australia, urging prospective customers to abstain, wherever possible, from placing their orders with non-British manufacturers. They are asked to do their utmost to wait until manufacturing conditions more favourable to export are brought about in Great Britain.

France.—A new company has lately been formed in Paris (15, Avenue Matignon), with a capital of £24,000, and the title La Compagnie des Chemins de Fer Electriques du Jura.

Patent Restoration.—An order has been made restoring Patent No. 4,401 of 1911, granted to Max Weertz, for "Improvements in apparatus for artificially producing daylight for colour-matching purposes."

LIGHTING AND POWER NOTES.

Bangor.—Year's Working.—There is a deficiency of £1,096 on the working of the electricity undertaking for the past year, as compared with £463 for the previous year. Owing to lighting restrictions, the revenue from lighting had decreased from £3,611 to £3,164.

Belfast.—In connection with the strike of labourers at the Corporation generating station, the men have returned to work, on the understanding that their claims would be dealt with during the week.

B. of T. Committee and Municipal Electricity Suppliers.—This week's addition to the numerous municipal authorities who have passed resolutions urging that greater representation shall be given on the B. of T. Committee on Electricity Supply includes Stoke-on-Trent, Burnley, St. Anne's, Morley, Aberdeen, and Carlisle. At a meeting of the Parliamentary Bills Committee of the Convention of Burghs, Councillor Stevenson, of Edinburgh, was appointed as its representative to give evidence before the above Committee.

Bolton.—Councillor Jackson recently drew attention to the fact that the Electricity Committee's gross profit had increased by £8,378 on the previous year, although the average price per unit had gone down from 1·05d. to 0·96d. The average cost of fuel had fallen from 0·316d. per unit to 0·243d., showing that the Committee was right in its policy of encouraging consumption by giving cheap rates to large consumers.

Bootle.—Plant Shortage.—Owing to the lack of sufficient plant, the Electricity Committee has been compelled to refuse new business, which would have required three times as much electricity as is used by the tramways, and would have brought in a revenue of about £9,000 a year.

Bradford.—Wages.—Representatives of the Corporation workers are demanding a 65 per cent. increase on pre-war rates of wages; the Corporation War Wages Sub-Committee has decided to revise the existing wages scale, so that men will obtain 12s. per week increase on pre-war rates and women from 4s. to 6s. per week. Various concessions are being made in regard to overtime and Sunday pay.

Cheltenham.—Price Increase.—The T.C. has decided, in view of the fact that the B. of T. arbitrator has granted an increase of 6s. 6d. in the wages of most of the employés in the electricity department, to raise the price of electricity 10 per cent. all round to consumers. *Birmingham Post.*

Clayton.—E.L. Proposals.—At the D.C. meeting, last week, a motion to rescind the agreement with the Yorkshire Electrical Distribution, Ltd., and to withdraw the Council's support from its application for a provisional order, was postponed for a fuller meeting of the Council. During the discussion it was pointed out that the D.C. was not in possession of Bradford's terms of recent date, and to throw over the company before knowing these would decrease the Council's bargaining power. It was also pointed out that if the motion was defeated, it could not be brought up for a further three months.

Continental. — France. — A considerable impulse is noticeable throughout France in electrical undertakings, in strong contrast to the period before the war. As a matter of fact, the number of these in 1884 was only eight. In 1914 the number had increased to 1,175, some of them with plant capacities of 10,000 h.p. The utilisation of the great hydraulic resources of the Alps region supplies energy to 10 departments, with an area of 57,000 sq. km. The waters of the Isère, the Arve, and the Durance furnish supplies which are utilised by 12 hydro-metallurgical companies with a total of 180,500 h.p. In 1914, numerous schemes were investigated for the establishment of new undertakings. As electrometallurgy has rapidly developed during the war, the greater number of these schemes have been realised, or are on the road to realisation. The Société de l'Electricité du Centre, which distributes electric current to the cities and factories of the Loire, Upper Savoy, and the Allier, disposes of 20,000 h.p. Before 1914, the manufactories in the South-East were only scantily furnished with power. One of the most marked results of the war is, however, the stimulation of industrial movement in the Lanquedoc, Gascony, and Guyonne districts, which has resulted in further electrical development. The Société de l'Energie Electrique of the Pyrenees has greatly increased its industrial *clientèle* in the course of the war. Its network is now more than 1,100 km. in extent, and its resources total over 50,000 h.p., supplied from the waterfalls, lakes, and rivers of the Pyrenees.

Spain.—In our issue of April 13th (page 405), we quoted some interesting statistics relating to the progress of the Spanish hydro-electric industry in 1917, which, we now learn, were first published in our valued contemporary *La Energia Electrica*. We regret that the source of the information was not indicated in the note.

Derby.—Proposed Loans.—The Electricity Committee has decided to apply for loans of £2,000 for mains, £4,000 for motors, and £7,500 for the extension of the power station in excess of the estimates.

Dewsbury.—Price Increase.—The Electricity Committee has decided to increase, from July 1st, the scale of charges to consumers as follows :—10 per cent. on the power and heating rates, 2½ per cent. on the lighting rate, and 2½ per cent. on the rateable value rate per unit.

Wages.—The T.C. has decided to make wage advances or bonuses granted since the outbreak of the war up to 10s. per week, exclusive of scale advances.

Gloucester.—Price Increase.—The T.C. has decided to increase the charges for current for lighting and power by 13⅓ per cent., as from the end of the June quarter, this making an advance of 33⅓ per cent. since the war broke out.

Year's Working.—The accounts of the Corporation electricity undertaking for the year ended March 31st last show a total revenue of £16,972, being, as compared with 1914-15 (the last year to show a profit), an increase of £1,411. The total works cost was £11,972, an increase of £4,132, as compared with 1914-15; coal, wages and rates accounted for an increase of £4,795 in the expenditure. The gross profit was £5,000, interest on loans and repayment of capital totalled £7,847, the net deficiency on the year's working being £2,847.

Halifax.—The Council in Committee considered proposals of the Electricity Committee for the purchase of land between the River Calder and the canal near Sterne Bridge, Copley, as a site for a new electricity station; the resolution was lost by one vote, and it was decided that the question be adjourned to a special meeting of the Council, to be held at an early date.

Harrogate.—The T.C. is to be asked to sanction an increase in the proposed loan application, from £3,000 to £4,710, for the installation of a by-product steam-boiler plant.

Lincoln.—Year's Working.—The annual report of the Corporation electricity undertaking for the year ended March 31st shows that the total revenue amounted to £27,325, an increase of £9,877: working expenses were £18,785, an increase of £8,268, due to increased cost of coal, wages, and materials. The gross profit was £8,492, an increase of £1,588, and the net profit £3,129, as compared with £1,690 for 1915-16, an increase of £1,439. The output of electricity for the year was 5,345,000 units, an increase of 69 per cent., the increase having been obtained without in any way increasing the capacity of the generating plant.

London.—Battersea.—The Electricity Committee having considered applications for an increase in the supply of electricity in the neighbourhood of Wellington Road, Battersea Bridge Road, and Nine Elms, recommends that the necessary extensions be carried out, at a cost of £1,441.

The Baths Committee recommends that the electric wiring at the Nine Elms Swimming Baths be replaced, and half-watt lamps substituted for the existing lamps, at a cost of £96.

In Belgrave Road, Pimlico, last week, 450 ft. of the pavement and 13 of the distribution-boxes of the Westminster Electric Supply Corporation were suddenly blown up, the force of the explosion wrecking many windows in the locality.

Hackney.—The Finance Committee recommends the Council to amend its application to the L.C.C. for sanction to the advance of £6,500 in connection with the linking-up scheme with the North Metropolitan Electric Power Co., substituting £3,500, as the Council has no authority to borrow money in respect of expenditure upon work of this purpose outside the Council's area.

The Finance Committee recommends that it be authorised to take up from the L.C.C. a loan of £6,500, repayable in 30 years, and £3,185, repayable within three years, at the rate of 5½ per cent., for extension of the electricity buildings.

The Electricity Committee recommends that a subscription of £3 3s. be made to the I.M.E.A. towards the current expenditure of the research into the heating of underground cables, conducted by the Research Committee of the I.E.E.

Loughborough. — Price Increase. — The T.C. has advanced the price of current supplied to cinemas from 1d. to 2½d. and for factory lighting from 3d. to 4d. per unit; existing consumers are to be charged a minimum of 5s. per quarter, and those becoming consumers after October 1st £2 a year.

Luton.—Proposed Loan.—Application is to be made to the L.G.B. for sanction to the borrowing of £3,660 for laying additional mains to works in the town.

Middleton.—The T.C. having been refused sanction to the borrowing of £5,110 in connection with the supply to Neva Mills, has decided to lay the case before the Manchester authorities, who have carried out the work for the Council, with a view to their loaning the money.

Morley.—Year's Working.—The total revenue of the electricity department for the past year amounted to £3,909, and the total expenditure to £2,863, leaving a gross profit of £1,046. After making provision for interest and sinking fund, however, there was a net deficit of £1,054, against a deficit of £612 for the previous year.

Newcastle (Co. Down). — Street Lighting. — The Electric Lighting Co. has offered to renew the street lighting contract, for the ensuing three years, at £240 per annum—an increase of £40.

Oldham.—Ald. Hardman, chairman of the Corporation Electricity Committee, at the monthly meeting, said the profits of the department during the past 12 months were £9,032, as against £5,100 in the previous year, and this result had been obtained despite many drawbacks. The falling off in the lighting revenue was £2,200, as compared with the previous year. They sold 14½ million units, as compared with 10 million, whilst in 1913 they sold only 6½ million. The revenue had risen from £46,500 to £72,500 in four years, though the average price had been reduced from 1·703d. per unit to 1·201d.; they had reduced their coal consumption per unit by one-half, and though coal cost them 1s. 9d. a ton more, they used 550 tons less.

Rochdale.—The Corporation has approved a new arrangement with the D.R. Cotton Mills, Ltd., for an increased supply of electricity. Instead of a maximum demand of 1,350 kw., the Corporation is to supply from 1,850 to 2,000 kw. normally, the company to pay an extra £2 per kw. in respect of every kw. over 1,350, this £2 being the new scale. Should the company require more than 5,000,000 units, the quantity provided for by the agreement, the excess is to be paid for at the same price per unit as other consumers, according to the new scale. It is hoped the arrangement will prove mutually satisfactory.

St. Helens.—The income of the electricity department for the year ended March 31st last, amounted to £40,657, and the expenditure to £41,159, leaving a debit balance of £502. There had been an increase in the income of £6,600, and in the expenditure of £7,400, of which £4,600 was for fuel and £1,000 income-tax.

Sheffield.—Prov. Order.—The Electric Supply Committee proposes that application be made to the B. of T. for a prov.

order to supply electricity in the rural district of Wortley and other districts surrounding Sheffield.

The Health Committee is asking the Electric Supply Committee to provide a reserve supply of electricity, with the necessary equipment, for the Lumley Street destructor, at an estimated cost of £830.

Sunderland.—Year's Working.—The report of the Corporation electricity undertaking for the year ended March last shows a total revenue of £78,200, made up as follows :—Private lighting and heating, £17,732 ; power, £41,701 ; tramways, £12,272 ; and public lighting, £2,479 ; working expenses totalled £45,502, and after meeting special expenditure, a gross profit of £29,469 remained. Interest on loans and sinking fund charges absorbed £31,491, leaving a debit balance of £2,025, which it was proposed to take from the rates. The report states that, following the stagnation in the shipbuilding industry in 1909 and 1910, efforts were made to increase the output and reduce the working expenses, with the result that by 1914 the credit balance had reached £9,011. Had the conditions then prevailing remained approximately constant, annual surpluses would have followed. The breakdown of a large turbine involved a loss of £3,500 for the 33 weeks it was idle. A Committee had been formed having within its area the principal electrical undertakings on the North-East coast, and on behalf of the Newcastle Electric Supply Co. a verbal proposal had been made to Mr. Blackman, of the Sunderland Corporation, as to a reciprocal supply between Newcastle and Sunderland.

Sutton (Surrey).—Street Lighting.—The Electricity Co. has made a further reduction in the charges for public lighting on account of the non-use of lamps, it having charged one-third of the contract price instead of one-half.

Swansea.—Year's Working.—At last week's meeting of the Electric Lighting and Tramways Committee it was reported that the working of the electricity undertaking for the year ended March 31st last, showed a gross profit of £18,357, as against £18,104 in the previous year. The total income was £39,015, as against £38,294, and the working expenses amounted to £20,658, as against £20,194. The loan charges, &c., amounted to £14,005, as compared with £13,215, for the previous year, and the net surplus was £4,412, as against £4,944 for 1915-16. After debiting special expenses, totalling £1,198, there remained a balance of £3,214, which had been placed to reserve, the reserve fund now standing at £14,065. The borough treasurer said that with regard to excess profits duty, he had succeeded in claiming exemption on the ground that the majority of the Corporation undertakings were unremunerative, and, therefore, the Corporation made no profits. In the tramways section the surplus for the year was £1,383, as against £1,557 in the previous year.

Tonbridge.—The D.C. has decided to carry out extensions at the electricity works, at a cost of £17,000, to supply local factories.

U.S.A.—On April 30th, the City Council of Los Angeles passed a resolution approving of an agreement for the purchase of the distributing systems of the Southern California Edison Co. and the Pacific Light and Power Corporation, in Los Angeles, and of a contract for supply to the city by the companies for a period of 30 years. The purchase price is £1,694,000, in addition to which there are certain extras. The minimum supply to the city is to be 25,000 h.p., at an annual load factor of at least 36 per cent., for 10 years. The city has also recently inaugurated a hydro-electric plant of 22,500 kw. for its own use. Before the agreement abovementioned can be executed, the charter of the city must be amended, with the approval of the State Legislature, which, however, has recently adjourned, and will not sit again till January 1st, 1919. To meet the difficulty, a temporary agreement has been made whereby the companies' systems are to be operated by them on behalf of the city until the permanent agreement can be brought into force; the companies are also distributing the power generated by the new municipal plant. But a third power company, the Los Angeles Gas and and Electric Corporation, which was not a party to the arrangement, has challenged the legality of the proceedings, on the ground that the contract violates the charter of the city, and has filed an action in the Superior Court with a view to restraining the city from continuing the operation of the temporary agreement.—*Electrical World.*

Wolverhampton.—New Plant.—In consequence of the urgent demand for more power, and with the support of the controlling authority, a scheme for installing three additional Stirling boilers, which were being completed for another purpose, has been prepared. The estimated cost of this plant, with stokers and draught plant, is £24,687, as against £18,457, the estimate for the original two-boiler scheme which had been adopted, and it is proposed that the Corporation shall pay a portion only of the extra cost.

Worcester.—Year's Working.—With further reference to our previous note, the total income of the electricity department for the year ended March 31st last was £25,178, compared with £21,225 for 1915-16, being an increase of £3,953. Generating and distributing costs totalled £13,576, leaving a gross profit of £11,602, which is equal to 14 per cent. on the capital outstanding. After payment of interest, sinking fund charges, and income-tax, there was a profit of £812. An output of 757,895 units was generated by the water plant at Powick, compared with 607,682 units in the previous year. During the year 3,487,561 units were sold, as compared with 2,557,104 units in 1915-16 ; lighting units decreased by 33,038, while power and heating units increased by 1,023,505. The cost of production, in spite of adverse conditions, was reduced to ·86d. per unit sold, as compared with ·89d. per unit in the previous year.

TRAMWAY and RAILWAY NOTES.

Blackburn.—The T.C. has decided, by 37 votes to 8, that the tramway service between Witton Stocks and Cherry Tree shall be closed down, in order that the rails may be taken up and utilised in repairing other sections.

Bournemouth.—The profits for the past year of the Corporation tramway undertaking totalled £16,275, being £1,218 more than estimated. The Council has decided, on the recommendation of the Tramways Committee, that no advantage would be obtained through the employment of women conductors.

Continental.—Spain.—A scheme for the construction of an electric tramway to connect the towns of La Corunna and Santiago is again under consideration.

Dewsbury.—Increased Fares.—Tramway fares between Dewsbury and Ossett and on neighbouring lines have recently been advanced.

Eccles.—Subject to the consent of the authorities, the T.C. has decided to lease the tramways in the borough for 35 years to the Salford T.C., who will pay a rent of £6,677 per year, being 10 per cent. on £66,767, the capital cost.

Irish Electric Railways and B. of T.—It is announced that the B. of T. now propose to take control of the Dublin and Lucan, and Dublin and Blessington Railways, as in the case of the other railways in the country. A strong agitation has been carried on with this object in view recently.

Glasgow.—Lottery Tickets.—Notwithstanding the protest of the Crown authorities, the Corporation tramway prize-drawing scheme has been continued, but on Saturday it was stated that unless the draw, which is legally regarded as a lottery, was stopped, legal proceedings would be taken against the Corporation and certain officials. A Conference on Saturday of the members and officials concerned decided to ask the Tramway Committee to consider the whole question. The tramway manager decided to withhold prizes after next week, but to continue the sale of tickets.—*Daily Telegraph.*

Lancaster.—Year's Working.—Actual figures now available show that the Corporation Electric Tramways, hitherto a heavy drain on the rates, have finished the past year with a deficit of only £65, as compared with the previous year's deficit of £1,512. The revenue has increased by £1,975, whilst the expenditure has decreased by £184, notwithstanding the payment of £200 to families of men on military service and nearly £100 in war bonus. A good deal of credit is given to the electric 'buses under the department.

Lancs. and Yorks. Railway.—On Tuesday, last week, on the electric portion of the L. & Y. Railway Co. between Manchester and Bury, a goods train and a billet train came into collision, three men being injured and the traffic disorganised for 12 hours.

Leeds.—The Corporation Tramways Committee is considering a suggested scheme for conveying coal on the tramways to the city hospitals.

Manchester.—Rate Relief.—The economists won the day at the adjourned meeting of the City Council last week. Owing to the decreased estimates of profits from the trading concerns, it had been expected that an increase of $4\frac{3}{10}$d. in the rates would be necessary, but the Council, by deciding to make further calls upon the gas, tramway and electricity undertakings, were able to reduce the increase to a fraction under 1d. in the £. The Electricity Committee had only proposed giving £16,570 to the rates, and this the Council approved by a majority of three votes only. Councillor Sutton said if the amendment to give £30,000 was carried, it would mean an increase in the price of electricity, which would handicap an important department, and Councillor Jackson said the system of getting these profits from the trading departments was a vicious one. The Tramways Committee was not so fortunate, however; it had proposed to hand over £50,000, as against £100,000 last year, and although it was pointed out that the demand for increased wages made by the employés would, if granted, absorb £90,000 a year, the Council, by 48 votes to 45, decided that the Committee should contribute the same amount as last year. To the suggestion that this would mean increased fares, the reply was made that Manchester's position was ridiculous, as there was no other town where tramway fares were so low.

Middlesex.—Fares.—The C.C. has sanctioned an increase in the fares of the M.E.T. Co., based on the principle of three consecutive stages for a 1d. Workmen's fares are to be half those for ordinary passengers, with a minimum of 1d. and maximum of 4d.

Newport.—Tramway Extension.—An inquiry was held recently by the Light Railway Commissioners into the proposal of the Corporation to extend the tramway from Pill terminus to the Alexandra Dock Gates, at a cost of £15,500. It was stated at the inquiry that the Commissioners were prepared to sanction the scheme.—*S.W. Weekly News.*

Sheffield.—Year's Working.—The annual report of the Corporation tramways department, issued this week, shows that up to March 25th the total capital expenditure had been £1,092,146. The income on revenue account for the year was £525,685, and the total working expenditure £335,765, giving an average cost of 8·340d. per car-mile, compared with 7·333d. in the previous year. In addition to the ordinary expenditure, £11,848 had been paid out in allowances to dependents of employés, leaving a gross profit on the year's working of £178,070. After making allowances for interest on mortgages, sinking fund, income-tax on profits, and other charges, there remained a balance on the year of £88,478, a decrease of £7,301 compared with the previous year. This balance will be appropriated as follows :—Street improvements, £8,381 ; renewals fund, £34,698 ; accumulated surplus fund, £1,179 ; special purposes fund, £2,000 ; and to special items of capital expenditure, £1,174 ; leaving a sum of £40,097 to be transferred to the general district rate and to the Development Committee. In the motor-omnibus section the traffic revenue was £34,407, and with other items the total income was £34,966. The working expenses totalled £25,432, and £443 had been paid out in allowances to dependents, and £3,159 set aside for depreciation of omnibuses. The gross profits were £5,932, and after allowances for sinking fund, &c., there remained a net balance of £3,807.

Walsall.—Year's Working.—For the 15 months ending March 31st, 1917, the net profit on the tramways was £11,963, and on the motor-omnibuses £3,146. Out of the total £5,000 is to be placed in relief of the rates and £1,800 to be placed against the cost of obtaining the Walsall Corporation Act, 1914.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—August 22nd. N.S.W. Government Railways and Tramways. Thirty-six induction motors (Specification No. 488). September 19th.—One 225-H.P. synchronous motor (Specification No. 489). Particulars from Electrical Engineer's Office, 61, Hunter Street, Sydney.

Melbourne.—July 25th. Victorian Railways. Step-down transformer and sub-station equipment for Sandringham-Black Rock electric tramway. Particulars from the Chief Storekeeper, Railway Offices, Spencer Street, Melbourne.

Erith.—June 23rd. Electricity and Tramways Department. One water tube boiler with superheater economiser, automatic stoker, &c. See "Official Notices" to-day.

Glasgow.—Electricity Department. Boiler house plant. E.H.T. switchgear (20,000 volts). See "Official Notices" to-day.

Newport (Mon.).—June 30th. Electricity Department. Induced draught plant, additions and extensions to fuel economisers and cooling towers. See "Official Notices" to-day.

Spain.—The municipal authorities of Ecija (Province of Seville) have lately invited tenders for the concession for the electric lighting of the town during an unnamed period. Tenders have also been recently invited by the municipal authorities of Guadalajara for the concession for the electric lighting of the town during a period of ten years.

Wolverhampton.—June 22nd. Reinforced concrete coal-bunkers and skeleton structure, for the Electricity Department. Mr. S. T. Allen, Engineer and Manager.

June 30th. Electricity Department. Cooling towers, motor-driven pumps. See "Official Notices" to-day.

CLOSED.

Sheffield.—T.C. A. Reyrolle & Co., Ltd. : 25 transformer protection sets.

Stretford.—U.D.C. Veritys, Ltd. : two 15-H.P. motors, at £92 15s. each.

Wolverhampton.—T.C. Accepted tenders :—

H. Gough & Son.—Building work in engine room, £1,301.
Gibbons Bros., Ltd.—Steelwork to extend roof of engine room, £350.
Willans & Robinson, Ltd.—Turbo-alternator set, condensing plant, &c., £22,690.
Higgs Bros.—Three 10-H.P. and one 5-H.P. motors, £180.
Stirling Boiler Co.—Boiler plant, £24,687.

Steel Works on the Tees.—According to the *Times*, the Tees Conservancy Commissioners last week transferred 21 acres of river frontage at Stockton-on-Tees to the East Coast Steel Corporation, who need the frontage for the erection of works which will cost three million sterling.

FORTHCOMING EVENTS.

Institution of Mining Engineers.—Friday, June 15th. At 11 a.m. At Burlington House, Piccadilly. General meeting.

Incorporated Municipal Electrical Association.—Thursday, June 21st. At 10 a.m. At the Institution of Civil Engineers, Great George Street, Westminster, S.W. Annual meeting. Presidential address by Mr. F. M. Long; papers on "Individual Interests in Municipal Enterprise," by Mr. J. H. Bowden; and "Fuel Economy," by Mr. J. A. Robertson.

Friday, June 22nd, at 10 a.m., Council meeting. At 10.30 a.m., annual general meeting.

Tramways and Light Railways Association.—Friday, June 29th. At 3 p.m. At Institution of Civil Engineers. Annual congress.

OUR HALF-YEARLY INDEX.

As it is necessary to effect every possible economy in paper consumption, the Index to Vol. 80 of the Electrical Review, which will be printed in the course of a few weeks, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d. post free. Any reader or advertiser at Home or Abroad who requires a copy for binding, or for other purposes, is asked to make application therefor promptly to : The Publisher, Electrical Review, 4, Ludgate Hill, London, E.C. 4.

NOTES.

Possible Delay in Publication.—In consequence of inconvenience which has occurred on one of the several premises at which this journal is produced, it is not unlikely that some delay in publication may arise this week. Under the circumstances we shall be glad if our readers will extend to us their usual kind consideration.

Labour Unrest Commissioners.—The following are the names of the Commissioners appointed to investigate labour unrest. They will begin work immediately :—

1. *North-East Coast.*—Sir Thomas Munro (chairman), Mr. P. Bright (Employers' Representative), Mr. H. Davies (Employés' Representative).
2. *North-West Coast.*—Judge Parry, Mr. John Smethurst, Mr. J. R. Clynes, M.P.
3. *Yorks. and E. Midlands.*—Sir G. Croydon Marks, M.P., Sir Maurice Levy, M.P., Mr. J. J. Mallon.
4. *West Midlands.*—Major J. W. Hills, M.P., Mr. J. W. White, Mr. A. G. Cameron.
5. *London and South-East.*—Judge O'Connor, Mr. Allan H. Smith, Mr. J. Voce.
6. *South-West.*—Mr. W. W. Mackenzie, K.C., Sir Alfred Booth, Mr. G. Chambers.
7. *Wales*, including *Monmouthshire.*—Mr. Lleufer Thomas, Mr. Thomas Evans, Mr. Vernon Hartshorn.
8. *Scotland.*—Sheriff T. A. Fyfe, Mr. Noel E. Peck, Mr. J. W. Ogden.

The Metric System.—At the annual meeting of the Incorporated Society of Inspectors of Weights and Measures, Mr. C. MacDonald, in a paper on "The Compulsory Adoption of the Metric System," said that at the beginning of the year the metric system was obligatory in trade in 38 countries, having a total population of 476,890,000. Its use was optional in 11 countries, having a total population of 727,233,000. The metric system might be described as the standard system of the world, and the development of foreign trade after the war would be facilitated by its adoption.

Mr. H. Cunliffe replied in a paper opposed to the change. He did not think compulsion should come except at the demand of the users of weights and measures. British weights and measures effectively satisfied the needs of international trade, and it was a matter for doubt whether the adoption of the metric system in this country would not assist Continental countries to enter the British market more than it would assist British merchants in entering theirs.

Mr. A. Granger submitted as a compromise that the pound weight should be made equal to the half-kilo, and the gallon equal to the half-decalitre. In each case it meant practically an increase of 10 per cent.—the new hundredweight to be 100 and the new ton 2,000 of these lbs. Measures of length should be left alone. A set of the new weights placed upon a shop counter would allow business to go on as usual simply by increasing prices 10 per cent. The retailers, a numerous class, desired no change. It would be comparatively easy to require that all goods sold by weight or measure should be sold in terms of weight and measure and no other. Thus at one stroke we should get rid of our sacks and sieves, our tods and trusses, our pots and pockets, and so on and so on. Further, corn would no longer be sold by a bushel, of which there are some 200 variations.—*The Times.*

At a meeting of the Electrical Section of the Newcastle-on-Tyne and Gateshead Chamber of Commerce it was decided to support the action of the Chamber of Commerce in urging that the Bill for the introduction of the metric weights and coinage be introduced into Parliament as soon as possible.

Lancashire and Cheshire Linking-up Scheme.—Communications have been received by the authorities interested, from the hon. secretary to the Committee for the inter-connection of Lancashire and Cheshire electricity supply systems, intimating that a Sub-Committee had under consideration details of a practical scheme, which will include the formation of a Central Joint Board and District Boards, and that a meeting of representatives of each group would in due course be summoned to consider such proposals.

Government and the A.S.E.—Dr. Addison, the Minister of Munitions, invited a large number of delegates from all parts of the country, representing the Amalgamated Society of Engineers, to meet him at the Central Hall, Westminster, on Wednesday, under the chairmanship of Mr. John Hodge, the Minister of Labour. Dr. Addison explained the position of the Government in relation to the Munitions of War Bill, the dilution of labour, and other matters.

Educational.—UNIVERSITY OF LONDON.—Arrangements have recently been completed for the establishment of a new department of technical optics, in connection with the Imperial College of Science and Technology at South Kensington. The department forms part of a larger scheme adopted by the London County Council in August last for the provision of instruction in this subject, including post-graduate and research work at the Imperial College, a trade school and senior day and technical courses at the Northampton Institute, and junior technical courses at two junior technical institutions, one in North London and one in South London. The Government, including the new Department of Scientific and Industrial Research and the Imperial College, has decided financially to support the Council's scheme, and all the necessary assents have been obtained. The amount of money immediately available is £4,000 a year for working expenses and £5,000 for equipment and more immediate necessities of the department. Mr. Frederic J. Cheshire has been appointed head of the new department, with the title Director of Technical Optics and Professor of Technical Optics at the Imperial College. He is the present president of the Optical Society.—*Daily Telegraph.*

The Earl of Halsbury, moving the adoption of the report and accounts at the annual meeting of the City and Guilds of London Institute, said that the need for technical training and the appreciation of its industrial value were increasing in many directions, and the Executive Committee of the Institute had already made preparation for a substantial development of chemical work, particularly in the direction of its industrial application, by the assignment of additional accommodation to the Department of Applied Chemistry at Finsbury. The available resources of the Institute's colleges were being utilised for technical purposes in every possible direction, and apart from naval and military work, this might have a far-reaching effect for years to come.

In order to make room for war staff, the offices of the Board of Education will shortly be removed to the Victoria and Albert Museum.

Institution and Lecture Notes.—American Institute of Electrical Engineers.—At the annual meeting on May 18th, Mr. E. W. Rice, jun., of Schenectady, N.Y., was elected president, with Messrs. F. Bedell, J. H. Finney, and A. S. McAllister as vice-presidents.

Illuminating Engineering Society (U.S.A.).—The Council has decided, in view of the national emergency, to abandon the 1917 Annual Convention. The papers will be published in the *Transactions.*

Association of Mining Electrical Engineers.—The last gathering of the session of members of the Midland Branch took place on June 2nd, when, by permission of the Stanton Ironworks Co., Ltd., an inspection was made of the electrical plant at the works at Stanton. Mr. F. Church was elected president for the coming year; secretary and treasurer, Mr. E. R. Hudson.

The Royal Society.—A special general meeting was held last week to consider certain changes made by the Council last year in Statute XII, relating to the election of Fellows. These changes empowered the Council to recommend for election—(*a*) Privy Councillors "whose election would assist the work of the Society"; and (*b*) "men distinguished in the scientific or educational service of the State, or by their services to science and its applications." The following resolution was carried:—"That this meeting is of opinion that the Council will serve the best interests of the Society by restoring Statute XII to the form it had before the change made in it by the Council on November 2nd, 1916, and by postponing further consideration of the statute relating to the election of Fellows until after the termination of the war."—*The Times.*

The Fellowship of the Royal Society is the "blue ribbon" of the scientific world, excelling in prestige all University degrees and similar marks of distinction; it would be a pity if this high standing were lowered by the election of mere politicians to the dignity of "F.R.S." Is this move on the part of the Council one of the results of the intimate relationship that has prevailed between the Society and the Government since the war revealed to the latter the fact that Science was indispensable to the State? One cannot touch pitch without being defiled, but, at least, let us preserve our premier scientific Society from unnecessary pollution.

Appointments Vacant.—Charge engineer for Maidstone electricity works; switchboard attendant and general assistant (35s.), for the Ascot District Gas and Electricity Co.; junior shift engineer (40s.), for the Islington B.C. Electricity Department; secretary to the borough electrical engineer (£200) and assistant to station superintendent (£200), for the Borough of Salford Electricity Department. See our advertisement pages to-day.

National Insurance (Unemployment) Acts, 1911 to 1916.—Contributions are payable in respect of:—

2,278 X. Workmen engaged in making or repairing time recorders and similar instruments.

2,286 X. Workmen engaged in the manufacture (including assembling) of turret clocks.

2,288 X. Workmen engaged in metal work and machine woodwork in connection with the manufacture of wind-screens for automobiles.

Contributions are not payable in respect of:—

2,277. Chauffeurs (other than those included under Decision A. 1,866 X, *Board of Trade Journal* of September 21st, 1916) engaged in driving and cleaning cars, and in doing occasional adjustments.

2,290. Workmen engaged in fixing automatic gas controllers in position in streets.

2,291. Workmen (other than those engaged in sawmilling, machine woodwork, or metal work) who are engaged in preparing railway signal posts, repairing railway station furniture, hammer shafts, brake sticks, &c., not intended for use in war.

The Electrical Industries on Tyneside.—At a meeting of the Electrical Section of the Newcastle and Gateshead Chamber of Commerce, the chairman, Mr. H. W. Clothier, presented a report on the scope of the Section, and it was agreed to take steps to make the Committee more fully representative of the electrical industries, and that a special meeting of all those connected with the industries of the district should be held on June 19th, at the Guildhall, Newcastle, to discuss matters of importance. With regard to the training of apprentices from Australia, it was agreed that the question involved in this procedure should be considered as soon as possible with regard to its effect on the British electrical industries, and that joint action of the sections of the industry in the district was desirable.

The British Empire Producers' Organisation.—At the luncheon meeting held yesterday at the Savoy Hotel, Monsieur C. Nabokoff, Councillor to the Russian Embassy, was the guest, and the chair was taken by Sir Charles C. Wakefield, Bart.

Legal.—AN IRISH ELECTRICAL ASSESSMENT.—In the King's Bench Division of the High Court of Ireland, Dublin, Justices Gibson, Madden and Kenny dismissed an appeal by way of case stated at the request of the Commissioners of Valuation, from the decision of the County Court Judge of Monaghan, reducing from £100 to £75 the valuation assessed on the buildings and plant of the Clones Electric Light and Power Co.

Electrical Trades Union. — At a meeting of the Birmingham Branch, last week, a Station Engineers' Branch of the Union was formed.

Accident.—Three men were injured through coming in contact with a live rail after a collision between two goods trains in a tunnel on the electric system of the Lancashire and Yorkshire line between Bury and Manchester.—*Times.*

Inquiries.—A correspondent asks for suggestions to prevent the transmission of noise from gearing on the top floor of a reinforced concrete building.

The address of agents of the United States Electric Tool Co. is asked for.

Makers of "King Eaton" small accumulators are asked for.

A correspondent wishes to know in what countries the bayonet type of lampholder is used to any extent.

Breaking Insulators. — At Dewsbury Police Court, last week, two lads, aged 16 and 15, were ordered to pay 16s. damage and 20s. 6d. costs between them, for wilful damage to telegraph insulators. Mr. E. H. Farrand, executive engineer for Leeds district of telephones and telegraphs, said that although the damage in his area in this way averaged £20 per month, he laid greater stress on the danger of communications being cut. The line was one of the most important in the country, and disaster might result from the interruption of messages sent by the military authorities.

Fatality.—A boy of 11, named John Prentice, who climbed a tree near Falkirk to obtain a good view of a passing aeroplane, slipped and fell among some electric wires, and was killed.—*Times.*

Belfast Association of Engineers.—On Thursday last the members of the above Society paid a visit to the Corporation electricity works under the guidance of Alderman Tyrrell and the city electrical engineer. Mr. Stanley Johnston, chairman of the Association, in thanking the latter gentlemen, drew attention to the inadequacy of the plant to supply the needs of the city, pointing out that if Belfast had had an Electrical Committee worthy of the name, they might have had one of the largest stations in the country. He complimented the city electrical engineer on having made £17,000 in the previous year from the inefficient scrap plant they had seen.

Evidently the visit was intended as an object lesson in "how not to do it," and, no doubt, the No. 1 engine room, with its 8—400-KW. sets still in use, was an excellent incentive to Mr. Johnston. The undertaking sold over 19 million units last year, although Belfast, with its shipyards and factories, ought easily to reach the 100 million mark.

British Battery Combine.—As our readers are well aware, one great advantage that industrial Germany has possessed over ourselves has been the fact that her manufactures were carried out on a larger scale and that there was a greater community of interests between trade concerns than has existed in this country. It has been recognised, therefore, that if we are to be in a position to compete with Germany after the war, some of our small concerns which are competing with each other in different branches of electrical work will doubtless find it to be correct policy to combine. The co-operative schemes for selling in the Russian market has been fully described in our columns. We now learn of an important manufacturing scheme which is being carried forward. We understand that the three battery concerns, the Hart Accumulator Co., Ltd., Pritchett & Gold and Electrical Power Storage Co., Ltd., and the D.P. Battery Co., Ltd., who made a joint offer (which has been accepted) for the shares in the Tudor Co. which were advertised for sale by the Public Trustee, are parties to the arrangement. Arrangements have been concluded for the managers of the Tudor Co. to remain in office, thus ensuring continuity of policy and practice in the business. As a natural outcome to the purchase of the Tudor shares, an announcement appears elsewhere in this issue to the effect that negotiations are in progress for an amalgamation of the four companies. It is hoped that a scheme will soon be evolved under which the united experience and connection of the various companies can be turned to the best account.

The Electric Vehicle Committee.—A meeting was held in London, on May 4th, 1917, when the officers of the Committee were re-elected for the current year and the annual report and accounts were submitted and approved.

The question of marking upon the batteries of electric vehicles the working limits for specific gravity was again under consideration, and in view of a report received from the Accumulator Makers' Section of the B.E.A.M.A., wherein objections were set forth to the proposal, it was decided to drop the matter for the present.

The secretary submitted the letters he had received from automobile manufacturers and electrical engineering firms in reply to the recent circular letters sent out to these firms setting forth the desirability of undertaking the manufacture of electric vehicles and equipments so soon as normal conditions return. Several firms had written stating that they were giving the question serious consideration.

London Electric Railways.—Compensation Claim.—Mr. A. Virgoe Buckland (of Messrs. Buckland & Browne, surveyors and land agents), has issued his decision as umpire in the claim for compensation, payable by the London Electric Railways, to the trustees of Mr. John Smith, in respect of certain property situate near to Victoria Street, Westminster, on the exercise by the railway company of their compulsory powers. The property consists of Nos. 29 and 31, The Broadway, which is leasehold, and of freehold land in Maundy Place. The umpire has decided that the amount of compensation payable is £4,588. At the hearing of the claim, on behalf of the trustees, Mr. J. H. Oakley valued the compensation at £5,776; Mr. W. H. Mills put the amount at £5,661, while Mr. A. L. Ryde (the arbitrator for the claimants), arrived at a total of £5,682. The value found on behalf of the Electric Railways by Sir Alexander Stenning, Mr. Samuel Walker (of Moorgate Street, E.C.), and Mr. Leslie Vigers (arbitrator for the company), was in the neighbourhood of £3,600.

Volunteer Notes. — County of London Engineer Volunteers (Field Companies). Headquarters, Balderton Street Oxford Street, W.

Orders for the Week. By Lieut.-Colonel C. D. Clay, V.D., Commanding:—

Monday, June 18th.—Technical for No. 3 Company, Right Half Company, at Regency Street. Drill, No. 3 Company, Left Half Company. Signalling Class Recruits' Drill, 6.30.

Tuesday, June 19th.—Lecture, 6.30. Sergeant Instructor Higgs, "Pontooning." Physical drill and bayonet fighting, 7.30.

Wednesday, June 20th.—Drill, No. 1 Company, Left Half Company.

Thursday, June 21st.—Drill, No. 2 Company, Left Half Company. Ambulance Class, 6.30. Signalling Class.

Friday, June 22nd.—Technical for No. 3 Company, Left Half Company, at Regency Street. Drill, No. 3 Company, Right Half Company. Recruits' Drill, 6.30.

Saturday, June 23rd.—N.C.O.'s Class, 2.30, under Company Commander Hyman and the Instructor of Musketry.

Sunday, June 24th.—Parade Clapham Common (Tube Railway), 9.45 a.m. for work at Bombing School. Uniform. Rations to be carried.

Macleod Yearsley, *Adjutant.*

The Birmingham Electrical Engineers, a unit of the V.T.C., have just been "recognised" and re-christened by the Army Council. In future they will be known as the Warwickshire Volunteer Engineers.

Formed in November, 1914, the corps has trained over 600 men, who have joined the Army and Navy. The present strength is about 250, and the men are rendering important service in connection with the scheme of home defence.

Recruits are invited, full information being obtainable from the Adjutant, Mr. S. T. Pemberton, 8, Church Street, Birmingham.—*Birmingham Daily Gazette.*

Strong Lightning.—During a recent storm at Oldham a woman was killed by a brick dislodged from the chimney of the Bell Mill, which had been struck by lightning. At the inquest it was stated that bricks from the chimney were hurled over the roofs of houses and fell about the street, narrowly missing several other people. The engineer at the Bell Mill said the lightning conductor at the mill had acted, for the earth at the bottom had been displaced, but the electric current must have been so strong that it was more than an ordinary conductor could deal with. To us it looks as if the conductor was improperly earthed.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The Motherwell T.C. has agreed to advance the salary of the electrical engineer by £50 to £350, with a further advance of £50 in May, 1918.

By 16 votes to 10, the Doncaster Town Council has resolved against a recommendation of a committee that the salary of the electrical engineer and tramways manager, Mr. E. S. Rayner, be increased by £50 per annum.

It appears from a Dublin newspaper report that the Belfast Corporation has revised the decision of the Electricity Committee respecting the appointment of a mechanical engineer for the electricity works, and has appointed Mr. J. R. Davison, of Manchester, who has had practical experience with the type of boilers in use at the Belfast works.

The Sheffield Electric Supply Committee has decided in favour of the salary of Mr. S. E. Fedden, general manager and engineer, being increased from £900 to £1,000 per annum, with two further annual increments of £100 each; also that the salary of Mr. H. E. Yerbury, deputy general manager and engineer, be increased from £600 to £700 per annum.

Walsall Corporation has declined to release Mr. Horsfield, the tramways manager, for service in the Shipyard and Labour Department of the Admiralty, being of opinion that his services are indispensable to the tramways undertaking.

The General Purposes Committee of Wolverhampton T.C. has endorsed a recommendation of the Electricity Committee that the salary of Mr. S. T. Allen, electrical engineer, be increased from £600 to £800 per annum, as from June 1st, 1917.

Mr. J. B. Feltham holds the position of waterworks engineer at Mexborough, not that of engineer-in-charge of the waterworks, as stated last week.

General.—On Saturday evening last, a large number of the staff and friends of Messrs. Albert Lee & Co., Ltd., assembled at the Holborn Restaurant to bid "farewell and God-speed" to Mr. Thomas Harris, the managing director, Mr. C. W. Chambers, the secretary, and Mr. J. E. Allden, the manager, on their joining the Army. The chair was occupied by Mr. E. Pattisson, assisted by Mr. A. Harris, brother of the managing director, who will fill his place till he returns, and among the guests were Mr. Takata and Mr. Morris, of the National Carbon Co., U.S.A. In the course of the evening complimentary speeches were made by the chairman and others. A gold wrist watch was presented by Mr. Morris, together with a cheque from Messrs. A. Lee & Co., to Mr. Harris. Mr. Chambers, who goes to the R.N.A.S., and Mr. Allden were also the recipients of wrist watches.

Mr. Arthur J. Cridge, of the British Westinghouse Electric & Manufacturing Co., Ltd., Trafford Park, Manchester, was married on Tuesday last to Grace Gertrude, younger daughter of Mr. and Mrs. S. G. P. Heath, of Putney. The ceremony took place at St. Stephen's Church, East Putney, and Mr. and Mrs. Cridge afterwards left for Cornwall, where the honeymoon will be spent.

The marriage took place at Dartford, on May 25th, of Mr. Melbourne Dewhurst, M.Sc., A.M.I.E.E., of Colne (Lancs.), and Miss Rebecca Stidolph, of Dartford.

At the annual meeting of the American Institute of Electrical Engineers on May 18th, the Edison Medal was presented to Mr. Nikola Tesla in recognition of his early original work in polyphase and high-frequency electric currents.

The American Institute of Radio Engineers has awarded the "medal of honour" for 1917 to Edwin H. Armstrong for his work in connection with regenerative amplification and oscillation by means of the vacuum-tube relay.

Roll of Honour.—Private H. Bentley, of the East Lancashires, who is wounded for the second time, was employed by Mr. Fairhurst, electrical engineer, of Darwen.

Captain Rupert Stanley, R.E., who has been decorated by the French Commander-in-Chief with the insignia of the Order of the Legion of Honour, is Professor of Electrical Engineering in the Belfast Municipal Technical Institute, which post he has held since 1903. He has done excellent service at the Front in connection with electrical and wireless work, and has been twice mentioned in dispatches.

Corporal J. H. Noble (20), West Riding Regiment, reported missing, was employed by Messrs. J. H. Taylor & Co., electrical engineers, Huddersfield.

Private C. M'Donald, Gordon Highlanders, who has died of wounds, was an electrical inspector with the Aberdeen Corporation.

Private R. W. Noble, 10th Canadian Regiment, who has died of wounds, was a Morecambe man, who left this country seven years ago, and became an electrical engineer on the Canadian Pacific Railway, stationed at Calgary, Alberta.

Private W. Naylor, employed in the Bradford City electricity department, is reported missing.

Private J. Barker, Loyal North Lancashire Regiment, posted missing in October last, now officially reported killed in action, was employed by Messrs. Dick, Kerr & Co., Ltd., Preston.

Sapper J. TARPETH, Wessex Engineers, who has died of wounds received in action, was on the Bath electricity works staff.

Private W. A. KNIGHT, South Staffs. Regiment, who has died of wounds, was in the winding department of the B.T.H. Co., at Rugby.

Sergeant HANDYSIDE, Royal Artillery, who was with Messrs. Willans & Robinson, Ltd., Rugby, has fallen in action. In 1915 he was awarded the D.C.M. and the French Medaille Militaire for distinguished valour.

Rifleman C. G. READ, K.R.R., killed in action, was on the staff of the B.T.H. Co., of Rugby.

Corporal J. HIRONS, R.F.A., who was an employé, at Rugby, of the B.T.H. Co., has been wounded for the second time, and seriously.

Private L. ROGERS, London Regiment, who has fallen in action, was on the clerical staff at the Ilford U.D.C. electricity works.

For gallantry in action, the Military Medal has been awarded to Corporal J. CARTLEDGE, formerly with the Potteries Electric Traction Co. Under heavy fire he laid a cable by compass in an unreconnoitred bit of country, and maintained the line through an attack.

Lieutenant J. G. KIRKUP, Northumberland Fusiliers, who was an electrical engineer with the Consett Iron Co., has been awarded the Military Cross.

Mr. P. W. HOOL, Army Ordnance Corps, formerly on the staff of the Bromley (Kent) Electric Light Co., has been mentioned in dispatches by Sir Douglas Haig.

Captain GUY CAMPBELL, Machine Gun Corps, formerly with Messrs. W. H. Allen, Son & Co., Ltd., Bedford, has been accidentally killed whilst supervising the throwing of live bombs. He had won the Military Cross.

Corporal E. RONDLE (Machine Gun Brigade), formerly in the general office of the India Rubber, Gutta Percha & Telegraph Works Co., Ltd., Silvertown, has been wounded.

Obituary.—MR. G. J. HARFORD.—The death has taken place at Birkdale, Southport, of Mr. G. J. Harford, who was in business as an electrical engineer in Liverpool. He was 48 years of age.

ALDERMAN W. F. COTTON, M.P.—Alderman W. F. Cotton, M.P., Dublin, who passed away on Friday last week in his 86th year, was for a considerable period a director of the Dublin United (Electric) Tramways Co., and was largely interested in the gas industry, having been chairman of the Alliance and Dublin Consumers' Co., prior to which he had held various offices under the company, and, earlier still, had been lighting superintendent of the city under the Corporation.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

L. Weekes, Ltd.—Particulars of £3,000 debentures, created May 26th, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

W. H. Allen, Son & Co., Ltd.—Further charge dated May 29th, 1917 (supplemental to mortgage dated November 21st, 1916, securing £103,980), to secure £50,000. Property charged: As in principal mortgage. Holder: H.M. Secretary for War.

Longford Wire Co., Ltd.—Charge on leasehold Longford Wire Works, dated May 25th, 1917, to secure two annual rents of £46 and £52 payable for residue of 999 years from 1900, subject to proviso that charge shall cease when buildings of double the value of such rents have been erected on the land. Holder: Sir Gilbert-Greenall, Bart., C.V.O.

Brompton & Kensington Electricity Supply Co., Ltd. (25,913).—Capital, £300,000 in 20,000 pref. and 40,000 ord. shares of £5 each. Return dated April 12th, 1917. 5,966 pref. and 34,034 ord. shares taken up. £5 per share called up on 5,966 pref. and 33,034 ord.; £195,000 paid; £5,000 considered as paid on 1,000 ord. Mortgages and charges: Nil.

British Insulated & Helsby Cables, Ltd. (52,285).—Capital, £1,000,000 in 100,000 pref. and 100,000 ord. shares of £5 each. Return dated April 9th, 1917. All shares taken up. £572,675 paid on 74,470 pref. and 40,065 ord.; £427,325 considered as paid on 25,530 pref. and 59,935 ord. Mortgages and charges: £700,000.

Alderley & Wilmslow Electric Supply Co., Ltd. (47,663).—Capital, £30,000 in 1 shares (10,000 pref.). Return dated May 16th, 1917. 15,009 ord. shares taken up; £15,009 paid. Mortgages and charges: £15,000.

Alert Electrical Co., Ltd. (78,971).—Capital, £2,000 in £1 shares. Return dated February 28th, 1917. 708 shares taken up; £708 paid. Mortgages and charges: Nil.

British Electric Transformer Co., Ltd. (76,351).—Capital, £200,000 in £1 shares (100,000 pref. and 100,000 ord.). Return dated April 12th, 1917. 61,988 pref. and 85,498 ord. shares taken up; £1 per share called up on 52,764 pref. and 9,529 ord., and 12s. 6d. per share on 14 ord.; £62,301 15s. paid; £85,179 considered as paid on 9,224 pref. and 75,955 ord. Mortgages and charges: Nil.

Bromley (Kent) Electric Light & Power Co., Ltd.—Capital, £75,000 in £5 shares. Return dated April 16th, 1917. All shares taken up; £75,000 paid. Mortgages and charges: £64,363.

Camborne Electricity Supply Co., Ltd. (57,950).—Capital, £10,000 in £1 shares. Return dated April 25th, 1917. 607 shares taken up; £605 paid, leaving £2 in arrears. Mortgages and charges: Nil.

City of Carlisle Electric Tramways Co., Ltd. (62,601).—Capital, £60,000 in £1 shares. Return dated March 5th, 1917. All shares taken up; £60,000 paid. Mortgages and charges: £57,500.

CITY NOTES.

British Electric Traction Co., Ltd.

The report of this company, as published in the financial Press, states that the gross profit for the year amounts to £226,744, compared with £244,064 for 1915-16. After deducting the general expenses and the amount written off sundry assets, viz., £26,772, there remains £199,971, plus £86,428 brought forward. Deducting debenture stock interest, amounting to £91,249, there remains £195,150, which the directors recommend should be applied thus:—To reserve £15,000, dividend of 6 per cent. on the cum. part. preference stock £42,764, dividend of 3 per cent. on the ordinary stock £39,787, to be carried forward £97,598. The aggregate receipts of the tramway, omnibus, and electricity supply companies in which the company is interested showed an increase, which was largely counterbalanced by the continued increase in the wages paid and the cost of all material. Many of the companies have increased the amounts placed to their renewal accounts and reserves, and while their financial position has been thereby improved the dividends distributed have been less than they would otherwise have been. The increase in the receipts has consequently not been reflected in this company's revenue from investments, and the net profit shows a reduction of £9,197 compared with the previous year. The amount standing to the credit of the reserve account at March 31st, 1916, was £410,000. It is proposed to increase this amount by £15,000, to be transferred from revenue as shown by the accounts. The investments now stand at £4,285,578, and yielded a revenue of £205,258, representing an average of 4.79 per cent. for the past year on the amount at which they appear in the balance sheet.

Lisbon Electric Tramways, Ltd.

Mr. L. BREITMEYER presided at the annual meeting, on June 6th. He said that the difficulties had been more acute in 1916 than in 1915, but the report was not altogether unsatisfactory. The only gratifying feature in the accounts was the expansion of traffic revenue, there being an appreciable increase (£24,000), which, unfortunately, was swallowed up entirely by the expenditure, which had grown at a rapid rate, the working costs exceeding those of 1915 by £36,000. The speaker referred to the unprecedented cost of supplies. Rails, which normally cost £6 per ton, were now five times that figure. Coal in pre-war times was 21s. to 22s. per ton delivered in their power house; a month ago it was £6 10s., and now it was not procurable under £10 per ton, and that with difficulty. In other words, the dividend was evaporating in the smoke-stack. The chairman discussed the opposition that they met with when they tried to raise the fares. They felt that it would be neither good finance nor prudent in the shareholders' interests to pay even the smallest dividend under the circumstances.

The Armorduct Manufacturing Co., Ltd.—It will be observed from an announcement appearing in our advertisements to-day that the business of the above company is being offered, under the Trading with the Enemy Amendment Act, for sale by tender as a going concern. Tenders must be sent to the Controller, Mr. J. Paterson, 1, Walbrook, E.C., by June 28th.

Automatic Telephone Manufacturing Co., Ltd.—The preference share and transfer books will be closed from 18th to 25th inst., for preparing dividend warrants on the preference shares for the half-year.

North Metropolitan Electric Power Supply Co.—After putting £10,542 to renewals reserve, 6 per cent. dividend and a bonus of 8s. per share are to be paid, carrying forward £1,775.

Cleveland & Durham County Electric Power Co.—The complete accounts of this company for the year 1916 occupy several pages of the *London Gazette* for June 12th.

China and Japan Telephone & Electric Co.—Dividend, 10 per cent., placing to reserve £26,736, and carrying forward £3,938.

Tramways & Light Railways Estates, Ltd.—For 1916 the dividend is 3 per cent., carrying forward £626.

Manila Electric Railroad & Lighting Corpn.—Dividend, 1½ per cent. (1.50 dol. per share) for the quarter to June 30th.

Madras Electric Supply Corpn., Ltd.—Six per cent. preference dividend, less tax, for 1916.

Barnsley & District Electric Traction Co., Ltd.—Dividend 6 per cent., carrying forward £1,014.

Peterborough Electric Traction Co., Ltd.—After paying the preference dividend, £742 is carried forward.

Longford Wire Co., Ltd.—The capital of this company has been reduced from £100,000 to £69,999.

Edison Accumulators, Ltd.

For 1916, the directors report that, in spite of the abnormal difficulties occasioned by the war, satisfactory progress has been made.

> The charges for freight, insurance, clearance, delivery, and dues have been excessive, and several consignments have been lost at sea. From this cause, and the serious delays due to the lack of available shipping, a large number of important orders are being carried forward to the next financial year. Tipping wagons fitted with Edison accumulators have been supplied to many of the principal municipal authorities throughout the country with satisfactory results, and a considerable number of delivery vehicles are in regular use by first-class business houses in London and the provinces. Owing to the reliability of these delivery vehicles, and their economy in working, repeat orders are constantly being received, and one of the most important firms in London has 80 such vehicles in daily use. The demand for Edison accumulator self-propelled trucks, which are coming into general use for handling heavy goods in railway stations, depôts, and factories, is continually increasing, and the company has on hand Government contracts of considerable importance. Although the balance sheet shows profits sufficient to meet the accrued interest upon preference shares after providing for reserve, it is proposed that payment should be deferred, an arrangement which will be advantageous to the shareholders in the near future.

The annual meeting of the company was held at Duke Street, S.W., on June 5th. Lord Montagu of Beaulieu, who presided, said that the profit for the year, exclusive of provision for excess profits tax, was £4,614. The tax mentioned, as at present arranged, operated especially to the disadvantage of companies, such as theirs, which had to build up new business. Even in the case of older companies it prevented provision being made for the severe competition inevitable after the war, but, while admitting the necessity for taxing large profits as a fruitful source of revenue, young companies should be leniently treated. Their freight and insurance difficulties had greatly increased during the year. They had paid over £18,000 in freight and war risk insurance, which normally would have cost about one-eighth of this figure, and they had been hampered by the formalities introduced by various Government departments. Considering the shortage of petrol, it was in the national interests that the company should receive more consideration from the departments concerned, especially from the Priority Committee. At present they had some £100,000 worth of unexecuted orders, and had paid many thousands of pounds for vehicles which were lying in New York, all of which would save labour, petrol, and expense if only they could be put to work. The value of orders received during the year was no less than double that of the previous year. Harrods, J. Barker & Co., Whiteleys, Selfridges, and the Hovis Co. were constantly extending their fleet of vehicles. Harrods alone had 80 in use. The Midland Railway Co. were now using in London and provincial towns over 50 Edison battery vehicles, and they found that they could make their deliveries at a lower cost than before either with horses or petrol lorries. The company were now considering considerably increasing their fleet of electric vehicles, and other railway companies would undoubtedly follow suit. Co-operative societies at Glasgow, Leeds, Blackpool, Leicester, &c., had adopted the company's system, and the collection of house refuse and other municipal work had brought more orders than the company could handle. Sheffield Cleansing Department had now 10 electric vehicles in service, and many other cities were also employing them. Another branch that they had developed was the use of industrial self-propelled trucks in factories, and for handling luggage, &c., in railway stations. With a business increasing by leaps and bounds when it was impossible to raise new capital, it was absolutely necessary to conserve the profits in order to extend the business. When the war was ended the results would readily attract the capital necessary to enable the company to operate on a scale commensurate with the demand that would undoubtedly exist.

Great Northern Telegraph Co., Ltd., of Denmark.

At the annual meeting, held at Copenhagen on May 25th, Consul-General W. Weimann, who presided, said that their war difficulties had increased considerably since the last meeting, but they had been able to maintain communication over the cables. Ten of their cables in European waters had suffered 15 interruptions, and 29 breaks had occurred in nine cables in the Far East. They had not yet been able to repair their cables in the Baltic which had been interrupted since November, 1914. The Wladiwostock and Kiachta routes had been maintained in very good working order by the Russian Telegraph Administration, but traffic over these lines between Europe and the Far East had decreased considerably. The concession granted to the company by the French Government for landing and working the cables between Denmark and France expired last year, but had been provisionally prolonged without alteration. Negotiations for a definitive arrangement would have to be entered into after the war. Rates over the cables in the Far East had been reduced for certain classes of traffic with Japan. The rates over the Iceland cable had been materially reduced as from January, 1917. The arrangement with the Danish Government for the erection and working by the company of two local wireless stations in the Faeroe Islands was finally concluded about a year ago. The installations (by the Marconi Co.) were recently so far completed as to admit of an *ad interim* service being started. On January 1st, 1917, a serious fire occurred at the company's buildings in Shanghai, in which are also housed the Eastern Extension and Commercial Pacific Companies. The damage was extensive, and many instruments were destroyed. The staff so quickly restored communication that the effect of this serious misfortune was hardly felt by the public. Certain rooms in the building had been fitted up as temporary instrument rooms, and office accommodation had been secured outside, pending the rebuilding of the premises. The speaker referred to the increasing difficulties of management as follows:—

> The most serious of these difficulties is that connected with the maintenance of the cables. Nearly all the cables belonging to the company in Europe cross the continually expanding minefields and prohibited areas, and should breaks occur in such places it may prove impossible to have the cables repaired.
>
> We have also met with difficulties in supplying our stations with instruments, telegraph paper, &c., &c., owing to the scarcity of material, diminution of transport facilities, and to the export and import prohibitions in force to practically all countries.
>
> The measures taken by the belligerents have also affected our staff arrangements. Thus it proves now and then difficult to obtain the necessary permission to appoint Danish operators to our stations in the countries involved in the war, and in England we have had to resort to a large extent to female labour, especially to replace our British employés who, voluntarily or by order, join the Colours. In Petrograd the military authorities have as a measure of precaution, gradually displaced our Danish and Russian operators, and have in their stead appointed Russian Government employés to work the instruments. This measure was adopted through no fault of the company.

The financial results of the year's working were so satisfactory that the directors came to the conclusion that they could propose the distribution of a total dividend and bonus of 24 per cent., or 2 per cent. more than for the year 1915. They, however, warned the shareholders that the extraordinary prosperity which the company was now enjoying would disappear when peace was concluded, or very soon after. As the cost of living, the taxation, and the working expenses, which were at present very high, and increasing almost from day to day, were not likely to become normal for some years after the conclusion of peace, a considerable decrease in the net receipts of the company might be looked for. In the circumstances they had strengthened the dividend equalisation fund by adding to it £55,556. The renewal fund for cable steamers was not sufficient to cover the cost of replacing the two oldest of the company's steamers, even at prewar prices, and much less so at the present enhanced prices, which would probably obtain for a long time. £27,778 is therefore added to this fund.

Calcutta Tramways Co., Ltd.—Sir H. Kimber, at the annual meeting, said that the revenue account showed an increase of 6 per cent. on the traffic receipts of 1915, and of 5 per cent. on those of 1914, which included seven months of pre-war takings. The Indian working expenses increased by £2,484. There was a decrease of £1,488 in power expenses due to the operation of the new generating and sub-station plant, but traffic expenses were up £842, and maintenance and repairs by £3,708, due to enhanced cost of materials. It was proposed to revert to the practice of paying the dividend on the ordinary shares, free of tax, after payment of the present final dividend.

Winnipeg Electric Railway Co.—Owing to very substantial increases in the cost of all materials, as well as to the serious competition of the jitneys in the city, the results for the year have been disappointing. For these and other reasons a discontinuance of dividends for the time being would strengthen the financial position of the company and more quickly guarantee an earlier date for the resumption of such dividends.

New General Traction Co., Ltd.—For the year ended March last, the revenue was £19,481. Profit £10,649, plus £7,901 brought forward. The directors recommend a dividend of 4 per cent. (less tax), and carry forward £8,070. The Norwich Electric Tramways Co. paid a dividend of 3 per cent., being the same rate as for the previous year. The Douglas Southern Electric tramways system is still closed down on account of the war. The income received from the Philadelphia undertaking amounted to £14,053.—*Financial Times.*

South Metropolitan Electric Tramways & Lighting Co., Ltd.—Total revenue for 1916, £68,793, compared with £69,281 for 1915. Placed to reserve, £4,000; dividend, 5 per cent. on preference shares, £8,478; carried forward, £400. The gross receipts from tramways and light railways increased by £27. The gross receipts from the electricity supply were £17,467, compared with £17,242. Total units sold, 1,267,631, compared with 1,195,371. Lighting and power units sold increased by 6 per cent and number of consumers by 3 per cent.

Rangoon Electric Tramway & Supply Co., Ltd.—Gross profits for 1916, £65,829. After paying debenture interest, preference dividend, and providing for reserve, depreciation, &c., 4 per cent. is to be paid on the ordinary shares, free of tax, leaving £2,902 to carry forward.

Northern Counties Electricity Supply Co., Ltd.—The accounts for 1916 show a gross profit of £12,104, against £11,624, and after paying debenture and other interest the debit balance of £6,654 brought forward is reduced to £5,815. —*Financial Times.*

Birmingham and District Power & Traction Co., Ltd.—After placing £5,000 to reserve and paying 4½ per cent. on the preferred ordinary shares, £5,570 is to be carried forward.

Lima Light, Power & Tramways Co.—Net profit, £P128,799, plus £P80,396 brought forward. After paying dividends and providing for general amortisation fund, reserve, new works, &c., £P2,742 is to be carried forward.

STOCKS AND SHARES.

Tuesday Evening.

The fine news which Sir Douglas Haig sends does much to infuse cheerfulness into the Stock Exchange markets. There remains a certain amount of nervousness in regard to Russia. This nervousness plays its part in laying a restraining hand upon business; but the advance on the Western Front has sufficiently encouraged confidence to bring a good deal of money into the House, and to revive the speculative interest in those markets where anything like animation prevails.

Accordingly, the groups in which iron and steel shares, rubber, explosive, and other similar industrial companies are located cannot complain of the volume of trade they are called upon to handle; although, at the same time, the purely investment stocks are rather neglected, and the man who is urged to buy War Loan is tempted to reply that, with war expenditure at its present rate, he is a little bit reluctant to embark freely upon securities of the fixed-interest and gilt-edged order, lest there should be competition later on that will reduce present prices and give him opportunities for using his money to greater advantage. A somewhat specious argument this, especially when it is recalled that Mr. Bonar Law hinted plainly that, so far as the Government were concerned, better terms were not likely to be offered in the future than those which accompanied the 5 per cent. War Loan.

Tube railway stocks are better, Metropolitans, Districts, and Underground income bonds all showing rises on the week, though the last-named touched 84½ before reacting a little to 84, which still leaves an improvement of a point. The shilling shares are better at 5s. 9d.; and this section shows up well as a whole in consequence of the expectation, referred to in our last notes, that before long there will be a re-arrangement of fares following upon the example recently set by the L.C.C. tramways.

The various tramway companies have been in the limelight, owing to the issue of several of the reports. The principal is that of the London United Tramways, which will probably come as a blow to stockholders. The price of the debenture stock is 37 to 39. The London United last year did not make enough money to pay its debenture and administration expenses. The debenture interest for July cannot be paid, and last Tuesday a receiver for the debenture-holders was appointed by the Court. Two well-known trust companies have summoned meetings, with a view to securing a strong debenture holders' committee. There is rather over 1½ million pounds sterling of first debenture stock outstanding, to say nothing of loans from the London & Suburban Traction Co. and the Underground Electric Railways.

There is little satisfaction to be obtained in jobbing backwards, though, at the same time, the temptation is great to point the finger to the numberless warnings of years ago at what seemed to us the inevitable end to the over-capitalisation of this company. Hard as it may seem, the only way to put the London United Tramways upon a sound footing once more will be to apply the pruning knife drastically to the capital account. No other course is open that we can see. The company has a large and important system, with plenty of business to its hand. Under vigorous and progressive management, on a reasonable amount of capital, the company should do well.

A large number of the shares in the company are owned by the London & Suburban Traction; and the latter, in its report, shows that it has just earned its preference dividend. The amount available for distribution is £84,800, against £83,600 in the previous twelvemonth. The company is also largely interested in two omnibus concerns, as well as in the London United and Metropolitan Electric Tramways. The Metropolitan last year paid 1 per cent. on its ordinary shares, but this cannot be repeated in respect of the past 12 months, although there was a small improvement in the gross earnings. Heavier working expenses are recorded in the case of all three companies. These are disappointing results; and it looks as though the rise in operating expenses should have been met earlier by re-arrangement of fares.

The electric lighting market is steady. The London shares are still mostly in demand, and a fair business is being transacted in the issues of the City companies. The North Metropolitan Electric Power Supply has declared a dividend of 6 per cent., together with a bonus of 8s. per share, the dividend being the same as that for 1916, but the bonus being additional this year. The preference shares are quoted at 17s. 6d., and the 5 per cent. mortgages at 85s.

The South Metropolitan Electric Tramways & Lighting Co. proposes to pay 2½ per cent. on the 6 per cent. preference shares, making 5 per cent. for the year—a reduction of 1 per cent. as compared with the previous period—and to carry forward £400, as against £800 brought into the accounts. Digestion of the British Electric Traction report has had little effect upon the prices of the stocks. The ordinary changed hands a few days ago at 33, the preference and 5 per cent. debenture stocks at 75½, and the 4½ per cent. second debenture stock at 65½.

British Columbia Electric Railway stocks are still flat, the preference at 57½ being 2½ down. We understand that important documents are on the way to this country in regard to the competition which is threatened in 1919 by the Municipality; and until these arrive it is not likely that any further steps will be taken. Brazil Tractions are better at 47½. Anglo-Argentine Tramway first preference have again given way, being quoted no better than 2⅞.

The industrial section is the firmest of them all, and the feature is furnished by Edison Swan £3-paid shares spurting to 15s. 9d., a rise of 5s. 9d. on the week. The 4 per cent. debenture stock is also better. Babcocks are good at £3. Callenders and General Electric preference both advanced. British Westinghouse preference lost 1/16 of its recent rise.

Marconis are an active and a strong market. It is confidently expected that the Government will pay the company a bonus shortly; and on the strength of this, the parent shares at one time touched 3 5/16, while the preference were 2⅞. The latter reacted to 2¾ and the others to 3¼, showing, however, substantial improvement on balance. The cable market is good throughout, the principal rise being secured by Indo-Europeans at 51, these being 30s. up. Globe ordinary gained 5s., and, in the lower-priced shares, West India and Panamas are 1/16 higher. There is little floating stock on offer.

Notwithstanding the decline in the price of rubber to 2s. 9½d. per lb., there is a good deal of business doing in the leading shares. Hopes are being fanned that some sort of action will be taken in relief of the excess profits duty, having regard to the pressure of the tax upon the younger companies as exemplified in a number of the recently-issued reports, these showing many instances of undoubted hardship. The market in the explosives continues active, in view of the Government's consent to a big combine; while most of the armament shares which go with those of the iron, coal, and steel group, are decidedly strong on buying that emanates mainly from the provinces.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price June 12, 1917.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	9	6½	—	£6 18 6
Charing Cross Ordinary ..	5	5	8½	—	7 2 10
do. do. do. 4½ Pref..	4½	4½	8¼	—	6 18 6
Chelsea	4	3	2⅞	—	5 4 4
City of London	8	8	12	—	6 13 4
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10⅝	—	6 11 9
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	7	10	5¼	—	5 11 7
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	8¾	—	5 6 8
Metropolitan	8	8	2⅛	—	6 0 0
do. 4½ per cent. Pref.	4½	4½	8⅛	—	7 4 0
St. James' and Pall Mall ..	8	8	6½	+ ⅛	6 3 1
South London	5	5	2¾	—	7 5 6
South Metropolitan Pref. ..	7	7	21/-	—	8 13 4
Westminster Ordinary	7	7	5¾	—	6 1 9
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	98	—	6 2 0
do. Def.	83,6	1½	22½	—	6 13 4
Chile Telephone	8	8	7	+ 1/16	5 14 4
Cuba Sub. Ord.	5	5	8	—	6 5 0
Eastern Extension	8	8	13⅝	—	*5 17 6
Eastern Tel. Ord.	8	8	139	—	*5 15 1
Globe Tel. and T. Ord.	7	7	12¾	+ ¼	*5 9 10
do. Pref. ..	6	6	10⅛	—	5 18 5
Great Northern Tel.	22	21	86½	—	6 0 7
Indo-European	13	13	51	+1½	6 7 5
Marconi	10	10	3¼	+ ⅛	8 1 6
New York Tel. 4½	4½	4½	99	—	4 11 0
Oriental Telephone Ord. ..	10	10	2⅜	+ ⅛	4 4 1
United R. Plate Tel.	8	8	6¾	+ ⅛	*5 18 6
West India and Pan.	6d.	6d.	1 3/16	+ 1/16	2 2 1
Western Telegraph	8	8	14	—	*5 14 4
Home Rails.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	24¾	+1	4 0 10
do. District	Nil	Nil	16⅛	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A" ..	Nil	Nil	5/9	+3d.	Nil
do. do. Income	6	5	84	+1	*5 19 1
Foreign Trams, &c.	Dividend 1915.	Dividend 1916.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	2⅞	— ⅛	9 11 4
do. 2nd Pref. ..	5½	—	2⅜	—	—
do. 5 Deb. ..	5	5	66½	+ ½	7 10 5
Brazil Tractions	4	4	47½	+ ½	—
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	57½	— 2½	8 13 10
do. do. Preferred	Nil	Nil	57½	—	Nil
do. do. Deferred	Nil	Nil	32½	—	Nil
do. do. Deb.	4½	4½	58½	—	7 1 8
Mexico Trams 5 per cent. Bonds	Nil	Nil	37	—	Nil
do. 6 per cent. Bonds	Nil	Nil	30	—	Nil
Mexican Light Common ..	Nil	Nil	14½	—	Nil
do. Pref.	Nil	Nil	22½	—	Nil
do. 1st Bonds ..	Nil	Nil	37½	—	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	3	+ 1/32	5 0 0
British Aluminium Ord. ..	7	10	27/3	—	7 6 10
British Insulated Ord.	17½	20	12⅝	—	7 18 5
British Westinghouse Pref. ..	7½	7½	2⅜	— 1/16	6 6 4
Callenders	20	20	13¾	+ ⅛	7 5 6
do. 5 Pref.	5	5	4		6 5 0
Castner-Kellner	22	22	3⅜xd	—	6 10 2
Edison Swan, £3 paid ..	—	—	15/9	+5/9	Nil
do. do. fully paid ..	—	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	71½	+1	5 12 0
Electric Construction	7½	—	1	—	7 10 0
Gen. Elec. Pref.	6	6	10	+ ¼	6 0 0
do. Ord.	10	10	15	—	6 13 4
Henley	25	25	15½	—	8 1 3
do. 4½ Pref	4½	4½	4	—	5 12 6
India-Rubber	10	10	12⅛	—	*8 5 0
Telegraph Con ..	20	20	87½	—	*6 8 2

* Dividends paid free of income-tax.

INDUCTION METHODS OF FAULT LOCALISATION.

By H. E. BLAKE, A.M.I.E.E.

From time to time in the electrical Press, the induction method of finding faults in buried cables with a search-coil and telephone is recommended. The suggestions made for carrying out this test invariably involve a considerable weight of apparatus to create an artificial load for passing through the fault. The following arrangement reduces the size of the whole of the apparatus required to a box, measuring not more than 9 in. × 5 in. × 7 in., together with a light search-coil, thus converting an unwieldy equipment into a cheaply constructed and conveniently portable one. A G.E.C. medical coil, No. 3,020, and a 4-volt 20-ampere battery of accumulators are mounted together in a box. Accumulators are preferable to dry cells, as their superior capacity copes with the fault resistance more successfully. The space below the medical coil can be utilised for notes, also for keeping a Sullivan wireless telephone receiver of 5 ohms resistance. When fault-finding apparatus is needed it is usually required without a moment's delay, and a great point is gained by having everything available in a compact form, instead of gathering the apparatus laboriously together after the emergency has arisen. With regard to the wireless telephone receiver, permission to purchase this must be obtained from the Postmaster-General, due to the war. This will be given in due course, on receipt of a guarantee that it is to be used for fault-finding and not for wireless telegraphy. The search coil should be wound with 100 turns of cotton-covered bell wire, on a light triangular wooden frame 6 ft. at the base and 3 ft. in height, with a cross arm for carrying it over the ground.

The accompanying diagram explains the method of procedure, and the apparatus may be used in the following ways :—

1. *To Locate a Fault to Earth.*—See diagram.

2. *To Trace the Run of a Buried Cable.*—Attach coil to one end of the cable, as shown in the diagram, and earth the other end of the cable. The sound in the wireless telephone receiver will be loudest when the triangular search coil is held parallel with, and directly above, the line of the cable.

3. *To Check the Position of a Fault Located by a Drop of Potential or a Loop Test, when Services are Tapped off the Cable under Test.*—A drop of potential or a loop test will only locate a fault accurately, if it is on the main; the result will show on the main, though the fault may really be on a service. It can be decided whether the fault is on the main or on one of the services by attaching the coil as in the diagram, and holding the triangle parallel with the services in the neighbourhood of the fault, as shown by the drop of potential or loop test. A loud sound in the receiver over a service will locate the fault on that service. The drop of potential test, in conjunction with the telephone test, gives very accurate results. By utilising two entirely different methods of fault finding, the result is invariably correct when they confirm one another.

It is often desired to find an earth on a L.T. network without making the faulty cable dead, where power consumers, doctors, &c., are connected to it. In these cases a condenser of 2 mfd. capacity must be inserted between the pressure lead of the induction coil and the cable under test. The condenser is necessary, because, though the main under test be at earth potential, if the fault should be in a consumer's premises, and he should remove it by switching off, the supply current would spoil the apparatus without a condenser in circuit. It will be found that the superimposed current will only be audible in the telephone on comparatively small networks, such as those on an A.C. system of distribution, where a faulty district can be isolated on one group of transformers. The make and break of the induction coil must also be slowed up by lengthening the arm of the interrupter, otherwise it is not possible to distinguish the superimposed interrupted current from the periodicity of the A.C. supply. When the network is too large, the superimposed current disperses itself over the whole area to complete its circuit through all the weak points, wherever they may be, including consumers' wiring, and the position of the fault under investigation is not found. It is far preferable to make the cable under test dead if possible, as it needs some practice to distinguish the sound of the supply current from that of the superimposed current. The test is rendered still more difficult by the noise of passing traffic in crowded thoroughfares, the beat of a petrol engine being specially confusing. Also on D.C. networks, any X-ray apparatus connected to the mains will be found to produce a sound in the telephone practically identical with that of the induction coil.

THE MORE RECENT APPLICATIONS OF ELECTRICITY IN THE PRESENT WAR, ESPECIALLY IN THE TREATMENT OF DISEASES AND WOUNDS ARISING THEREFROM.

By WARRANT OFFICER W. LEEMING, A.M.A.

[The following paper was awarded the "Cecil" Medal and prize of £10 in the competition advertised by the Dorset Field Club in our issue of December 8th, 1916. Mr. Leeming is the officer in charge of the Massage and Electrical Department of the Monte Video Convalescent Camp, Weymouth.—Eds. Elec. Rev.]

Introduction.—In dealing with this subject, it will be necessary to state clearly the author's experience, which commenced some eight years ago with a thorough training and diploma in the North of England, five years' private practice in Australia, during which the author was two years Honorary Masseur and Electro-Therapeutist to the Melbourne Hospital, and more recently, since the beginning of the war, in the same capacity at the Australian Command Depôt, Monte Video Camp, near Weymouth, Dorset.

Upwards of 3,000 patients have come under the author's observation during the past two years, several hundred of whom have been under personal treatment.

In the course of the paper, the author proposes to detail various definite cases which have successfully yielded to methods of electrical treatment which before the present war were unknown.

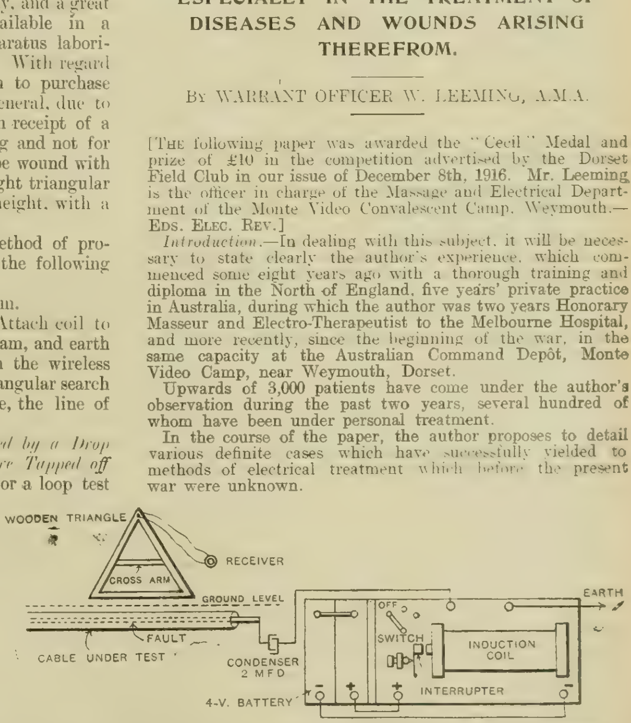

Diagram of Connections for Telephone Method of Fault-finding.

The sound in the receiver becomes faint at the fault for lead-sheathed cables or for cables in metal pipes, and ceases at the fault for V.B., when the triangle is carried along above the route of the cable.

For the purposes of the paper, the subject will be dealt with under the following headings :—

1. Radiant Heat, Rontgen Rays, and Electric Vibration.
2. Paralysis in its various forms.
3. Ionisation — Destruction of Organic Matter — Septic Wounds.
4. Faradisation on Relaxed Muscles.
5. Sciatica, Treatment of.
6. Rheumatism, Treatment of.
7. Synovitis, Treatment of.

1. *Radiant Heat, Rontgen Rays, and Electric Vibration.*—The application of each of these treatments may be classed as secondary compared with the closer application of electricity, as in faradisation and galvanisation which in many cases is vitally important for a partial or complete recovery of the patient.

The therapeutic value of radiant electric heat in congescent hospitals has been unquestionably proved since the present war.

Neuritis, muscular rheumatism, synovitis, and periostitis, all of which diseases are continuously dealt with, show a marked improvement within one to two weeks. The main advantage of the dry electric heat produced by carbon lamps, over vapour and other forms of heat, is that the acceleration of the heart and the respiratory system is slight in comparison with the more exhausting Turkish bath, for instance.

Radiant heat can be arranged so as to increase the vascular circulation in very small areas; the pores of the skin are opened, and the nerve centres beneficially influenced, as proved by the fact that patients frequently become sleepy when undergoing radiant heat treatment. The result is the stimulation of the superficial tissues, and the elimination of foreign matter, mainly through the pores of the skin, but also by increased absorption in the deeper tissues.

It is important in most cases of wounds which have destroyed a certain area of skin that the scar tissue is not exposed to the full rays of the lamps. The fact of the scar tissue being without pores renders that part incapable of eliminating moisture. The result is that the sweat collects under the tissue and forms a water blister, which naturally necessitates the building of new scar tissue, to replace the affected part. A strip of lint placed over the scar is sufficient to prevent scar-blistering, without interfering with the therapeutical effects of the electric heat.

The author has seen cases of acute synovitis of the knee, and of fibrositis, which have shown remarkable improvement in a few weeks due to treatment with radiant heat, ionisation, and massage.

Many forms of radiant heat baths are now made, ranging from the small type for local affections to the cabinet bath for body treatments, the results of which are precisely similar. An excellent type of apparatus suitable for most local applications is shown in fig. 1.

The number of carbon lamps (16 c.p.) may vary between six and 12, according to the heat required, and the bath is so constructed that the greatest amount of heat is retained inwardly. A temperature of 250 deg. F. may thus be reached without unduly raising the temperature of the other parts of the body not under treatment.

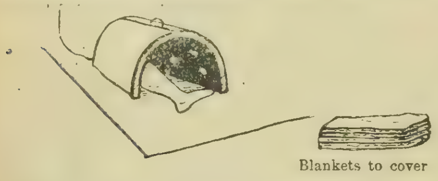

Fig. 1.—Radiant Heat Bath.

The uses of the Röntgen rays are well known in connection with the present war. Apart from the importance of X-rays in accurately revealing the position of fractured bones, splinters of bone, &c., they are of great value in locating other solids, such as shell splinters.

A remarkable instance came under the author's treatment a few weeks ago. A soldier in the 1st Battalion, Australian Infantry, received two machine-gun bullets, which entered the left side of the neck. One of the bullets found its way out at the other side of the neck. The two bullets had entered in *exactly the same point*, consequently the medical men considered it as a through and through wound, but could not understand why the left arm was paralysed.

It was two months after the wound was received that an X-ray photograph was ordered, and showed the second bullet resting above the left shoulder. The subsequent operation proved that this bullet has been causing pressure on the brachial plexus of nerves, as the day after the removal of the bullet the patient was able to move his arm. He has since practically recovered the complete use of his arm with galvanisation.

The therapeutical effect of Röntgen rays is of considerable importance in the treatment of skin eruptions, ulcers, &c. The influence on the vitality of the tissues is very similar to radiant heat, light, and other applications of electricity. In weak doses, the rays are organically stimulative, with no appreciable reaction; but in stronger doses there may be a destruction of tissue if applied continuously.

Electric vibration is a mechanical device capable of setting up, by electric motor, a vibration varying from 250 to 1,000 vibrations per minute. This is applied through a rubber pad for preference. The effect is stimulative and contractive. The depth of the tissues which undergo stimulation is directly proportionate to the speed of the vibration. As a stimulant for weak and relaxed muscles, its use is of some value, also in increasing local circulation to an affected part. Vibration is sometimes useful in cases of nerve lesion caused by a wound.

2. *Paralysis in its Various Forms.*—The cases which are cited are both varied and remarkable. They may be divided mainly into three headings, namely :—

(*a*) Cerebral.
(*b*) Spinal.
(*c*) Peripheral.

(*a*) Cerebral injuries are not very common, thanks to the latest headgear worn in the trenches, but cases of hemiplegia do occur as the direct result of a head wound which has pierced the skull.

The usual treatment for these cases is "make-and-break" galvanisation applied on the affected limbs. Good results are invariably found by the local or bi-polar method, rather than by direct application to the brain, or uni-polar method, which is trying to the patient. The safest and best plan, in the author's experience, is to find out the particular group of nerves which are affected, and apply the anode or positive pole to the plexus, previously ascertained. A good method is to damp thoroughly eight thicknesses of plain lint and apply the electrode through this. A bandage is quite sufficient to keep the pad and electrode in position. Make the cathode the labile pole, and apply through a small circular pad electrode, for preference, to the various motor points. The motor points are the points of entrance of a nerve which governs a muscle, and their positions are more or less definite. The following diagram (fig. 2) gives an idea of the motor points of the arm.

It is important to locate these points in the treatment of hemiplegia in order to give the full amount of stimulation to the nerves which are injured. For ordinary purposes an alternation of about 30 seconds applied in this way will give very beneficial results.

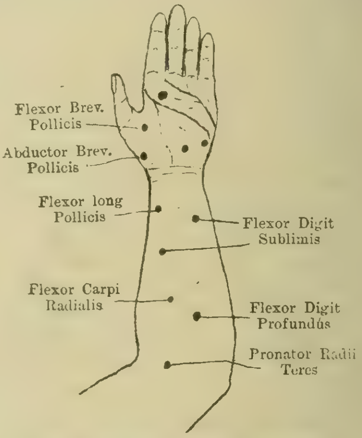

Fig. 2.—Motor Points of the Arm.

Cases occasionally occur of men affected with cerebral disturbance, or partially hysterical condition, caused other than by wounds; shell-shock and over-strained condition of the nerves often gives rise to cerebral trouble, the result being a lack of co-ordination between the nerve centres and the muscles.

This is more frequent in young soldiers between the ages of 17 and 21. The following is the case of a boy of 18, in the 22nd Battalion, A.I.F., who had a bullet wound through the forearm, which showed every symptom of "drop wrist." It had been splinted, and he had become convinced that he could not move his wrist. Tests for reaction of degeneration showed that the nerves were really in perfect condition, which pointed to a lack of co-ordination with the brain. The author applied faradisation as a nerve stimulant, and also to demonstrate the excitability to the patient, and by inducing mental control perfect use of the hand was restored in a week. The patient in question was able shortly afterwards to wheel a barrow filled with coal.

(*b*) Spinal paralysis, or paraplegia, is chiefly caused in the present war by shell-shock, but may also in some instances be due to a wound. The paralysis always appears below the seat of injury or lesion. These cases are often more obstinate than cerebral injuries from the electro-therapeutic standpoint. Their treatment is practically the same as in cerebral injuries, and is usually somewhat prolonged, according to the extent of the injury, but experience shows that electricity is the best treatment for the ultimate cure of paraplegia.

(*c*) Peripheral paralysis is the most common form dealt with in connection with wounds. Injuries take place in all parts of the body by gun-shot wounds, which in about 75 per cent. of cases cause some injury to the course of a nerve, resulting in loss of power or sensation.

Often in cases of peripheral paralysis neuritis of the nerve is set up, causing much pain to the patient. Great relief has been obtained by the bi-polar application of the constant galvanic current for 15 minutes. In passing, it is necessary to mention that in all cases of pain caused by wounds galvanisation has remarkably sedative effects.

A wound through the upper arm in many cases injures the musculo-spiral nerve, the well-known result of which is "wrist drop." The nerve in some cases is completely severed, and, of course, it is useless to give electrical treatment until an operation to join the severed ends has been performed. But in many cases the nerve is still intact, though badly injured, and it is in these cases that electricity is of the utmost value in restoring the life of that nerve.

The faradic, which is the induced, interrupted current, has been found by the author to have very beneficial results in certain cases. Care has to be taken that reaction of degeneration is not present in the nerve, as permanent harm may be done by the unscientific use of faradisation.

Good results have been produced by the application of slow faradisation and "make-and-break" galvanisation on alternate days. A definite instance of the success of this treatment came under the author's personal treatment at the beginning of October last. The patient in question was a sergeant in the 60th Battalion, Australian Infantry, and a native of Geelong, Victoria. His wound was received on July 19th, 1916, and the bullet passed through the back of the knee, as illustrated in fig. 3.

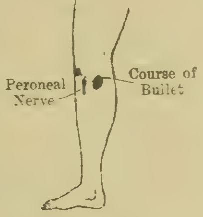

FIG. 6.

Evidently serious injury had taken place to the deep peroneal nerve, causing "drop foot," and it was thought in the Birmingham Hospital that the nerve was completely severed.

As stated, he came under treatment at Weymouth at the beginning of October. In less than one month of the treatment just detailed, used in the bi-polar method, slight movement of the foot was observed. Within two months the patient could walk, practically without a limp, with support only from a plaster of paris mould on the foot, and could take several steps without support of any kind. He sailed for Australia about December 12th; consequently, he was only under treatment at Weymouth for a little over two months.

3. *Ionisation — Destruction of Organic Matter — Septic Wounds.*—The process of ionisation is the science of introducing into the human system by electrolysis the ions or atoms of certain medicines, chosen for their curative or stimulative effect. It is of the greatest importance in connection with wounds, and there is still a field for much development in this particular branch of the science.

Very frequently cases are sent for treatment with wounds in a very bad condition. A piece of cloth, a poisoned piece of shell, or other matter completely foreign to the system, may be the direct cause of the trouble. Inflammation is set up, which may or may not spread to other parts, and large deposits of foreign matter form in the region of the wound.

The ionic medication of *sodium chloride* has been found to give excellent results. The following method has been used very successfully in the author's practice, that is, by applying eight thicknesses of plain lint, soaked with a saturated solution of sodium chloride, and afterwards squeezed, to the actual wound. The anode, or positive pole, is applied directly into the open wound by a suitable electrode, preferably small. The electrode should be firmly bound to the lint with a dry bandage. The cathode, or indifferent pole, may be applied similarly at a convenient point, and the galvanic current introduced for 15 to 20 minutes. The strength of the current may vary between three and 20 milliamperes, according to the convenience of the patient. The results of this method of treatment are both rapid and almost painless. It may easily be said to have superseded the clumsy and discomforting methods of fomentations, which increase the sensitiveness of the surrounding tissues. On the other hand, the galvanic current allays the pain at the same time that it helps to destroy organic matter.

Since August last the author has given the ionic medication of sodium chloride to upwards of 50 patients, who had suffered in different ways with septic wounds, and, without exception, they have yielded to the above treatment in less than two weeks from the commencement. The length of time in healing these wounds varies according to the area affected by the poisoning.

Not infrequently pieces of cloth, also bone, are brought to the surface by ionisation.

The author has made certain definite discoveries in the treatment of the trophic ulcers, which often arise from "trench feet." These ulcers show great obstinacy to the ordinary modes of treatment, but yield slowly and definitely to the ionisation of *zinc sulphate*. The solution is best introduced at the negative pole, and the same process may be followed as in the ionisation of septic wounds, with the difference of polarity only.

It is advisable, after the ulcer has healed, to continue the treatment for some time to assist the nutrition of the surrounding tissues, and so prevent the ulcer recurring elsewhere.

The ionic medication of sodium salicylate in cases of joint rheumatism has been found of some benefit.

4. *Faradisation on Relaxed Muscles.*—It invariably happens that when a limb has lost its functional activity, muscular weakness and relaxation occurs in a more or less acute form. In such cases faradisation has been found distinctly beneficial in toning the muscle fibres by contraction.

Wounds frequently cause a spastic condition of a certain group of muscles, such as the flexors of the leg, the extensors being correspondingly stretched; faradisation is an extremely useful adjunct to the massage treatment for troubles of this kind in inducing a counter-contraction of the stretched muscles against the spastic muscles. A similar effect is produced in cases of sprains and dislocations, which, incidentally, are fairly numerous in convalescent camps, and it is probable that the toning effect of the faradic current extends to the ligaments as well as to the surrounding muscles.

5. *Sciatica, Treatment of.*—Galvanisation has long been acknowledged as a powerful agent in effecting a cure of sciatica. The form of sciatica which soldiers contract on active service, through exposure, is similar in many respects to that from which civilians suffer. But in addition to the ordinary form of swelling and contraction in the nerve, caused by cold and damp, peripheral neuritis of the sciatic nerve occasionally establishes itself as the direct result of a wound in the buttock.

Cases are not uncommon in which a bullet has actually been resting on the nerve, and has set up the ordinary symptoms of sciatica, together with partial paralysis. The author has found the ionic medication of sodium salicylate, applied at the negative pole, to be of distinct benefit in treating these cases. The bullet itself is, no doubt, influenced by the electric current and attracted towards the surface of the skin; the stimulating and soothing effect of this treatment is most marked. The length of time taken to restore the tone of a nerve in this way varies according to the extent of the injury sustained, but in all cases the pain is quickly reduced.

One notable effect of sciatica is a complete loss of sensation in certain parts of the leg, usually on the front and outer side of the tibia and fibula bones, and the dorsal side of the foot. Massage and faradisation has been found the most efficient treatment for this loss of sensation. Radiant heat proves equally useful, however, in certain cases where the stimulation of the skin is required.

Skilful massage alone will produce reasonably good results, but in all cases of sciatica, probably more than half the time may be saved by adopting electric stimulation, together with manipulations which give tone and increased circulation to the surrounding muscles. Neither treatment is complete in itself, but if both are skilfully applied, success is practically assured.

6. *Rheumatism, Treatment of.*—Muscular rheumatism and rheumatoid arthritis are the most prevalent forms of this complaint which arise with troops on active service. Many men have hereditary tendencies to rheumatism, which is aggravated by the exposure under active-service conditions, and it is by no means easy to effect a lasting cure by massage, electro-therapeutics, or hydropathy in this class of patient. A number of cases respond readily to persistent treatment, but one difficulty, from the operator's standpoint, is that the patients themselves do not take sufficient care of their health whilst under treatment. In addition, there is some danger of reaction resulting from treatment, but, despite the possibilities of these counter-actions taking place, many lasting cures have been achieved.

In muscular rheumatism, massage is equally as important as electricity. Radiant electric heat, followed by massage, may be said to be the ideal treatment in these cases. Relief is certain at all times, and a large percentage of definite cures can be effected.

Chronic rheumatism in the joints is best treated by the ionic medication of sodium salicylate, 2 per cent. solution, applied through the affected joint, followed by massage, and being supplemented occasionally by radiant heat. The results are usually slow, and at times rather disheartening.

7. *Synovitis, Treatment of.*—This disease is fairly common among soldiers on active service, the bursæ at the knee and elbow being mainly affected. A wound is frequently the cause of synovial trouble, and in all cases of wounds involving a joint, a certain amount of laceration of the membrane invariably happens.

The value of radiant electric heat in these cases has been previously mentioned, and the more common form of synovitis, which many athletes develop, yields, in a very short time, to the same treatment.

Conclusion.—So far, the author has not referred to the applications of sinusoidal current, but a brief reference here may not be out of place. The rise and fall of the sinusoidal current, being less marked than that of faradism, makes this current more suitable for the testing of reactions of degeneration, and for stimulation. Whereas strong faradism produces a state of tetanus in the muscles, it is quite absent in the application of the sinusoidal current. The therapeutic effects of the faradic and sinusoidal currents are almost identical.

The use of the sinusoidal current is not general in military convalescent camps, for two reasons, namely: (*a*) Because the alternating current necessary is not often available, and (*b*) because the sinusoidal plant is considerably more expensive than the faradic.

The scope of this paper has been confined to the author's personal observation and experience in the science of electro-therapeutics. Great progress has been made in this branch of hospital work since the beginning of the war, and there still remains a large field for research and experimental work in the treatment of diseases and wounds.

AN A.C. BRIDGE METHOD OF COMPARING INDUCTANCES.

By T. PARNELL, M.A.

(*Abstract of paper read before the* PHYSICAL SOCIETY.)

THE simple Maxwell inductance bridge cannot be used conveniently for the comparison of fixed inductances on account of the tedious double balance necessary, though by reason of its simplicity and symmetry the bridge has much to recommend it. By making use of a current detector whose deflections depend on the component of the current in quadrature with the E.M.F. applied to the bridge, it is possible to make the condition for no deflection depend either chiefly on the inductances or chiefly on the resistances.

The arrangement of the bridge is shown in fig. 1. In series with the bridge is placed either a non-inductive resistance, R, or a condenser, K. If R, r, and s are all large compared with p, q, g, Pω and Qω, it will be shown that, with R in circuit, the balance depends chiefly on the inductances P and Q, and that with K in circuit the balance depends chiefly on the resistances.

With R in circuit, s is adjusted for no deflection: this gives an approximate balance for the inductances. Then, with K in circuit, q is adjusted for no deflection: this gives an approximate balance for the resistances. The process is repeated, and after a few balances values of s and q are obtained that give a balance with either R or K in circuit, in which case the bridge is completely balanced, and $P/Q = p/q = r/s$.

The first few balances need only be made roughly, and the whole process can be carried out very quickly; when the apparatus is adjusted, an unknown inductance can be balanced against a standard to one part in a few thousand in a few minutes.

As detector a sensitive moving-coil galvanometer and rotating commutator may be used. In this case the commutator is mounted on the axle of the small alternator or rotary converter that supplies the bridge current, and the brushes of the commutator are adjusted till no deflection is produced, when the E.M.F. used on the bridge is applied through the commutator to a high non-inductive resistance in series with the shunted galvanometer, thus showing that the commutator is in quadrature with the E.M.F. When the commutator is thus adjusted the deflection of the galvanometer is approximately proportional to the component of the current in quadrature with the E.M.F. applied to the bridge.

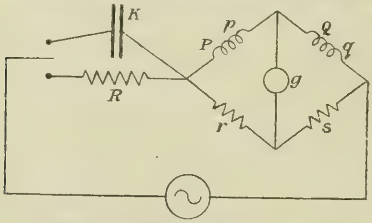

FIG. 1.—A.C. INDUCTANCE BRIDGE.

A more convenient detector is the Sumpner reflecting electro-dynamometer, manufactured by Paul. The suspended coil moves in the field of a laminated iron electromagnet excited by a field winding with a large number of turns; the resistance of this field winding is small compared with its reactance, and therefore the total flux through the field coils is approximately in quadrature with the applied E.M.F. The flux density is sensibly constant throughout the air-gap and proportional to the total flux; when, therefore, the moving coil is connected across the bridge, and an E.M.F. in phase with the E.M.F. used for the bridge is applied to the field coils, the mean torque on the moving coil is approximately proportional to the component of the current in quadrature with the bridge E.M.F.

If the mutual inductances between the various conductors and also their capacities and the inductances of R, r, and s are negligible, the final balance is independent of wave-form and frequency. The preliminary balances depend on wave-form and frequency. An approximate knowledge only of the conditions for these preliminary balances is required.

Measurements of a number of coils with various values of the voltage and of R, K, and r gave results consistent within 1 in 1,000. Owing to the presence of R or K, it is necessary to use fairly high voltages in order to keep up the sensitiveness.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

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7,651. "Automatic electrical control for trains." G. D. K. MOSS. May 29th.

7,656. "Telephone transmitters." B. A. PILKINGTON. May 29th.

7,659. "Electric generator and dynamo." O. J. REILLY. May 29th.

7,676. "Magazine telegraph transmitters." L. M. POTTS. May 29th.

7,679. "High-speed electric locomotives." BRITISH THOMSON-HOUSTON CO. F. W. CARTER. May 29th.

7,680. "Transmitting valves for wireless telegraphy." F. P. DRIVER AND OSRAM-ROBERTSON LAMP WORKS. May 29th.

7,681. "Transmitting valves for wireless telegraphy." C. H. HARVEY AND OSRAM-ROBERTSON LAMP WORKS. May 29th.

7,682. "Transmitting valves for wireless telegraphy." O. DURDLE AND OSRAM-ROBERTSON LAMP WORKS. May 29th.

7,683. "Electric plug couplings." W. R. CLEMENTS & W. T. HENLEY'S TELEGRAPH WORKS CO., LTD. May 29th.

7,684. "Electric secondary or storage batteries." O. OLDHAM. May 29th.

7,702. "Electric generators." SOC. DE PARIS ET DU RHONE. May 29th. (France, May 26th, 1916.)

7,710. "Electrically-operated contact-breaker for battery ignition system, magnetos, &c." W. H. NIX. May 30th.

7,712. "Overwinding switch for electric cranes, &c." S. H. HEYWOOD AND S. H. HEYWOOD & CO. May 30th.

7,718. "Rectifying interrupters for X-ray purposes." A. L. DEAN. May 30th.

7,730. "Voltage regulators." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). May 30th.

7,735. "Arc lamp for medical and surgical purposes." E. E. GREVILLE. May 30th.

7,739. "Magneto-ignition apparatus for internal-combustion engines." AKT. GES. BROWN, BOVERI ET CIE. May 30th. (Germany, May 30th, 1916.)

7,749. "Magnetos." H. GUILLOU. May 30th. (France, January 27th, 1915.)

7,771. "Generating." S. J. WILLEY. May 31st.

7,814. "Process of obtaining nitrogen from air." ELEKTRIZITATSWERK LONZA. May 31st. (Switzerland, June 17th, 1916.)

7,820. "Miners' safety lamps." R. LAMBOURNE. May 31st.

7,821. "Generation of mechanical power by different currents." D. SUCHOSTAWER. May 31st.

7,826. "Electric fuse box." A. L. HOLMAN. May 31st. (Denmark, July 21st, 1916.)

7,836. "Sparking plugs." L. BLAIZOT & M. BROTTY. May 31st.

7,846. "Dynamo-electric machines." SUBMERSIBLE AND J. L. MOTORS, LTD., AND H. K. WHITEHORN. May 31st.

7,847. "Sparking plugs for internal-combustion engines." W. O. KENNINGTON. May 31st.

7,875. "Commutator brush assembly for internal-combustion engines." F. VALMINT. June 1st.

7,882. "Electric insulating materials." A. R. MULLER. June 1st.

7,900. "Telegraph, &c., poles." W. G. YOUNG. June 1st.

7,925. "Electric arc lamps, including flame arcs." S. E. R. BEECROFT. June 2nd.

7,934. "Hanging-straps for electric cars, &c." M. YAMASAKI. June 2nd.

7,943. "Wireless signalling systems." BRITISH THOMSON-HOUSTON CO. AND GENERAL ELECTRIC CO. June 2nd.

7,953. "Electrical measuring instruments." G. A. CHEETHAM. June 2nd.

7,957. "Electric spark-gap protective devices." G. GILES. June 2nd. (Switzerland, June 26th, 1916.)

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

4,938. ELECTRIC TIME SWITCHES. A. M. Coates. April 4th, 1916. (106,108.)

5,091. ELECTRIC MAKE-AND-BREAK DEVICES. E. C. R. Marks (American Model & Instrument Co.). April 6th, 1916. (106,111.)

5,884. ELECTRICALLY-OPERATED TEMPERATURE ALARMS. J. P. M. A. Struyver. April 25th, 1916. (106,117.)

6,467. DYNAMO-ELECTRIC MACHINES. J. W. Howard. May 5th, 1916. (106,118).

7,244. ELECTRIC FURNACE ELECTRODES. V. Stobie & S. Davenport. May 22nd, 1916. (106,152.)

9,804. HAND OR PORTABLE ELECTRIC LAMP. H. S. Gulston. July 12th, 1916. (106,025.)

10,228. PROCESS OF ELECTRO-PLATING NON-CONDUCTING SUBSTANCES WITH COPPER. U. Unno. July 20th, 1916. (106,184.)

10,328. CONTACT SCREW OF THE ARMATURE OF FIELD TELEPHONE INDUCTION COILS. H. C. Back. July 22nd, 1916. (106,029.)

10,919. MAGNETO-ELECTRIC MACHINES. F. R. Simms. August 2nd, 1916. (106,195.)

11,968. ELECTRIC GLOW LAMPS AND THE LIKE. C. O. Bastian. January 26th, 1916. (Divided application on 1,271/16.) (106,036.)

13,482. MULTIPLE FUSE PLUGS. Six-In-One-Fuse Co. January 18th, 1916. (103,469.)

13,593. ELECTRIC RESISTANCE FURNACES. J. C. Landtmeters. September 25th, 1916. (106,044.)

13,816. SYSTEMS OF ELECTRIC DISTRIBUTION. British Westinghouse Electric and Manufacturing Co. October 7th, 1915. (101,711.)

15,429. MEANS FOR EXPEDITING AND SAFEGUARDING RAILWAY TRAFFIC. H. A. Thompson. October 30th, 1916. (106,051.)

16,359. CONTACTS FOR ELECTRIC SWITCHES, AND OTHER ELECTRICAL APPARATUS AND THE MODE OF AND MEANS FOR MOUNTING OR SUPPORTING SAME. A. Crawford & W. Preston. May 15th, 1916. (Cognate application, 15,033/'16.) (106,054.)

18,649. ELECTRO-MECHANICAL MAKE-AND-BREAK MOVEMENT FOR ELECTRIC CIRCUITS. F. de Coppart d'Hamale. December 30th, 1916. (106,064.)

1917.

3,765. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. A. G. [illegible] March 15th, 1917. (106,256.)

THE

ELECTRICAL REVIEW.

VOL. LXXX. JUNE 22, 1917. No. 2,065.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: June 22, 1917. [No. 2,065.

Page
Electric Range Standardisation 665
The Problem of the "One-Man" Business 666
Sale Prices in the German Electrical Industry 666
The Meeting of the Incorporated Municipal Electrical Association, 1917.—I. 667
Anthracite Coal, by W. H. Booth (*concluded*) 669
Electric Steel 670
New Electrical Devices, Fittings and Plant (*illus.*) 672
War Items 673
Business Notes 675
Notes 679
City Notes 681
Stocks and Shares 683
Market Quotations 684
Auxiliary Motors and Control Gear for Steel Works (*illus.*) ... 685
Cleaning Dirty Insulators... 687
Correspondence—
Electric Power in a Cotton Mill 687
Legal 687
New Patents Applied for, 1917 688
Abstracts of Published Specifications 688
Contractors' Column ... ... Advertisement page xxii

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ELECTRIC RANGE STANDARDISATION.

THE recent N.E.L.A. Convention issue of the *Electrical World* contains an interesting reference to a topic which has frequently figured in our own pages in connection with electric cooking development on this side—viz., the standardisation of apparatus.

Our American friends have been spurred on, exactly as the ELECTRICAL REVIEW was, seriously to consider this matter on account of the comparative costliness of the apparatus, which is one of the greatest impediments to its introduction.

In their case, however, abnormal cost is attributed to the war, while we have all along suffered from the effects of lack of organisation and co-operation in manufacturing and selling. We urged that "what is required on the part of the central-station authorities and manufacturers is some agreement fixing standard lines of development and standard dimensions and ratings, and aiming at some degree of interchangeability of parts"; and later we pointed out that the most acceptable general type of apparatus has already been settled for us by our gas friends, and that a majority of the makers of electrical cooking apparatus agreed to this in principle, so that "the problem is narrowed down practically to an agreement on one or two standard sized cookers, and the construction of electric heating devices within certain limiting dimensions, and having standard methods of attachment"; we also urged the discarding of special features which experience with gas cookers has shown to be quite unnecessary, and which consumers are unwilling to pay for.

Let us see how the N.E.L.A. Sub-Committee on Electric Range Standardisation proposes to deal with the problem in the States. First of all, it is felt that the public need can be met with fewer models, and manufacturers are urged to sacrifice the commercial feature of individuality in favour of better workmanship and lower cost, two fundamental types being suggested, with standardised over-all dimensions and a height of 33 in. for cooking surfaces.

The Sub-Committee recommends an agreement on minimum standards in quality, thickness of insulation, and in gauges and kinds of sheet steel; that ovens should be in three sizes, the smallest being 18 in. × 12 in. × 12 in. (which is the standard for small American gas stoves), and the largest 18 in. × 18 in. × 14 in.; that heaters for broilers should measure approximately 12 in. × 12 in. with about 1,800 watts loading; that the built-in terminal box be discarded, as non-essential and costly, in favour of wires to which the wireman can connect up; that heaters be separately fused, and the fuseboard accessibly located; that pilot lights be dispensed with as non-essential; and that switch design and operation be standardised.

With a view to saving expense, it is considered that separate heaters for hot cupboards can be avoided by placing the latter next to the ovens. Standard crates and names of parts are proposed, and size, wattage, and renewals of heaters are discussed in this report, which, it will be noted, takes a very similar standpoint to that taken by ourselves.

Another factor which hinders the development of public opinion in the States in favour of the electric cooker is described as the lack of "the humanising of it."

Our readers will no doubt be able to trace the intended analogy, for it is obvious that complete success will not result until electric cooking is regarded as an essential and familiar feature of the home; to the instinctive requirement of cooking service, so successfully fostered by the gas industry in this country, must be added a preference for electric cooking service, which must be made available on similarly easy terms.

The Problem of the "One-Man" Business.

In several important centres there is a growing demand that the position of the proprietor of a one-man business should be more sympathetically considered. The Military Service Acts contain provision for exemption in cases of proved serious hardship owing to exceptional obligations. Many a man has given up his position—trade or professional—and has no prospect of resuming his former place when he returns, and he has in addition left a family who must live in very reduced circumstances and pay 100 per cent. above the normal for everything, so that his small savings, if any exist, must soon be gone. But this is not serious hardship according to the Acts. It is serious hardship, however, undoubtedly, and there is a good deal of it about. The Civil Liabilities provision was designed to afford some measure of relief in such cases, but even then the case of hardship remains, though it becomes a little less "exceptional," we suppose. What should be the position of the man of fighting age and fitness who has put his entire capital into a business which cannot be continued without him? If the business must be sold at a great immediate sacrifice; or if it must be closed because nobody is available to buy it—are these "exceptional" hardship cases? Incomes of thousands a year have to give place to mere Army pay and Civil Liabilities provision; stock, fixtures, and furniture have to be realised at a forced sale and goodwill sacrificed—are these things sufficient to constitute exceptional hardship? We recognise that shopkeepers in a small way are finding relatives—sometimes their wives—friends, solicitors, and others, who can "carry on" on their behalf; but how about the owner of a business which has been built up by reason of technical knowledge and training, and for the continuation of which similar knowledge and training are essential, but cannot be secured because there are no substitutes available? Would such not be a case of an exceptional character? The business must be entirely sacrificed, and the capital lost, unless we can conceive of the shutters being put up only temporarily pending the resumption of operations under precisely similar conditions, and with the same clientèle, when the military owner returns. If such conditions cannot be conceived of, is this a case of exceptional hardship? Everybody will agree that the mere possession of capital should be no excuse from military service if a man possesses fighting fitness and years; under some conditions the present socialistic atmosphere would suggest that a man of "means," even after forced realisation, was better able to afford to go than many a poor professional man. Yet it is becoming a matter of national importance which cannot be ignored if we are to prevent too great a disorganisation of industry and trade; and the Civil Liabilities provision should be increased to meet hard cases. Owners of one-man businesses reasonably complain that there are still large numbers of single and married men under 30 years of age fit for general service, and with no capital or business liabilities, who are sheltering in munitions works and controlled establishments—men who have changed their occupation since August 15th, 1915.

The "one-man" business-man is prepared to go when the country's need demands it, at whatever sacrifice, but he feels that such as the foregoing, who are making a good thing out of the change of occupation, and are not "skilled" to such an extent that they cannot be replaced, ought to be called upon first. We believe that the Government is working towards this end at present. The question at the moment is whether it is doing so well that it can afford to defer imposing heavy sacrifices upon genuinely "one-man" businesses. By some it is requested that these be placed in a "reserved occupation" class. One thing that might be conceded without much discussion, we should think, is the granting to appellants of this kind (in the event of leave to appeal to the Central Tribunal being refused by the County Tribunal) permission to appeal to the Central Tribunal itself for such leave. There is a feeling that this would provide for the exercise of greater discrimination as to what is a case of real "exceptional" hardship, and would be the means of modifying the existing grievance.

The number of one-man businesses, if we include every little shopkeeper, is too large for the matter to be settled off-hand either way, and, as we say, the mere possession of capital, however invested, and of a good income, can be no protection in these days of hardship and sacrifice. What is exceptional hardship must be settled carefully according to the merits of the case and the needs of the Forces, remembering always the fit men who still shelter under convenient umbrellas, and remembering, too, that the closing of one business brings profit to a rival, or sometimes a very favourable opportunity for a new-comer who is not British, or even Allied.

Sale Prices in the German Electrical Industry.

According to information which has recently been published in Germany concerning the electrical engineering industry in that country, the 11 leading firms are working together for the purpose of fixing prices on common account. At the present time the conditions in the market for castings, sheets, insulating materials, &c., are such that almost all the firms who supply these state that they are unable to accept orders at definite prices. In so far as deliveries can be effected, the contractors stipulate that payment must be made at the quotations which are in operation at the time of delivery, and electrical manufacturers have been compelled to follow this example and refuse to accept fixed prices for most of their products, as the raw materials are constantly rising during the execution of the orders, whilst increasing wages and other expenses tend to operate in the same direction.

The electrical firms under these circumstances quote prices which take into consideration the quotations for raw materials which prevail on the receipt of the order, but they require payment on completion at prices which correspond with the alterations which may have occurred in the meantime. In order, however, to inform customers of the situation of prices within a certain period, the 11 firms have undertaken to issue circulars to the former in the future. In these circulars the situation of prices at any time will be expressed by war price increases on certain basis prices; and basis prices for manufactures made according to the practice followed in peace times (with copper, brass, bronze, &c.) are considered to be the prices which prevailed before the war, and for machinery and other manufactures with substitute metals (iron, zinc, aluminium, &c.), also the basis prices are those which ruled for materials and wages before the war. By way of explanation, it is mentioned that the firms concerned fixed for June this year, and for manufactures for which definite prices could not be quoted, four war price increases, which vary according as the orders are executed on peace practice or war practice methods. Three of these relate to peace practice (with copper, brass, bronze, &c.). The first is for direct war orders, the second is for indirect war orders for which materials are released by the Government for each individual order, and the third is for orders for peace purposes, whilst the fourth applies to war method of execution with substitute metals. We publish in our "Business Notice" pages to-day a table showing the percentage increase on the basis prices as compared with the pre-war period.

THE MEETING OF THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION, 1917.—1.

Once more it falls to us to record a meeting of the I.M.E.A. under circumstances which vary little, except in the matter of rendezvous, which has perforce been altered to the "Civils," from those of the last two annual meetings, being overshadowed by the great European conflict which has now lasted nearly three years. As was the case last year, the proceedings were timed to occupy a day and a half, yesterday being given up to the presidential address by Mr. F. M. Long, and papers by Mr. J. H. Bowden on "Individual Interest in Municipal Enterprise," and by Mr. J. A. Robertson on "Fuel Economy," while this morning the annual business meeting of the Association is to be held, when the work of the Council during the year will come under discussion, and new officers will be elected.

Mr. Long's address bears the stamp of brevity, with which few will quarrel; it is a plain recital of the principal events of the year directly affecting municipal supply authorities; even the pet theme of "fuel economy" receives no direct reference, though this is amply atoned for by Mr. Robertson's able paper on the subject. The President recognises that the first steps towards the larger development of the use of electricity in the service of this country have been taken, as evidence of which he cites the linking-up schemes and the Board of Trade Committee on Electricity Supply; he further indicates certain important industrial developments which are taking place, in which the electric furnace plays an essential part, such as the production of steel, at Sheffield, Birmingham, Bradford, Glasgow, &c., of nitric acid from the air by the Kilburn Scott process, and carbide, in Lancashire, of phosphorus, and arcorundum—an abrasive material similar to carborundum—in the Midlands, and other instances could be quoted.

In the Sheffield area, 27 electric steel furnaces, of 27,350 KW. capacity, have been connected up since 1914, and 14 others await connection, Sheffield's annual output of electric steel being approximately at the rate of 100,000 tons at the present time.

The production of nitric acid and carbide, referred to above, is estimated to involve the use of 25,000 KW. ultimately, while over 8,000 KW. is prospectively required in connection with the manufacture of phosphorus.

These may be only indications of a greater development, but one may foresee that future progress along such lines will revolutionise electricity supply in certain areas, at least. While developments of the kind indicated above will necessarily be confined to specific centres of industry, Mr. Long touches on another subject familiar to our readers, which, though offering less spectacular results, opens up a wider field of usefulness to the electrical industry, viz., the supply of electricity in agricultural areas. No one needs to be reminded of the importance of agriculture, to the nation at the present time, or of its deplorable condition in the past, though we are afraid that many electrical engineers do not realise that the obligation rests on them to lift British farming methods to the higher plane required in the future, because other than electricity, there is no single agent which can achieve so much towards this result. Mr. Long refers to the varied uses of electricity in this connection, and to the further more difficult question of supplying large areas, and concludes with a suggestion that each undertaking should investigate the problem and prepare a scheme which could be put into effect after the war is over. Although he discounts the possibility of erecting special plant to supply such areas, nevertheless the practicability of farmers co-operating to meet their own requirements is proved by continental experience.

The address refers to the preliminary step taken by the Board of Trade in appointing a committee to inquire into the question of electrical trade after the war, which, it may be surmised, led to the appointment of the further Committee on Electricity Supply, the terms of reference of which are welcomed as evidence of a new attitude of the Board towards the supply industry. Mr. Long urges the fundamental necessity of reorganisation of the Government control of the industry, together with the granting of additional powers, a view which was concurred in by the Council of the Institution of Electrical Engineers in the second of its recommendations to the Trades Committee, and the Council of the I.M.E.A. has since made specific recommendations on this subject; it being felt that one Government department or board should be specially appointed to deal with all matters affecting the control of municipal undertakings.

The Supply of Electricity Bill, in which additional powers in the matter of wayleaves, lines above ground, joint working and methods of charging are sought by the I.M.E.A., in conjunction with the Association of Electric Power Companies, is referred to, attention being directed more particularly to the joint working of undertakings, and the question of methods of charging, which, in order to avoid legal disputes as to their validity, it is proposed shall be approved by the Board of Trade, though in the event of a special board being created, it is suggested that the latter would be better situated to deal with such legislation as is proposed.

Turning to Mr. Bowden's paper on "Individual Interest in Municipal Enterprise," this will appeal to everyone connected with municipal electricity supply work, and to very many who are not within that charmed circle. It preaches the doctrine of co-partnership, advocating the necessity of riveting the interest of the individual on the business by enabling him to participate in its prosperity, the author remarking that "hitherto individual interest has been centred on outside advancement." He further indicates the results, present and prospective, of the profit-sharing scheme adopted in connection with the Poplar electricity undertaking, which as many readers probably know, has come through the financially difficult war period with flying colours. There are few who will disagree with the principle enunciated by Mr. Bowden, though there are many who will do nothing, because they do not appreciate that there is such a thing as "efficiency" in labour, whether mental or physical.

Mr. Robertson's paper on "Fuel Economy" contains probably the clearest statement yet made on the relative merits of coal and by-product gas for the generation of electricity, and shows, assuming the correctness of his data, that for every 100 tons of coal consumed by direct firing, 155 tons would be required with producer gas-fired boilers; although with by-products at a high price, the latter would still be a profitable procedure, at pre-war prices a financial loss would result. He further estimates that not less than 30 million tons of fuel per annum could be saved on factory and domestic uses alone by the employment of electricity for a large proportion (not the whole) of such uses. Mr. Robertson naturally treats his subject from the central-station standpoint, but we are not quite sure that the economist who realises "the necessity for fully utilising our national resources to meet the economic conditions arising out of the war" will not regard the saving at home of 30 million tons of coal per annum, simply in order that our available export tonnage may be increased—as, for instance, suggested recently by Mr. Fleming, of the Investment Trust Corporation—as merely an alternative method of "squandering our most valuable national asset"; nor that a good case could not be made for diminishing raw coal exports and increasing the export of the much more valuable coal products, in which case the problem of utilising surplus gas would need reconsidering.

[The Presidential Address.]

The following is a short abstract of Mr. Long's presidential address:—

The war has already given a great stimulus to the utilisation of electrical energy in processes which before had been very little developed in this country, among which the following may be mentioned:

Steel Furnaces.—Electric furnaces are now being extensively used in those districts where the manufacture of steel is carried on, and I may quote from some interesting notes given me by Mr. Fedden, of Sheffield:—

"Since the end of 1914, I have connected 27 steel furnaces, ranging in size from 260 kw. to 3,000 kw., making a total of 27,350 kw. Fourteen others are awaiting completion and connection.

"Showing the progress that furnace loads have made since the war, I estimate that by the end of next month (April) there will be at the rate of 85,000 tons of electric steel made per annum from this department's supply, making a total of approximately 100,000 tons per annum made in Sheffield.

"The chief factor in electric furnace development at the commencement of the war was due to the enormous quantity of steel turnings and the numerous other turnings in connection with war material.

"The majority of these turnings contain a good percentage of valuable alloys, and the greater portion of these would have been lost if the turnings had been melted in the ordinary steel furnaces. There is also a difficulty in dealing with these turnings in the ordinary steel furnaces, owing to their lightness and difficulty in handling, which is easily overcome in the electric furnace."

From a steel manufacturer I get this opinion:

"The advantages of making steel by electricity are that you can get a very much better control of the heat than in any other furnace, and that you are enabled to use turnings and other scrap in place of expensive hematite iron for the production of high-class steel."

Steel furnaces have been put down in many parts of the country, as in Birmingham, Bradford, Glasgow, &c., and there can be no doubt that developments will be very considerable in all steel-producing areas, absorbing very large quantities of power.

Air Nitrates.—Another development of very great interest is the establishment in Manchester of a factory for the manufacture of nitric acid from the air, utilising the new Kilburn Scott three-phase furnaces. The first plant to be erected, of an experimental character, will require some 1,000 kw., but if successful, it is expected that this may develop into a very large undertaking, ultimately requiring some 15,000 kw., and it will be a 24-hour day load.

Carbide Factories.—A carbide factory is being established at Manchester, the ultimate demand of which will be of the order of 10,000 kw, mainly of an off-peak character. It is estimated that the consumption will run to from 50 to 60 million units per annum.

Phosphorus.—A factory for the manufacture of phosphorus will be starting at Wolverhampton next year, requiring 4,600 kw., and another 4,000 kw. will in all probability be required.

Arcorundum.—The manufacture of arcorundum has been started in Wolverhampton. This is an abrasive material similar to carborundum made by fusing bauxite in electric furnaces. This is an entirely new industry in this country, and the plant at present consists of one 300-kw. furnace, with another going in shortly.

The above are a few instances of the use of electric furnaces, and there are others that cannot be referred to at present.

Beyond these larger uses of electric energy, it is interesting to note that there has been started in various parts of the kingdom the manufacture of articles that were formerly imported from Austria or Germany.

In a district in the South of England, supplied by a municipal undertaking, works are proposed, or have been started, for the production of substitute for aspirin, emollients, and other fatty medicinal products, phosphorus compounds, coal tar dyes, antiseptic and disinfectant products of the formalin class, plant for acetylene welding, acids, glycerine, &c., each of these requiring from 20 to 300 kw., and in the aggregate estimated to require 5½ million units per annum.

Over and above the development of industries as above, which for the main part concern the larger towns, there is the question of the development of the use of electricity in agricultural areas, which is a matter that concerns small as well as large undertakings.

Electricity, if given full scope, can be of enormous assistance; it is the only means by which power, lighting, heating, and electroculture can all be supplied.

A supply of electricity in villages would add enormously to the amenities of country life, not only in improved lighting, but also in rendering possible the use of the kinematograph; a small matter, perhaps, but not unimportant in view of the strong attractions offered by the towns.

Electroculture is a matter of very great importance. It has shown such results in the experimental stage that there can be no doubt that when it is more fully understood it will be a factor of enormous benefit to the country.

The use of electricity for light railways, for canals, and for charging electric vehicles is also a matter which may become of great importance.

To bring electric power within the reach of all possible users in the country involves an extensive system of overhead wires. This, however, must be a matter of development, the natural course of which would be for lines to radiate out from existing supply stations. It is a matter, therefore, that should appeal to those local authorities owning supply stations, as they, and they alone, can give these facilities.

Setting aside for the moment the questions of obtaining powers and of wayleaves, there is the outlay to be considered. This might be more than a small town could take responsibility for, and means would have to be found for dealing with it. What is wanted now is that each undertaking should investigate this problem, and prepare a scheme which could be put into effect after the war is over. It is most desirable, however, that there should be uniformity as regards system, in view of possible linking up or bulk supply later on.

Board of Trade Committee.—It has been apparent for many years that the conditions under which the supply industry has laboured have been a great hindrance to free development, and efforts have been made from time to time to deal with some of the difficulties.

Many committees have sat and reported, but with little practical effect. Now, however, as a result of the changed attitude towards industry brought about by the war, the Government have realised that something must be done, and a preliminary step in this direction was taken by the appointment by the Board of Trade of a Committee to inquire into the question of electrical trade after the war.

This Committee's report has not yet been published, but as a result in all probability of the recommendations contained in the report, the President of the Board of Trade has appointed a further Committee (on electricity supply), the terms of reference to which are welcome evidence of a new attitude of the Board towards the electric supply industry.

There are innumerable matters on which legislation is required, but the fundamental necessity is the reorganisation of the Government control of the industry, together with the granting of additional powers.

Your Council have, at the request of the Trades Committee, made some specific recommendations, which, however, it is not possible at the present stage to make public.

It has long been felt that the control of municipal undertakings by three departments of the Government, the Board of Trade, the Local Government Board, and the Home Office, is not at all satisfactory, and that the powers exercised by these departments under the Electric Lighting Acts should be conferred on one department or board specially appointed.

This board should be as free as possible from political influence, and should have full powers conferred upon it. It should include among its members engineers of extended experience in electricity undertakings, who should devote their whole time and interest to this business. Its powers should be such as to enable it to deal, without reference to any higher authority, with all matters concerning electricity undertakings, excluding only the owning or operating of such.

Supply of Electricity Bill.—With the further powers that municipal undertakings have been seeking for many years, we are all familiar, but there are some additional powers sought in the Supply of Electricity Bill which has been drafted by representatives of your Council, in conjunction with the Association of Electric Power Companies, to which reference may be made. These are wayleaves, lines above ground, joint working, and methods of charging.

The questions of wayleaves and powers to run overhead lines are recognised as vital to the development and supply of cheap power, and though hitherto of more concern to power companies, they are equally important now to municipal undertakings, in view of linking-up and the supply of rural districts.

Powers for joint working of undertakings, whether municipal or company, are desirable and necessary. The exercise of such powers is, however, another matter, and one fraught with far-reaching effects.

The question of methods of charging is one that needs to be put on a more definite basis. It has been found necessary, in order to extend the use of electricity for all purposes, to differentiate between charges for supplies for light, power, heat, &c., as well as to devise special methods of charging, the validity of which can only be settled in a court of law. This is not satisfactory, and it is proposed that power should be given to the Board of Trade to approve methods of charging whether for energy supplied, stand-by supply, or other services rendered. Such methods would then have legal authority, and opportunities for vexatious litigation would be removed.

For the present nothing further can be done, but the draft Bill was put before the Trades Committee, and has presumably been handed on to the new Committee.

Should the Government create a special board or delegate to a special department of the Board of Trade the powers already outlined, the obvious course would be for such board or department to take over the Bill, amending it as they think fit, and to promote legislation to give it effect; but until it is known what the Government will do, the matter must remain in abeyance.

ANTHRACITE COAL.*

By W. H. BOOTH, F.G.S.

(*Concluded from page* 647.)

Ungraded Anthracite.

Anthracite coal is usually graded to size in round lumps, nuts, beans, &c. In the United States this grading is carried into a larger number of sub-divisions, from round lumps down to so-called "rice," or even smaller particles.

For use in gas producers, particularly in producers of small size, grading is essential for a uniform quality of gas.

Grading is also desirable when anthracite is fed to a furnace by a mechanical stoker. Grading is, indeed, so very usual that many people think it is necessary in all cases, but this is not so.

For the firing of steam boilers anthracite may be employed just as it comes from the mine, except that large lumps of 8 or 10 in. diameter are broken into smaller lumps with a hammer, exactly as are lumps of bituminous coal.

But beyond this reduction of the large pieces anthracite may be, and is, fed directly upon an ordinary grate of long straight bars, and, so fed, can be burned with ordinary chimney draught at the rate of 7 or 8 lb. per hour per sq. ft. of grate surface. The bars are not destroyed at this rate of combustion, and the only precaution taken is to use a small spray of steam in the ashpit, which, as above described, helps to keep the bars cool by the heat absorption that is brought about by the disassociation of the steam at the grate surface, where it makes contact with the hot fuel.

Anthracite thus fired is a self-stoking fuel; that is to say, it must not be touched with a rake or stirred in any way, or it is very liable to be extinguished. In throwing on fresh coal this must be spread over the coal surface, taking care to fill up the slack or hollow places. Thus treated, a fire will burn six hours before it requires to be cleaned. To clean a fire, the front part is pushed back, and the ashes raked out from the bared portion of the grate, and the bar space cleared with a double-toothed pricker bar. The fire is then brought forward, and the back part of the grate similarly cleaned, after which the fire is levelled and re-coaled.

Boilers which were first set to work in 1850 at a well-known distillery—the distillery of Messrs. Watney & Co., Ltd., London—have been fired with run of mine anthracite for the past 50 years, using Thames water, the boilers being made throughout of Lowmoor iron.

The rate of combustion is about 7 lb. per sq. ft. per hour, and though this easy rate moderates the power output of the boilers, it certainly has conduced to an extremely long life of now nearly 70 years with good economy of fuel both in quantity and cost, for the efficiency of the Cornish-type boiler at moderate rates of coal consumption and gentle draught is proverbial. A kiln fire close by these same boilers was at work with the same coal with equally satisfactory results, and it is hardly necessary to say that the chimneys apparently are standing idle, for nothing visible comes from them.

This long experience should suffice to show everyone that anthracite can be used with ease and economy just as it is mined, and in ordinary furnaces with plain, simple bars. The anthracite employed at the above distillery is the "Gwythien Goch," of which an analysis is given below, the method of working is in all ways just that which is followed where bituminous coal is burned, and no greater difficulties are encountered.

So long as the form of furnace is correct, there is nothing to prevent the use of very much larger grate surfaces in modern boilers standing on a ground area no larger than that occupied by a Cornish boiler with its much smaller grate area. Thus from an equal area of ground a very much larger output can be secured than is being secured from these fine old boilers above described.

This, however, is a mere question of design and proportion not difficult to deal with in new installations. But in ordinary manufacturing industries it is far better to avoid the uncomfortable hustle of the electrical generating station, and to provide easily-worked boilers, both for reasons of fuel economy and longevity and freedom from costly repairs.

For the benefit of the critical, who may say that the statements as to the effects of steam are too general, let definite figures be taken to prove them.

Take an ordinary case of a boiler evaporating 10 lb. of water per lb. of coal and turning 5 per cent. of the steam into the ashpit.

One pound of steam contains one-ninth of a pound of hydrogen, the calorific value of which is 62,100 ÷ 9, or 6,900 B.TH.U. This is the heat produced when 1 lb. of water is produced by the combustion of one-ninth of a pound of hydrogen, and conversely it is the heat absorbed or rendered latent when 1 lb. of steam is reduced to its elements, hydrogen and oxygen, when passed through red-hot carbon.

The calorific capacity of the carbon in 1 lb. of anthracite is just about double this figure, or 6,900 × 2 = 13,800 B.TH.U.

Now, if 1 lb. of anthracite evaporates 10 lb. of water in the boiler, and 5 per cent. of the steam is turned into the ashpit—that is to say, one-twentieth, or $\frac{1}{2}$ lb.—the decomposition of this $\frac{1}{2}$ lb. of steam will absorb 3,450 B.TH.U., or 6,900 ÷ 2—that is to say, one-fourth of the heat produced at the grate by 1 lb. of coal.

This is practically equivalent to reducing the temperature of the grate by 25 per cent.; and further, this cooling effect is chiefly operative at the immediate surface of the grate, and is completed on the lower layers of fuel, so that taking an area of fire equal to 1 lb. of coal, the upper part of the area will be hotter than the lower part which touches the grate bars. Obviously the temperature reduction at the grate bar surface will be more than 25 per cent., and the reduction of the upper part of the fire will be less than 25 per cent., and it is just the amount of temperature reduction at the grate surface which is of value. The steam does not, of course, burn as some people imagine; it merely splits up or unburns, and then the two constituent elements re-unite a little later, and so give back the heat they absorbed when split up at the grate surface. In short, heat and temperature have been removed from the grate surface, where they are not wanted, and transferred to the boiler surface where they are wanted. Thus the action of steam resembles the action of the hydrocarbon gases, distilled off bituminous coal. But it is constant with anthracite and intermittent with bituminous coal unless this is continuously fed to the fire, as by a mechanical stoker.

It is not generally known to London steam users that Welsh anthracite can be burned simply as mined, without grading, and that it burns perfectly without special draught. Were it better known, it would undoubtedly be more used, for, as a rule, the steam boilers in the London district are not overworked, and would give all the steam required, at the easy rate of combustion suited to smokeless anthracite.

The following figures of calorific capacity per lb. of fuels may be useful for those wishing to make a few calculations for themselves. The figures given are those determined by Berthelot:—

1 lb.	B.TH.U.	Product.	Weight.
Hydrogen H	62,100	H_2O	9 lb.
Carbon	14,647	CO_2	$3\frac{2}{3}$,,
,, ...	4,415	CO	$2\frac{1}{3}$,,
Carbonic oxide gas CO	4,415	CO_2	$1\frac{4}{7}$,,
Do. per lb. of its content of C ...	10,232	CO_2	$3\frac{2}{3}$,,

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* Memorandum specially prepared for Mr. T. T. Pascoe, of Swansea, to whose courtesy we are indebted for the opportunity to publish it.—Eds. Elec. Rev.

The temperatures of combustion of carbon and hydrogen, when burned with air, are as follows :—

Carbon to CO_2	4,988° F.
,, to CO	2,705° F.
Hydrogen to H_2O	4,554° F.
Carbon monoxide CO to CO_2 ...	3,494° F.

To burn 1 lb. of carbon to CO_2 demands 11½ lb. of air, or, say, 150 cb. ft. These are the minimum theoretical figures. In practice the amount is from 20 to 50 per cent. greater. If more than 50 per cent. excess is used, the practice begins to be rated as faulty.

To light up an anthracite fire, the grate should be covered with paper, and the coal spread over it to the desired thickness. A space about 18 in. diameter should be left near the dead plate, and on this should be started a fire with the usual greasy waste, wooden chips, &c., and coal well piled up in a heap. The furnace door should be left open, and the fire lighted. When it is well alight, it should be kept fed with coal, and will ignite the adjoining coal, and as the fire burns up, the paper will burn and admit air below the coal. But until the coal is alight there will be no loss of draught through the grate.

An ashpit damper may be fitted if desired, and will assist to get the fire well ignited before much air is admitted at the grate. It can be opened as soon as the fire has spread over the whole of the grate surface.

Analyses.

No. 1.—Elsecar Hard Steam Coal, Barnsley.—A Bituminous Coal.

Carbon	79·40	per cent
Hydrogen	4·58	,,
Oxygen and hydrogen	8·20	,,
Ash	3·04	,,
Sulphur...	0·50	,,
Water	4·22	,,

No. 2. -Nixon's Navigation Welsh "Smokeless."—Semi-Bituminous

Carbon	86·48	per cent.
Hydrogen	4·04	,,
Oxygen	3·62	,,
Nitrogen	0·88	,,
Sulphur	0·70	,,
Ash	3·04	,,
Moisture	12·4	,,

No. 3. -Analysis of "Gwythiën Goch" Anthracite.

Carbon	87·72	per cent.
Hydrogen	4·10	,,
Oxygen	3·15	,,
Nitrogen	1·61	,,
Sulphur	0·62	,,
Ash	2·80	,,

No. 4.—Hartley. Durham.—Bituminous Steam Coal.

Carbon	82·47	per cent.
Hydrogen	4·95	,,
Oxygen	6·35	,,
Nitrogen	1·49	,,
Sulphur...	0·89	,,
Ash	1·76	,,
Water	2·06	,,

ELECTRIC STEEL.

At the Spring meeting of the American Electrochemical Society, at Detroit, the first six papers presented during the technical sessions related to electric steel. For abstracts of these we are indebted to *Metallurgical and Chemical Engineering.*

A paper by Dr. John A. Mathews, president of the Halcomb Steel Co., of Syracuse, N.Y., entitled "Comments on the Electric Steel Industry," stated that a duplex process was generally employed, using an open-hearth furnace for preliminary melting and refining, the liquid steel being transferred to the electric furnace for deoxidation, desulphurising, and for making additions or adjustment of the desired analysis, but now the lower cost of wholesale power and increased electrical efficiency made cold melting feasible in many localities.

Most of the recent electric-furnace installations were intended for cold melting. The Halcomb Steel Co. had two such installations in operation, and two under erection, but this was not because of any difficulties with the duplex method, which would certainly be continued. If electric furnaces of large size, say, from 10 tons and upward, were to be a success, it would only be upon the basis of using molten charges. They were not altogether successful as cold melters. The electric furnace had not replaced the crucible furnace or crucible steel; its field had been the production of very high-class steel for special purposes. Simultaneously with the birth of the automobile and aeroplane industries, new requirements for materials of construction came into being, and it was in meeting these requirements that the electric furnace found its best and greatest application. To these, of late, had been added the requirements for munitions of war.

The reasons why the electric furnace with proper handling produced a superior product for the most severe requirements of automobile, aeroplane, and munition manufacture were as follows :—

1. Experience shows that the chemical composition of consecutive heats can be held more closely to a standard than with any other process. This is most noticeable when handling easily oxidisable metals like vanadium, chromium, silicon, and manganese.

2. From the above it is apparent that less of these metals will have to be added to ensure a given final minimum, hence there will be less of the oxides of these metals produced in the steel and to be removed from the steel.

3. The more nearly composition can be controlled, the more certain are likely to be the results of subsequent heat treatments.

4. Electric steel is usually chemically purer than any other steel. Sulphur, especially, is readily removed. . . . If segregation of sulphur and phosphorus are not to be feared, the percentage of cropping may be reduced and the yield of sound metal increased—a step in the direction of economy and conservation.

5. Low sulphur in electric steel usually means a prior reducing condition favourable to complete deoxidation. This condition is favourable to sound ingots, freedom from blowholes and seams produced from them. Quiet metal has less tendency to segregate in the mould, as to either metallic or non-metallic elements, and produces steel free from "ghost" lines or laminations.

6. Alloy additions may be made in the furnace itself rather than in the ladle, which increases the chance of thorough assimilation, diffusion, and homogeneity.

7. From a combination of the above reasons, it unquestionably results that electric steel is less easily injured by overheating than is the case with other steel. It will stand more heat in the forging or heat treatment without injury; that is, it has a wider safe heat range. This opinion has the weight of both experimental evidence and practical experience in the hands of competent observers among users.

8. Electric steels are usually freer from slag and non-metallic inclusions than are Bessemer and open-hearth steels.

9. All of the above characteristics make for quality, when quality is the first consideration. The electric furnace possesses an economic value in its adaptability for handling and recovering alloy scrap values. Some alloy scraps do not make desirable additions to open-hearth furnaces or, if made, a large share of the alloy metal is lost in the slag. With the widespread and increasing use of alloy steels it is highly desirable that alloying elements be not lost when contained in the scrap.

These advantages and others follow because, as Siemens observed, "the fusion is effected in a perfectly neutral atmosphere," and because a number of distinguished engineers and inventors produced commercial, workable furnaces in which these results could be attained on a large scale.

Electric furnaces, like automobiles and aeroplanes, are of little use without skilled operators. They are not automatic devices which run themselves. Carelessness in their operation will lead to disastrous results. They are not nearly as foolproof as crucible furnaces, which require considerable skill, but of a different order from that required for electric melting, assuming that steel of equal quality is to be produced by either process. . . .

"The United States has taken the lead in electric-furnace development, after a very slow start in which we seemed to be lagging behind some of the European countries. In our own plant we have grown from 500 k.v.a. to 5,500 k.v.a. of installed capacity for electric melting, while in the U.S.A. there is no less than 150,000 k.v.a. in operation or just being installed. The annual tonnage capacity of the furnaces using this current I estimate to be about 1,250,000 gross tons of ingots and castings. It is impossible to figure this exactly, because some furnaces may operate on either refining or cold melting charges, and, of course, the output is much greater when the former method is used. This infant industry already represents an output about eight times as great as the crucible-steel production, and one-eighth that of Bessemer production. These two processes are not declining, but are more or less stationary, with wide annual fluctuations."

In the discussion, Mr. Turnbull said that in Canada the electric furnace could operate 15 or 18 dollars more cheaply than the acid open-hearth under present conditions, and for some years to come.

Dr. Lindsay referred to the largest cold-charge electric steel plant now in course of construction by the Canadian Government at Toronto, where 10 Heroult furnaces of six tons each will be employed for cold melting for the production of shell steel.

Dr. Richards referred to the still more ambitious project of the U.S. Steel Corporation for the South Chicago plant. This will not be, however, for cold melting. It will comprise Bessemer converters, two 250-ton open-hearth furnaces, and 10 electric furnaces of 30 tons' capacity each. The steel will be transferred from the Bessemer converters to the open hearths (serving as reservoirs), and finally to the electric furnaces. The total capacity of this triplex process will be 50,000 tons of steel per month.

Mr. R. F. Flinterman, president of the Michigan Steel Castings Co., Detroit, Mich., presented a paper on "The Electric Furnace in the Steel Casting Plant."

Under the term "small steel castings" are included castings used for the most part for automobile trucks, tractors, light machinery parts, and for other purposes, where the size and shape of the part, its lightness of section or difficulty of production preclude its being made practically in open-hearth foundries. In the latter, the work is largely a tonnage proposition. The work is much heavier, and on the whole simpler, and the methods used cannot be applied successfully to the manufacture of lighter and more intricate castings.

The castings the author's plant has been manufacturing run from ½ lb. up to 250 or 300 lb. They make some pieces running up to 2,000 lb., but the average weight is about 20 lb.

Before installing the electric furnace they employed the crucible furnace. This was followed by the side-blown Tropenas converter, but their third and "very likely final choice" was the electric furnace. The Heroult type was decided on, and the first furnace of six-ton capacity was installed in November, 1915. The second furnace of three-ton capacity was ready to run February 12th, 1916. Both furnaces have been running continuously since their installation, and the converters have been discarded.

It required several months to adapt the electric furnaces to shop conditions. This has, however, long since been accomplished, and the furnaces have come up to expectations most completely. As regards the quality, there is no question of the superiority of the electric steel over converter metals. This applies to both acid and basic electric steel.

"It is only natural that this should be so if you compare the two methods. In the converter at the end of the blow there is a mass of metal at a high temperature, covered by a highly oxidised slag, and the metal itself undoubtedly contains oxides. The addition of ferro-silicon and ferro-manganese at this point deoxidises the metal more or less completely, but the metal is still in contact with a slag carrying a high percentage of iron oxides, &c.

"In the electric furnace the covering slag is completely deoxidised before ferro-silicon and ferro-manganese final additions are made. The metal is constantly giving up oxides to the slag during the deoxidising period, and is practically free from oxides before the final deoxidisers are added.

"In our opinion, it is the more complete absence of oxides in the electric steel which accounts for the superiority of this steel over converter steel. The results obtained on physical tests are universally better."

These results could be consistently obtained from every heat, which they were never able to do in converter practice. The superiority of the electric steel was also manifested in the case of long, thin-section castings, such as cross-members on engine supports. The loss due to shrink tears was much reduced with electric steel. On one particular pattern they made 100 castings from electric steel, and found no shrink tears whatever. With exactly the same practice and pattern they found that 90 out of 100 castings made from converter steel had slight tears or cracks, which had to be welded in order to save the castings. This particular casting was very difficult to make, and was perhaps an extreme case, but the test made brought out this difference in behaviour most vividly.

The reason for this behaviour is due to two facts:—

1. The lower sulphur content of electric steel.

2. The absence of impurities, particularly of oxides. This resulted in much greater strength at high temperature, and this greater strength was able to resist the pull exerted on the steel during that period, when the castings were shrinking or shortening. This behaviour of electric steel was true with both acid and basic steel, particularly with the latter, when a lower sulphur could be maintained.

The high quality of the electric steel was the one essential point which induced them to abandon the converter process in favour of the electric furnace. The hopes in this regard had been most fully realised. The time seemed now at hand when this fact would be fully realised by the trade at large, as was evidenced by the increasing demand for electric steel. Since writing the paper he had received a contract specifying particularly that electric steel must be used.

It was particularly pleasing to have the high quality steel without any increase in cost. Under present market conditions, with low-phosphorus pig iron selling at an exorbitant price, the electric steel could be produced at much lower cost than converter steel. "As our practice improves we feel confident that we can compete with converter steel, even under normal market conditions."

At the present time they were using acid linings and bottoms entirely. The reason for abandoning the basic process was the prohibitive price of magnesite. They had not been able to secure a large supply, since the dealers were loath to take on new customers, and they were finally obliged to resort to acid practice.

One great difficulty with the basic process was the slag. In spite of all precautions, there was much more trouble from slag in the castings than they had ever had from converter steel. With exactly the same methods, this slag trouble disappeared with the change to acid steel. This was due to the greater refractoriness or higher melting point of the siliceous slag, which brought about a more complete separation of the slag from the metal.

An ideal arrangement for a steel foundry would be to use a "reversed duplexing process," as it were. Part of the metal should be melted in a basic furnace, where the metal would be refined and sulphur and phosphorus eliminated in the usual way. The stock used in this furnace should be of a much cheaper grade, and would more than offset the increased cost of re-handling the refined metal through the acid furnace as the next step in the operation.

In the meantime, the acid furnace would be working on a partial charge of steel, to which when molten would be added the refined metal from the basic furnace. The final deoxidation under an acid slag could then be completed and metal withdrawn in the same manner as was done now. The ultimate output of the battery of furnaces would be the same in any given period as though the furnaces were all running either basic or acid independently, and this method of "reversed duplexing" would have several distinct advantages for the producer of steel castings.

One other advantage of the electric furnace was its great usefulness in making any of the alloys. This had been demonstrated by the constantly increasing adoption of the electric furnace by tool steel producers and other makers of special steel. The author's experience in making alloys in the converter process was most unsatisfactory, since they were unable to obtain consistent results. With the electric steel the results had been very gratifying. They had been able to obtain any desired analysis regularly, and, in consequence, the subsequent heat treatments had given them the high physical qualities which they were after. This opened up a large new field for the maker of small castings, since there was a large demand for alloy castings for certain purposes, where lightness and great strength and thoroughness were necessary.

To make a superior casting, the electric furnace metal must have a perfect mould, prepared with every possible care and attention to detail, properly gated, properly fed, and properly vented. When such a happy combination had been properly brought about, the resultant casting would be superior, and in this manner only, and by no other methods, could they derive the full benefit of the wonderful quality possessed by electric steel.

In the discussion, Dr. Richards said he had sent out an inquiry to 40 or 50 practical steel men as to how it was possible to get better and more reliable steel castings, and the recommendation made in 19 out of 20 answers had been to specify electric-furnace steel castings. This was significant.

A paper, entitled "Notes on Electric Steel Melting," by J. L. Dixon, of the John A. Crowley Co. (owners of the American patent rights of the Groenwall-Dixon furnace), first dealt with mechanical and electrical considerations of furnace design.

Mechanically, great strength is required. Especially the moving parts of the furnace mechanism, such as the tilting gear and the electrode-raising gears, should be of rugged design so as to withstand the rough usage they would receive in the average foundry. These gears must be fully protected from any accidental breakout or overflow of liquid metal. Any improvements in this direction would immediately show almost unexpected benefits, owing to the fact that the furnace operators were relieved of an unnecessary anxiety.

Another essential, perhaps the most important, was to avoid too great intricacy. This remark applied especially to the parts comprising the electrode contacts and supporting devices.

In designing a very large electric furnace requiring a large number of electrodes, the difficulties might be overcome by suspending the electrodes from an overhead device quite independent of the shell of the furnace. This would certainly be the most convenient arrangement if the furnace was not tilting, but of the stationary type, as was quite probable with the very large furnaces that would come in the future.

In a well-designed furnace the power factor should be 90 per cent. or more. The power factor was improved by (1) an increased number of electrodes, more especially if they were all of different polarities; (2) a higher voltage on the electrodes.

With respect to current fluctuations or overloads, again an increased number of electrodes was beneficial, owing to the spreading and averaging effect. This question of current fluctuations and disturbances was often a very serious one, more especially with furnaces connected to small power stations, and some radically new design in automatic controlling apparatus was necessary.

"Take, for example, the case of a three-phase furnace with three upper electrodes. When there is an overload on one of the electrodes, either one or both of the remaining electrodes are also overloaded, even though at that moment they are correctly located relative to the bath of metal. But the fact that they are correctly located is not observed by the automatic controlling apparatus, which, acting under the impulse of the increased current, raises these electrodes, so that when the offending electrode is brought to its correct position the unoffending electrodes are carrying currents that are too small. In this way, a more or less continuous hunting is set up, and partly on account of this the automatic controlling apparatus has to be 'damped,' which lessens its sensitiveness and ability to deal quickly with any real trouble that may occur."

Furnaces with a bottom electrode were more easily controlled than those without.

The author then took up thermal considerations, and advocated the highest possible voltage for melting down the charge. Obviously, the higher the voltage the smaller might be the electrodes, and the higher would be the power factor. With furnaces of 10 tons' capacity and upward, a voltage higher than usual had been found to be absolutely essential, but even in smaller furnaces there were advantages in this respect not directly attributable to the smaller resistance or induction losses.

For the furnace bottom, the writer had always obtained good results from either magnesite or dolomite tamped in with tar.

The walls and roof receive their greatest punishment at the end of a heat. This, no doubt, was largely due to the reflecting power of the white slag. In addition to this, however, the writer was inclined to believe that there was some chemical influence very active at that time.

Mr. Turnbull said that contact devices had always been made of copper, but lately cast-steel holders had been introduced, and cast-iron roof cooling rings had been in use for over a year; he recommended their use, at least for ·25 cycles.

Mr. Stone said the central station's chief objection to electric furnaces was that in view of their large size, compared with motors, it was necessary to isolate an electric furnace installation completely from the rest of the system, beginning at the power plant. This was necessary with motors only in exceptional cases for large capacities. Equalising the load as much as possible over 24 hours would be an advantage to the central station, and would reduce the cost of power.

A paper by C. A. Buck, of the Bethlehem Steel Co., described the 10-ton Girod furnace now in operation at the Bethlehem Steel Co.'s plant in South Bethlehem, Pa. This furnace made its first heat May 16th, 1916, and to February 23rd, 247 heats had been made; the quality of steel produced had been gradually improved.

(*To be concluded.*)

Incandescent Lamp Sales in the United States.—According to the *Electrical World*, the sales of Mazda incandescent lamps in the United States in 1916 increased by 31 per cent. over the previous year, reaching a total of 145 millions. In addition, over nine millions were exported, making a total of 154 millions, compared with 116 millions in 1915. Of these, 129 millions were tungsten filament and 25 millions carbon and graphitised-filament lamps, the latter showing an increase of one million. The 40-watt tungsten lamp was in greatest demand, the 25-watt size coming second, and the 60-watt size third. The sales of 50-watt lamps are rapidly increasing. About nine million gas-filled lamps were sold in 1916, compared with three millions in 1915, nearly half being 100-watt lamps.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Truck-Type Switchboard.

From a perusal of the annual reports of the Electrical Inspector of Factories, it is evident that a large proportion of the electrical accidents come under the heading, "Cleaning, repairing, &c., at live switchboards or other live conductors."

The total number of accidents under this head reported during the four years 1911-14 inclusive was 157, whereas the *total* electrical accidents for the crresponding period was 341. It is therefore not surprising that the "Safety First" campaign should be extended to electrical switchgear, and numerous designs have recently been introduced to make switchgear dead for cleaning and repairs, one of the most important being the truck-type switchboard for high-pressure supplies.

Messrs. Ferguson, Pailin & Co., Ltd., of Higher Openshaw, Manchester, have recently introduced a switchboard of this class which has several unique features. The main idea has been to make the switchboard absolutely fool proof, and to render it impossible for anyone to touch live gear.

The truck cannot be withdrawn until the oil switch is "off," neither can the truck be replaced with the oil switch "on"; when the truck is withdrawn, shutters automatically close over the holes through which the plugs have passed, so that the whole of the live metalwork is protected, and as the carriage is wheeled in, the shutters are automatically raised to allow the plug insulators to pass. This is a most important feature, as the switchboard can be left with any of the trucks withdrawn and no high-tension metal exposed.

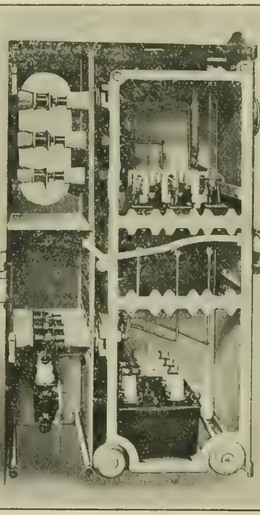


Fig. 1.—Truck-type Switchboard with Side Removed.

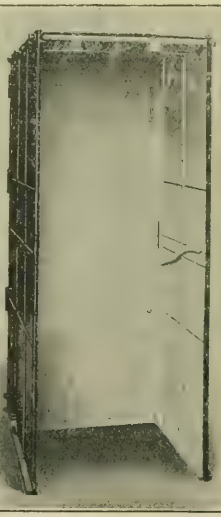


Fig. 2.—Cell with Truck Withdrawn.

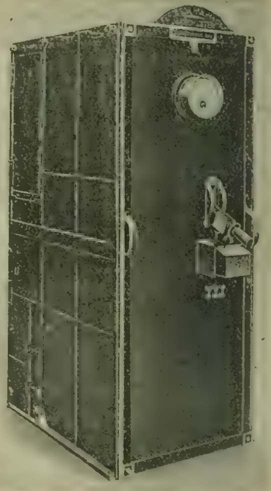


Fig. 3.—Exterior of Complete Cell Unit.

The plug contacts are self-aligning, the plugs being circular in section and having a free movement in both directions, so that they can adjust themselves to make perfect contact in the sockets, even though the carriage may be slightly out of alignment. Prrctically no movement is required, as the runways for the carriage are part of the side frames and are not dependent on the station floor, which may be uneven.

The carriage wheels are fitted with roller bearings, so as to provide ease of movement.

The oil switch has a heavy breaking capacity, and is provided with separate tanks for each phase. The switch used has been standardised by two large electric supply authorities, each of which has generating plant exceeding 50,000 kw.

The structure may be erected against the wall, so as to economise in space, and the design allows of easy extension, and any number of panels may be added from time to time. Switchboards of this class are at present being built for two separate Government Departments.

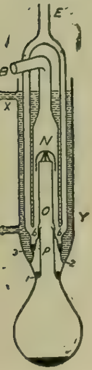
High-Vacuum Mercury-Vapour Pump.

The diffusion pump of Gaede has stimulated a number of new designs of high-vacuum pumps. In the *Physical Review*, Mr. C. T. Knipp describes a design made wholly of glass as an improved high-vacuum high-speed mercury-vapour pump (fig. 4). The bulb to be exhausted and trap are fused to B, while the tube E is attached to the supporting or rough pump. The mercury vapour rising from the lower bulb, which is heated in a sand or heavy oil bath, streams up through the short tubes P and O, and is deflected downward through an annular throat by an umbrella N. The issuing mercury vapour at once condenses on the water-cooled surface of the enveloping tube, and the gas that comes from B is forced mechanically downward from the lower edge of N along the cooled surface of the condensing chamber. This accumulated gas is removed through the lateral tubes *b b*, which unite at the top and form the exhaust tube E, all being enveloped by the water jacket X Y, as shown in the figure. This construction keeps the mercury, which collects at the ring-seal 3, cool, and thus removes the objection that mercury vapour having an upward velocity would enter the annular condensing chamber. A small opening shown at 3 serves as a valve, which allows the accumulated mercury to pass, yet, owing to the surface tension, maintains a perfect seal. The short tube P is inserted to shield the hot mercury vapour streaming up from the boiler from condensing on the surfaces at 3. The upper end of P telescopes loosely into the lower end of O, while the lower end is secured by the ring-seal 1, having also a small valve opening in it, through which the mercury passes back into the boiler. By making the upper end of P conical, condensed mercury vapour is caught in the annular space formed, and automatically seals the space P O from the cavity just outside of P. The cold mercury collected at the ring-seal 3, and the adjacent water jacket, thus have but little opportunity of cooling the hot stream of mercury vapour passing up through P O, and, furthermore, the temperature gradients between the ring seals 1 and 2, and 3, and *b b* are not abrupt; hence there is no danger of the glass cracking. This construction very much simplifies the glass-blowing, since the tube throughout the process is kept perfectly symmetrical.—*Electrical World.*

"Selco" Electric Sirens.

Those of our readers who live or work within the active radius of the "Taube" will fully appreciate the urgent necessity for adequate public warning of the coming of these aerial raiders, whose daylight visits depend so largely on the element of surprise.

For such a warning we know of no more effective instrument than the electric siren, which can be installed on any high building and controlled either by hand, on the spot, or electrically, from a distance, with equal facility. It would give an outside warning, which would be immensely more effective in saving life in the street than any private intimation.



IG. 4.—High-Vacuum Pump.

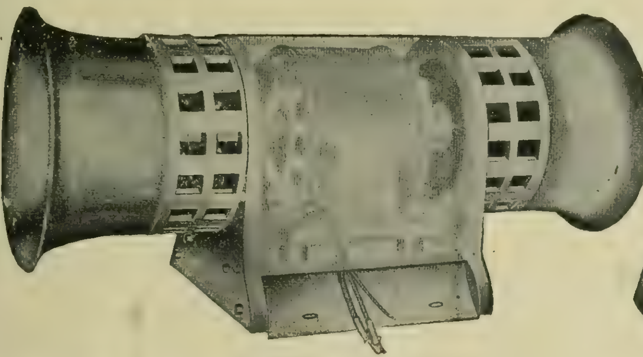


Fig. 5.—Two-mile Radius Electric Siren.

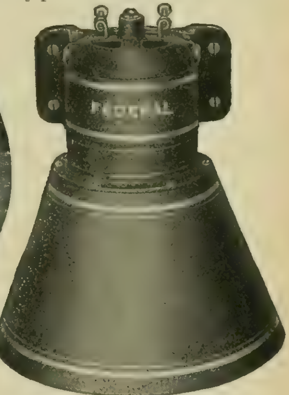


Fig. 6. Electric Siren for Factory Use

A typical siren of the type referred to is shown in fig. 5, which has a sound radius of two miles, is 52 in. long, 30 in. in depth, and weighs 350 lb. Switched on and off at five seconds' interval, it gives a distinctive note. This type is, we understand, already in use in some Government industrial establishments at home, and as even larger sizes are made, there should be no difficulty in dealing with comparatively large areas.

Smaller sirens of a similar type are supplied for both interior and exterior use, one of the latter type, which has been adopted for factory, mining, and similar purposes, is shown in fig. 6.

These sirens are constructed for standard pressures from 100 to 250 volts, direct or alternating current, in the latter case of from 50 to 60 cycles, but can be specially made to suit other conditions, and are supplied by Messrs. S. G. Leach & Co., Ltd., of 26-30, Artillery Lane, E.C.

Saving Coal in France.—The French Government has issued a decree prohibiting the use of gas from 8.30 am. to 12.30 p.m., from 2 to 5.30 in the afternoon, and from 9 at night until 4.30 in the morning. Electrical engineers are instructed, says Reuter, to endeavour to find means of substituting electrical energy for steam engines in factories—surely not a difficult problem nowadays!

The Magnetic Elements.—The report of the Astronomer Royal states that the mean values of the magnetic elements for 1916 were:—Declination, 14° 46·9′ W; horizontal force, 0·18494 C.G.S. units; dip, 66° 52′ 45″. The declination is decreasing at the rate of about 10 minutes a year, and the H.F. by 0·00014, while the dip is increasing.

WAR ITEMS.

Exports to China.—The "London Gazette" for June 15th contains a further list of persons and bodies in China and Siam to whom exports may be consigned.

Reconstruction in Invaded France.—The French Minister of the Interior has established a Committee—the "Commission Consultative des Marchés et des Stocks"—to study the question of purchase of materials for reconstruction work in the invaded districts of France.—*Board of Trade Journal.*

The Fruits of Barbarism.—The "Sheffield Daily Telegraph" is circulating "Scraps of Paper," setting forth a "Solemn Oath," the swearer of which declares beneath the grouped flags of all the Allies that he will not (1) knowingly purchase anything made in Germany, or (2) transact business with or through a German for ten years after Peace is declared. The oath is to be translated into the languages of Allied nations for circulation among them, and the Chambers of Commerce are to be asked to distribute the forms.

The I.E.E. and the U.S.A.—The Institution of Electrical Engineers has received the following cablegram from the American Institute of Electrical Engineers in response to a message expressing the Institution's appreciation of the American nation's entry into the war:—

"To Institution of Electrical Engineers, 1, Albemarle Street, London.—The American Institute of Electrical Engineers duly appreciates your message. We hope that the electrical engineers of Great Britain and of America working together in close co-operation can bring to a satisfactory conclusion the many electrical problems of the war.—American Institute of Electrical Engineers."

Banks and Industry in Germany.—The "Berliner Tageblatt," reviewing a recent financial publication, calls attention to the constant development of the system by which German bank directors accumulate directorships of the concerns in which their banks are interested, and the large number of directorships held by prominent industrialists. The number of directorships held by Herr Louis Hagen, of Cologne, is 56; by Herr Karl Fürstenberg, of Berlin, 55; by Herr von Schwabach, of Bleichröders, the former British Consul-General in Berlin, 42; by Herr Robert von Mendelssohn, Herr Franz von Mendelssohn, and Baron Simon von Oppenheim, 40 apiece; and a large number of industrialists and bankers hold between 30 and 40 directorships apiece.—*The Times.*

A Disabled Soldier's Pension.—The Mytholmroyd (Yorkshire) Local Distress Committee have inquired of the Minister of Pensions as to the somewhat strange action of the National Pensions Authority in intimating that they contemplate reducing the pension of Private Smith, a local discharged soldier, by 2s. 9d. per week, as they have discovered that Smith, who lost his right arm in the war, was a left-handed man. It is stated that Private Smith received a course of instruction in electrical work at Battersea Polytechnic after his discharge, and that, as a result, a post had been found for him at Rhondda. We are not familiar with the details of the case, but we hope they will be fully investigated. The last thing in the world that the nation will approve is ungenerous treatment of those who have suffered serious disability through fighting at the Front.

The Ministry of Munitions and the A.S.E.—The Minister of Munitions (Dr. Addison) addressed an important meeting of A.S.E. delegates from all parts of the country (250 in number) at Westminster, on June 13th, respecting the amendments which it was proposed to make in the Munitions of War Bill. He dealt emphatically with the extreme urgency of the need for war munitions of all kinds with which the engineering workers are concerned, shipbuilding, &c., and explained the position of the dilution question. The right to strike was recognised, and the right to continue dilution, where it had occurred on commercial work during the war, would cease on the termination of the war. Wages awards which were binding upon a firm employing a majority of workers in any trade or branch of a trade, could by the power of the Ministry, be made binding not only on them, but on the other employés engaged on or in connection with munitions work. It was also proposed to abolish the leaving certificate system altogether. We refer our readers to the *Times* for June 14th for a full report of these important proceedings, the exact details of the changes will no doubt come before the House of Commons shortly.

Marylebone Electricity Staff.—Marylebone B.C. Electricity Committee reports that as the new schedule of protection to workmen issued by the Ministry of Munitions only referred to undertakings certified by the Ministry as engaged or war work, application was made for the undertaking to be certified under the Munitions of War (Amendment) Act, 1916, in order that the employés may receive exemption from being called for military service.

To be Wound Up.—Among the companies appearing in this week's list of concerns to be wound up under the Trading with the Enemy Act, is the following:—

Seitz Works, 39 and 40, Trinity Square, London, E.C., and their agents, Kahn & Rothbarth, of the same address, who are also agents of other German manufacturers (gymnastic and electrical apparatus). Controller: R. E. Smith, 53, New Broad Street, E.C.

Westinghouse Wages.—About 500 members of the clerical staff, both male and female, of the British Westinghouse Manufacturing Co., Ltd., Trafford Park, benefit by an award made by Mr. Vesey Knox, K.C., on behalf of the Chief Industrial Commissioner. The award gives males and females over 30 years of age a war bonus of not less than 8s. a week, the minimum wage for women members over 20 years of age to be not less than 21s. a week, and clerks under 30, both male and female, are to receive bonuses according to their length of service. No bonus will be paid to those engaged during the present year, and the award only applies to employés receiving less than £3 a week. It takes effect from April 17th.

Men in Protected Trades and Tribunal Exemptions.—At Southwark Tribunal, the Town Clerk reported that he had written to the Local Government Board with reference to the position of men granted certificates under the schedule of the protected trades who also held exemption certificates from the Tribunal. The point was whether in the event of the Tribunal withdrawing their certificates the men or their employers would have the right to a further appeal to the Tribunal should the trade protection certificate be withdrawn, as it might be at any moment by a recruiting officer. The Board had replied that a certificate granted a man under the schedule of the protected trades was not a certificate of exemption under the Military Service Act. A man holding such a certificate was entitled to hold any other valid exemption certificate so long as it continued in force. The Military Representative said there was a possibility of the men lending one of their certificates if they held two, one from the Tribunal and the other under the protected trades schedule. The Tribunal decided to adjourn all appeals from men and their employers who held certificates under the schedule of the protected trades until the latter were withdrawn, thus reserving their rights to an appeal to the Tribunal at any future date.

At Bermondsey, Ald. Wills proposed that all the appeals for exemption on behalf of men holding the trade protection certificates should be adjourned, and that the Town Clerk write to the Local Government Board for their instructions. He pointed out that if the trade certificate was withdrawn, and the Tribunal now withdrew their certificates, neither the men nor their employers had the right to any further appeal to the Tribunal, though they might be engaged on work of national importance which was not Government work. The Military Representative acknowledged that if the trade protection cards were withdrawn neither employer nor employé would have any further right to an appeal at the Tribunal on business grounds, and he doubted if the men would have the right to an appeal on domestic grounds. The Tribunal agreed to adjourn these cases pending the reply from the Local Government Board.

Credit After the War: The British Trade Corporation.—In the House of Commons, last week, the President of the Board of Trade, Sir Albert Stanley, referred to the criticisms that had been directed to the proposal to grant a charter to the above Corporation. He said he desired to make it clear to those engaged in trade and industry exactly what they were entitled to expect from the Corporation. The outstanding objection raised was that the Board of Trade was setting up a great trading corporation which would operate in opposition to existing businesses, whereas, as a matter of fact, it was a corporation to give financial assistance to the trade and industry of the country. In regard to the clause which provided for payment of a certain proportion of the profits to the directors, a White Paper had been issued containing a declaration putting the Corporation under an obligation to give financial assistance to British traders and manufacturers, and not to enter into competition with British traders, merchants, and manufacturers. The clause respecting directors' share of profits would only operate when shareholders had approved of it in general meeting. If the Corporation failed to observe the conditions imposed upon it by the White Paper declaration, it would place the charter in jeopardy and render it liable to revocation. Sir Albert said he hoped that all were agreed as to the imperative necessity for some such institution in this country. The necessity for it had been constantly brought before the Board of Trade, not only since the war, but before it. Members of the House were probably well aware of what Germany and other countries were doing to meet trade conditions after the war. There would be an entirely altered state of circumstances when the war came to an end, and we were bound to recognise the facts and take whatever steps we could to help those who were in British trade and industry in order that they might meet their foreign competitors on equal terms. Joint stock banks here had not in the past done a great deal to help British traders, because they were obliged to keep their capital liquid so as to be able at any time to redeem their note circulation. They were not setting up a British trade bank, but a British Trade Corporation. There was no subsidy attached to it, and no agreement of any kind whatever, but it had been put under an obligation to come to the assistance of those who were engaged in trade and industry in this country. He suggested a Corporation because he did not want it to be imagined that they were setting up an ordinary bank, but an organisation which would do business on different lines from the ordinary joint-stock bank. The Charter did not confer a monopoly. The Corporation was not a privileged body sheltering under the Government's wing, but an institution devised to work in a fair field open to all for the benefit of the great trading and manufacturing interests of the country. He hoped after his explanations that all hostility would be removed, and that the Corporation would be able to start on its career with the goodwill and encouragement of the House.

There was some further discussion on the matter in the House, and, in reply thereto, Mr. Bonar Law (Chancellor of the Exchequer) said, among other things, that when the war was over the one thing that would be needed most would be credit, without which it was certain that trade and industry would become paralysed and there would be an enormous amount of unemployment and distress in this country. If this were a case of raising £10,000,000 even on the ordinary lines of a joint stock bank to give greater facilities he would have said it was a good thing for the country, and he would have been glad to see the charter given. If any group equally reputable came to him working on precisely the same lines, and for the same purpose, he would give it the facilities so far as he was concerned. If a charter was an advantage it was also a disadvantage, and if the body were formed under the Companies Acts it would be free from many of the obligations which were imposed upon it by its charter. He was certain they did not give any preference to this company over existing bodies which were prepared to do the same kind of work, but the charter was a mark of the goodwill of the Government. There could be no question that German banks gave greater facilities to traders than were granted by similar institutions in this country. It was no uncommon thing to find German banks giving credit for six, nine, and ten years. Where could traders get anything like that credit in this country? The Corporation had been formed for the purpose of giving help of this kind. The Government was not giving any monopoly to the Corporation. They were quite ready to give the same privileges to any similar body of men who would undertake to do the same kind of work. The problems which would face the Government when the war came to an end would be more difficult even than the carrying on of the war, and he thought the House of Commons would do wrong to reject the first serious effort made in the direction of reconstruction after the war.

Exemption Applications.—At Hebden Bridge, the Clerk to the Council applied for H. Poole (20), single, assistant at the electricity works, who had been granted exemption on January 18th, 1916. The Advisory Committee had agreed to let the oldest assistant remain, but they wanted some contribution from the electricity department. If Poole were taken the department would be left with only one cable jointer, who was the station superintendent. The Military representative said if the Hebden Bridge electricity department was so dependent on a man of that age they must be in a bad way. Exemption to September 1st was granted, but the department was strongly recommended to arrange for Poole's release.

At the Lonsdale Appeals Tribunal, at Lancaster, the Military appealed against decisions of the Morecambe Tribunal. The Town Clerk asked for the retention of Mr. Annetts, chief electrical engineer to the Morecambe Corporation, who is aged 36 years, and his assistant, Mr. A. Darnborough, aged 32. Morecambe Tribunal had given them conditional exemption. The Military appeals were dismissed, the exemptions to continue.

Oxford Tribunal heard a claim for extended exemption filed by H. G. Watson (29), electrical engineer and fitter. The case had been put back for inquiries from the Dilution Officer, as stated here last week, and a certificate was produced from the recruiting office, munitions area, stating that appellant was not eligible for military service until he was sent a calling-up notice bearing the stamp of the Munitions Area Recruiting Office. The case was dismissed.

Before the Hants Tribunal, an appeal for further exemption was made by Mr. J. J. Virtue, electrical engineer, of Aldershot. He claimed that he had to maintain a large number of engines used by various firms for industrial purposes, and that without his assistance they could not keep the machines running, there being no one else in the town to take his place. The Local Tribunal stated that he had a partner (Mr. Burch) who could carry on the business, but that partner had been enrolled on the electricity staff of the Aldershot Command, leaving him to entirely control the business, which was now a one-man concern. He explained that Mr. Burch had attended to all the work at the camp, and recently he and certain workmen were taken over by Captain Mayne. The Tribunal allowed two months, with leave to apply again.

An appeal made for the retention of R. A. Pride (40), who is in charge of the electric light plant at Shiplake Court, Henley-on-Thames, has been dismissed, with a month's grace, by the County Tribunal.

At Burnley Tribunal, Mr. Mozley, tramways manager, appealed for a senior conductor and checker on the local tramways, aged 39, married, and C 2. He also applied for a cashier, 20, single, and C 1. He said they were in a helpless position in the general office. It was becoming serious in delaying the accounts. They could not get out the annual accounts; they were already a month late. The case of the conductor was adjourned for a fortnight in order that the man might be re-examined, and the cashier was given until the end of July.

An appeal was made at Southend by the Corporation for the retention of a mechanic and linesman engaged at the electricity works. The man has a certificate granted by the Munition Area Dilution Officer, and Mr. O. N. Howard (Military Representative) said he should take further steps in the case. On his suggestion, the case was struck out.

On the appeal of the Corporation, Gillingham (Kent) Tribunal has granted exemption, pending substitution, to G. Sullivan (39, Class C 2), stoker at the electricity works. Mr. A. D. Chalmers, borough electrical engineer, said that, despite all his efforts, he had failed to get a substitute.

A Whitehaven electrical engineer appealed for an electrician, aged 35, the only qualified man left in the business, and whose departure would mean the closing of the business. The Tribunal allowed a month with a view to the man taking up work of national importance.

At Ryde (Isle of Wight), P. Churchill, of the electric light works staff, stated that he had been called up, although the Tribunal had given him provisional exemption. He was informed that all such exemptions had been withdrawn, and that he had the right to appeal to the Tribunal.

A Military appeal was made at Colchester against conditional exemption held by F. E. Rodwell (32, Class A), a stoker at the Corporation electricity works. Mr. W. Frisby, electrical engineer, said that Rodwell was sent to the works by the Tribunal. The exemption was cancelled.

At Aldershot, on June 12th, an appeal was made by A. F. Edwards (33, Class A), electrical wireman, employed since July, 1915, at the central power station. He complained that he had been discharged, having been released by a War Office order, whilst single young men had been taken on from a private firm. The Clerk said that applicant was actually in an exempted trade. This, and a similar appeal by another wireman, were put back for a month for the Military Representative to bring the matter to the notice of the Aldershot Command.

At Eastbourne, a review was made of the certificates of 12 men at the Corporation electricity works, seven being in Class A 1, three in B 2, and two in C 1. The Electricity Committee asked to retain the men as being in reserved occupations, and on the ground that the staff had been reduced to the lowest limit, and that the men, by their work, helped munition work, and provided light for military hospitals, &c. An application had been made to the Ministry of Munitions to have the works certified. The electrical engineer (Mr. J. K. Brydges) said that if the staff was further reduced it would involve risk. The cases were respited until the reply of the Ministry of Munitions is received.

BUSINESS NOTES.

Fire.—The recent fire at the MORGAN CRUCIBLE CO., LTD.'s works at Battersea, which caused slight damage to an isolated building of the Crucible Factory, will only affect the delivery of a few special sizes of crucibles for a few weeks; the production and delivery of Morganite and Battersea carbon brushes are in no way affected.

Plant for Disposal.—The Dartford U.D.C. invites offers for one Ledward's evaporative condenser (10,000 lb. of steam per hour), with air pump. Particulars are given in our advertisement pages to-day.

Sale Prices in the German Electrical Industry.—The following is the table referred to in our leader pages to-day, showing the percentage increases on the basis prices as compared with the pre-war period:—

PERCENTAGE INCREASE IN BASIS OR PRE-WAR PRICES.

—	No. 1: Direct war orders executed according to peace time practice with copper, brass, bronze, &c.	No. 2: Indirect war orders for which copper, brass, bronze, &c., are released by the Government for each order.	No. 3: Orders for peace purposes.	No. 4: Orders with substitute metals (iron, zinc, aluminium, &c.)
	Per cent.	Per cent.	Per cent.	Per cent.
Small motors up to 5 KW. (1,000 revolutions), including crane and lift motors, &c.	125	140	200	35
Generators and motors over 5 KW. and up to 100 KW. (100 revolutions)	150	165	210	100
Generators and motors of over 100 KW. ...	160	175	230	110
Electric locomotives ...	160	170	190	140
Turbo-generator sets ...	140	145	—	—
Steam turbines	140	145	—	—
Starting switches, regulating resistances, &c.	125	140	180	125
Transformers (not oil insulated)	150	165	225	150
Switching apparatus ...	110	125	170	100
Switchboard fuses and high-pressure fuses ...	115	130	200	115
Excess pressure protecting apparatus ...	120	135	190	120

It is explained that the electrical firms receive supplies of copper and copper alloys from the controlling departments at fixed prices for classes Nos. 1 and 2, these being higher for No. 2. In the case of class 3, and in so far as orders for peace purposes can be carried out, it is mentioned that for these must be used exclusively any stocks released for this purpose, supplemented as far as possible by imports. The State War Department makes no range of prices for substitute metals, whilst materials for the manufacture of cables are allotted for each order, and the customer is charged on the basis of the prices paid for these materials.

Denmark.—A company has been started in Copenhagen with the English title of the Industrial Trade Co., with a capital of 1½ million kroner, to import raw materials and half manufactured products, and export the completed articles—viz., ventilators, certain machine tools, motor carburetters, metal-filament lamps, &c.

Trade Announcement.—MESSRS. TAYLOR, TUNNICLIFF AND CO., LTD., have moved their London offices to 110, Cannon Street, E.C. 4. For the present their telephone number is "City 8693."

Dissolutions and Liquidations.—VAUGHAN ENGINEERING WORKS, LTD.—A petition for winding up this company has been presented by Edgar Allen & Co., Ltd., and J. Bedford & Sons, Ltd., Sheffield, and it will be heard on June 26th.

J. YULE & CO., hardware and electrical stores, 613, Manchester Road, Poplar, E.—Messrs. J. Yule & T. E. Nankivell have dissolved partnership. Mr. Yule will attend to debts and continue the business.

CALMON ASBESTOS AND RUBBER WORKS, LTD.—The Controller, Mr. E. H. Fletcher, has applied for his release.

J. L. & P. WEIDNER, London, E.C., selling branch of German manufacturers of leaf metal and aluminium, &c.—The Controller, Mr. G. Bostock, has applied for his release.

The British Ignition Apparatus Association.—There are now 11 members of this Association, all engaged on the manufacture of ignition magnetos:—The British Thomson-Houston Co., Ltd.; the British L.M. Ericsson Manufacturing Co., Ltd.; the British Westinghouse Electric and Manufacturing Co., Ltd.; the Electric Ignition Co. (1913), Ltd.; the Fellowes Magneto Co., Ltd.; Messrs. Hill Bros., Ltd.; the L.M. Magneto Syndicate, Ltd.; Messrs. North & Sons, Ltd.; the Stentophone Magneto Works Ltd.; Thomson-Bennett Magnetos, Ltd.; and Messrs. C. A. Vandervell & Co., Ltd.

Book Notice.—A treatise on "Gyrostatics and Rotational Motion," by Prof. A. Gray, F.R.S., is in the press, and will be published by Messrs. Macmillan & Co., Ltd., as soon as may be possible under present circumstances. It aims at giving a complete account of tops and gyrostats, gyrostatic action in machinery, and gyrostatic appliances.

LIGHTING AND POWER NOTES.

Australia.—The Sutherland Shire Council (N.S.W.) has entered into a contract with Mr. T. A. Robinson for the supply of electric lighting in Cronulla; 72 street lights of from 50 to 100 C.P. are to be installed, whilst electricity for private consumers will be available at 5d. per unit.

In connection with the proposed electric lighting and pumping scheme for Mittagong, N.S.W., Mr. J. N. Franki has been instructed by the Municipal Council to prepare plans and specifications.

The Brisbane City Council has adopted a recommendation for the lighting by electricity of certain streets in the East Ward; it is proposed to substitute 20 electric lights of 200 C.P. each for 31 gas lamps. The cost of the installation is estimated at £370, and it is considered that there will be a saving in operation and improved lighting.

The ratepayers of Murwillumbah Council, Queensland, have authorised the borrowing of £7,500 for an electric lighting scheme.

The Sydney City Council has considered a report by the Lord Mayor, Alderman R. D. Meagher, in reference to the restriction of the electric lighting service owing to the shortage of plant at the Council's power house and the inability to obtain from Great Britain for some long period any considerable addition to the plant. The Lord Mayor reported that there was a possibility of making use of the surplus generating plant at the power houses of the Railway and Tramway Commissioners; terms and conditions had been submitted on which the Council might obtain a bulk supply of electricity for a period of two years, with option of renewal; this would necessitate the purchasing of transforming machinery, at a cost of £20,000, for distribution purposes. The cost of the energy to the Council would be 0·3d. per unit. The Council would be required to take electricity to the value of not less than £6,000. The city electrical engineer states that it is impossible to obtain the transforming machinery and switchgear from British manufacturers, and if ordered from the U.S., the only available source, it would probably be ready for use by the winter of 1918. The Lord Mayor's report was referred back to the Electric Lighting Committee for further consideration.—*Tenders.*

Belfast.—Year's Working.—The working of the Corporation electricity undertaking for the year ended March last resulted in a gross profit of £36,541, as against £45,700 in the previous year; after deducting loan, sinking fund, and income-tax charges amounting to £30,830, as compared with £28,200 in 1015-16, there remained a net profit of £5,697, as compared with £17,400 in the previous year. The city electrical engineer, Mr. T. W. Bloxam, in his report states that the large increase in the working expenses, due to a record wages bill and the high cost of coal and other materials, was the cause of the reduction in the profits.

The Tramways and Electricity Committee has decided to consider the report at a special meeting.

Burton-on-Trent.—Year's Working.—During the past year the Corporation electricity undertaking earned a total revenue of £23,956; working expenses amounted to £12,110, and after deducting loan charges, £7,183, contributions to capital expenditure £942, and special expenditure (including £240 bonus under the profit-sharing scheme), £710, there is a net surplus on the year's working of £3,010, which it is proposed to allocate as follows:—£1,350 to expenditure incurred on mains extensions, services and transformers, and £1,660 to the renewals fund. The total number of units sold during the year amounted to 3,993,197, an increase of 493,859, or 14·11 per cent. as compared with 1915-16; power supply showed an increase of 538,432 units, and heating and cooking an increase of 44,080 units. The total average works cost was 728d., as against ·658d. in 1916, and the total costs 1·259d., as against 1·265d. in the previous year. The total capital expenditure, including £2,458 during the year, was £129,938, the net outstanding debt at March 31st, 1917, being £59,383. The maximum load of 2,000 KW. was reached on December 12th, 1916, being an increase of 249 KW., due to the large increase in H.P. connected during the year, the total H.P. of motors connected now being 4,051 H.P., an increase of 691 H.P.

Cheam.—Street Lighting.—The Electricity Co. has given a rebate of 66 per cent. on the contract price for street lighting.

Dublin.—The Executive of the Dublin Citizens' Association had under consideration the ruling out of order at a Corporation meeting of a proposed addendum to a report on the new housing scheme in the Spitalfields area for the provision of electric lighting, and strong exception was taken to the procedure by which a report of a Committee cannot be amended in open Council until it has been sent back to the Committee.

Electricity Accounts.—The method of collecting electricity accounts in Dublin, which has always been regarded as curiously anomalous, was referred to at a Corporation meeting recently, when Mr. P. T. Daly urged that the Electricity Committee ought to have the collection in its own hands, and that commission should not be paid to men for accounts which they did not collect. Mr. Sherlock, ex-Lord Mayor, explained that for 10 years the Corporation had been trying to get the collection of its own accounts, but had been told, in the most positive manner, that it had no legal power to take over from the rate collectors the collection of electricity accounts. The percentage of bad debts was, however, extraordinarily low. Alderman Farrell mentioned that when an officer of the Council died recently, it was found that he owed an account extending over several years for electric light. That, he said, was a monstrous state of affairs. Councillor O'Neill, chairman of the Electricity Committee, said the widow of the officer referred to was paying the amount by monthly instalments.

A special meeting of the Corporation, after considering the report of the Special Committee which inquired into the administration of the electricity undertaking, and the recommendation that, failing Col. d'Alton, Mr. Mark Ruddle should take entire charge, as general manager, for two years, decided that the report should go back to the Electricity Committee, with the full powers of the Corporation to deal with the matter.

Dundalk.—Tar-oil Fuel.—It was reported at the Urban Council that all five engines at the power station are now running on tar-oil, the results, so far, being satisfactory. Paraffin is being used as pilot ignition oil, the quantity being about 10 per cent. of the total quantity of tar-oil used. The expense in fitting new ignition gears on engines is expected to be recouped in less than six months' working, by the saving from the use of tar-oil, which is a home product.

Grimsby.—Year's Working.—The report of the year's working of the Corporation electricity department to March 31st last shows a gross revenue of £26,951, works costs amounting to £16,208, and interest, loan repayment, &c., to £7,955; the net profit was £2,787, an increase of £936. The output for the year was 3,154,188 units, an increase of nearly 20 per cent. on the year 1915-16.

Hereford.—The T.C. has decided to dispose of two Belliss-Silvertown generating sets for £600, and a Worthington condenser for £200.

Kettering.—Year's Working.—During the year ended March 31st last, the Council's electricity undertaking sold 2,435,776 units; the revenue amounted to £19,052 (£7,000 being derived from sales at ⅞d. per unit); the generating, distribution, and management costs totalled £12,185, leaving a gross profit of £6,867. Interest and sinking fund charges totalled £6,317, leaving a surplus on the year of £550. A balance of £4,275 is carried forward, and the reserve stands at £5,492.

It has been decided to lay an additional feeder at an estimated cost of £2,250; also to increase both lighting and power charges by a further 10 per cent.

King's Lynn.—Year's Working.—At a meeting of the T.C., the Electricity Committee presented a statement showing that the receipts for the year ended March 31st last were £7,933, as against £8,068 in the previous year, and expenditure, £7,643, against £7,049, leaving a profit of £290, as compared with £1,018 a year ago. The average works cost for the year was 1·609d. per unit, as compared with 1·257d. in the previous year, and the total cost of production, 3·614d. per unit, as against 3·194d. The Committee recommended that from the end of the present quarter the charges for current used for power be increased 10 per cent. After some criticism the report was adopted.

Kirkcaldy.—At the last meeting of the T.C., a statement was submitted giving reasons for deciding not to adopt Sir John Snell's recommendation to sell the Corporation electricity undertaking to the Fife Electric Power Co. The proposal that the Corporation should sell its works to a profit-earning concern and become bound to it for a period of years, possibly for perpetuity, was contrary to the tendency of all modern legislation, which had aimed for years at putting in the hands of the municipalities all the public utility services. The Corporation and the public of Kirkcaldy were determinedly opposed to any proposal to place themselves in the hands of a company.

Leeds.—Year's Report.—In further reference to our note on page 573 on the year's working of the Corporation electricity undertaking, during the year under review 54,992,742 units were sold, an increase of 10,203,520 units, or 22·78 per cent., 40,143,880 units being for power purposes, as compared with 27,385,097 in the previous year. The aggregate capacity of the motors connected has grown from 35,054 to 48,513 H.P.; the report states that the rateable value system of charging for private residences is being increasingly adopted, the sales to such consumers being 66 per cent. greater than in the previous year. The total cost of production per unit sold was ·98d., as compared with ·91d. in 1916. The total all-in costs were 1·04d., and the average price obtained per unit sold was 1·06d. The maximum load was 22,255 KW., the total capacity of the plant being 32,600 KW. During the year a new 6,000-KW. alternator was brought into use.

Leicester.—Year's Working.—The accounts for the year ended December 31st last show that 7,030,940 units were generated at the Aylestone works, 5,252,121 units being sold. The total revenue amounted to £46,257, a slight reduction (£360) on the previous year, while the total costs amounted to £31,917, some £5,000 increase on 1916. The gross profit of £14,701, with £763 taken from the reserve, was absorbed in meeting interest, sinking fund, and other charges. The reserve funds in hand now amount to £11,290. The Aylestone station supplied 1,393,310 units to the Lero station. The Lero station had an output from steam-driven plant of 18,169,920 units, of which 1,585,601 units were required for station use; 9,412,336 units were supplied to power consumers, and the balance to the tramway undertaking. The power consumers supplied from the Lero plant numbered 292, with 11,100 H.P., of motors. The total costs of the Aylestone undertaking averaged 1·45d. per unit, and the receipts were 2·12d. The overall costs of the Lero station, including interest and sinking fund charges, ·71d. per unit, and an average of ·95d. was received for the power units sold, the surplus (on power supply only), after allowing for distribution, interest, and sinking fund charges on cables, &c., being ·135d. per unit, or, roughly, £5,300, which is incorporated in the tramway accounts.

London.—Stoke Newington.—The Electric Light Committee recommends that the Council's minimum charge for electricity supply of 13s. 4d. per quarter be suspended during the June and September quarters of the year, when the Summer Time Act is in force, commencing with the current June quarter.

Poplar.—The Electricity Committee recommends the Council to support the Bradford resolution for increased municipal representation on the Board of Trade Committee on Electricity Supply.

Marylebone.—The B.C. is recommended to agree to a further increase of ¾d. per hour in the wages of employés of the electricity department (dating from April 1st), except to the clerical staff, women, boys, and engineering assistants.

L.C.C.—The Finance Committee recommends the Council's sanction to the borrowing of £9,185 by the Hackney B.C., the balance of the costs of the buildings in connection with the large scheme of extensions of the B.C.'s electricity undertaking; also to the borrowing by the Islington B.C. of £4,000 for an additional feeder in the Belle Isle district, and by the St. Pancras B.C. of £5,840 for the purchase of electrical plant.

Newport (Mon.).—Price Increase.—The Council has decided to increase the charges for electricity by a further 10 per cent., making 30 per cent. altogether.

Nuneaton.—Price Increase.—The Electricity Committee is recommending the Council, at its next meeting, to increase the charges on all accounts for the quarter ended 30th inst. by 20 per cent., except power accounts, where the increase will be 10 per cent.

Ormskirk.—Price Increase.—The Electric Supply Co. has decided to increase the price of electricity, from July 1st, 1917, by ½d. per unit for lighting purposes, and by 10 per cent. for power, cooking and heating.

Ossett.—The T.C., last week, decided to increase the war bonus to Corporation male employés to 7s. per week, and that of female employés to 5s. per week.

Southport.—The T.C. has referred back the minute giving the Electricity Committee's sanction to the Birkdale Electric Supply Co. to raise the charges to private lighting consumers in the district, the suggestion put forward being that in certain particulars the Birkdale Co. was charging more than the Corporation, in violation, it was alleged, of the understanding said to exist.

The Electricity Committee had sanctioned an application by the Birkdale Electric Supply Co. to charge 5d. per unit plus 5 per cent. to private lighting consumers, "on condition that the increased profits of receipts so arising shall not be taken into account in the event of the future purchasing of the undertaking by the Corporation."

Swindon.—The T.C. has decided that the existing scale of charges for energy shall continue, it being considered, after taking into account the prospective capital expenditure, that the charges are sufficient to meet the expenses of the undertaking during the next three years.

Tasmania.—The Launceston Council has asked Mr. Butters, chief engineer to the State Hydro-electric Department, as to the prospects of the Government erecting a transmission line to the city in readiness for the winter of 1918, and he has replied pointing out the necessarily high annual charge, £7,500, and that he cannot recommend such a line, but has referred the question to the Government.—*Tenders*.

Torquay.—Price Increase.—The T.C. announces that from the Midsummer reading of the meters the charges for energy for all purposes other than lighting will be increased by ½d. per unit, or the percentage equivalent.

Whitehaven.—The T.C. has decided to make no alteration at present in the charges for energy, owing to the issue some time ago of a leaflet pointing out that no advance in the charges for electricity was proposed. A war advance of 10 per cent. had been suggested by the electrical engineer.

Worcester Park.—Street Lighting.—The Lighting Committee has been instructed to consider the question of lighting the whole district with electricity; it is stated that the Gas Co. refused to consider the application of the Council for a reduction in the charges on account of the reduced-lighting regulations.

TRAMWAY and RAILWAY NOTES.

Australia.—The question of the electrification of the Glenelg and other suburban railway lines in South Australia was referred to recently by Mr. A. B. Moncrieff, Commissioner of Railways. He said that, as far as the Glenelg line was concerned, it would undoubtedly be a paying proposition. It would be wise to give the matter consideration, but to hold their hands while the present prices prevailed.

The Prahran and Malvern Tramway Trust (Victoria) has authorised the construction of an electric line along Burke Road.—*Tenders*.

The returns of the revenue and expenditure of the New South Wales tramways for the nine months ended March 31st last show a gross revenue of £1,499,781, an increase of £13,917; working expenses amounted to £1,222,255, an increase of £65,967; and the net revenue was £277,526, a decrease of £52,050. The car-mileage was 19,098,588, a decrease of 741,808 miles, and the passengers carried numbered 221,220,660, an increase of 2,648,678.—*Sydney Daily Telegraph*.

Bradford.—Tramways Report.—The city treasurer presented the statement of accounts for the year ending March 31st to the Tramways Committee last week. He stated that the figures did not accurately represent the whole position, because expenditure on repairs and maintenance had necessarily been deferred owing to the war, and would have to be met later. This unascertainable amount was outstanding as a debit to be ultimately provided for. The year's net profit was £30,802, as compared with £29,771 last year. Traffic income had increased by £11,920, the year's average income per car-mile being 1s. 1½d. Traffic expenses, including the wages of drivers and conductors, had increased by £11,700, and general expenses had increased by £1,200. In these expenses accident insurances and compensations had increased from £2,800 to £4,500, chiefly due to the Wyke accident. There was a decrease in costs of repairs and maintenance of £10,000 as compared with last year, and of £14,000 as against two years ago, £9,000 less having been spent on the maintenance of rolling stock. Power expenses had been decreased by £500. The payment to dependents of men on military service was £14,350, an increase of £6,013. Interest on loans was slightly increased, and the contribution to sinking fund was £800 less, some early loans having been paid off. The accounts in connection with the railless system were included in the figures already given, but the separate accounts of the department showed a deficit of £3,176, without allowing anything for the feeding value of the service to the general tramway undertaking. One-half of the original cost of the undertaking has been paid off, there being now outstanding loans of only £550,000, whereas the capital expenditure was £1,100,000. After carrying to reserve and renewals account the profit, and meeting renewal expenses incurred during the year, the balance of that account now stood at £91,000, from which £10,000 had been appropriated in relief of the rates for the current year.

Continental.—France.—The Chemins de fer du Midi have just commenced the electrification of their system by the installation of electric traction on the Lourdes-Pierrefitte and Tarbes-Bagnères-de-Bigorre sections. This first experiment has proved successful, having resulted in a saving of 500 fr. (£20) per day in working expenses.

Two hydro-electric generating stations have been provided for—one being now completed and the other in course of construction. These stations, according to a recent issue of *La Nature*, present special features, in that they have to supply a public service which has to work without interruption. The water supply is derived from certain mountain torrents a mile or two from the generating station.

The Soulom station—*i.e.*, that which is now completed—comprises a machine room, transformer room, a switch room, and two high-tension network distributing towers.

The generating plant comprises three turbines of 3,500 h.p. and two of 350 h.p. driven by one water supply, and the same number of turbines, of the same power, driven by a second supply. Each turbine drives an alternator running at 500 r.p.m. in the case of one of the water supply lines, and at 330 r.p.m. in the case of the other. The alternator supplies single-phase current at 6,000 volts and 16·66 cycles per second; its effective electric capacity is 2,400 kw. The small turbines, working at 600 r.p.m., drive d.c. generators supplying current at 125 volts for supplying the auxiliary services and exciting the alternators.

The alternating current is conducted by aluminium bars to the transformer room, where the pressure is raised to 60.000 volts, and thence to six oil-break switches. Two main switches placed at each end distribute the supply to the two towers already mentioned, whence aluminium cables conduct it to the transformer substations. In the latter the energy is stepped down from 60,000 to 12,000 volts, and distributed to the railway. Bow collectors are fitted on 56-ton motor coaches, the pressure being further reduced for use in four single-phase motors, each of 125 h.p. These coaches can attain a speed of 85 km. (53 miles) per hour. The goods locomotives weigh 85 tons, and are also fitted with bow collectors, and have two 600-h.p. motors each. They can haul a load of 300 metric tons over a 1·6 per cent. gradient.

Protection against lightning is provided for by electrolytic arresters fitted on the supply lines; slow discharges are guarded against by hydraulic dischargers.

This generating station of Soulom, with its two supplies of energy and two groups of machines, is capable of supplying 12,000 kw. constantly, plus a reserve of 2,400 kw. One of the groups, with its own water supply, is used as an emergency set.

Glasgow.—Lottery Tickets.—At a special meeting last week, the T.C. decided to approach the B. of T. for the purpose of securing a licence to legalise a lottery scheme with the object of providing comforts for sailors, soldiers, and other sufferers through the war. It will be recalled that the Lord Advocate and Secretary for Scotland tabooed the scheme, and that the latter refused to receive and discuss the position with a delegation from the T.C. The sale of tickets on the tramway cars was suspended last week pending a definite finding, and three representatives visited the B. of T. to negotiate in the matter. The receipts for the past 11 weeks amounted to £16,881 12s. 9d., of which £15,778 was distributed.

Financial Statement, 1916-17.—The completed statement of accounts of the tramway department for the year ending May 31st, 1917, has now been issued, and shows that the 12 months under review have been the most notable in the history of the undertaking. As was published in the Review recently, the total receipts amounted to £1,260,115, as against £1,157,336 for 1915-16. The total expenditure was £838,065, compared with £773,442. The balance carried to net revenue account amounted to £422,049, while the interest on investments brought in £78,637. The total free revenue amounted to £500,686. From this there fell to be deducted £339,707 ; the surplus which will go to the common good of the city is £160,984, against £43,548, and it is pointed out that recently the Committee freed the undertaking from debt, and thus enabled the T.C. to subscribe £2,000,000 to the 5 per cent. War Loan.

Halifax.—Shortage of petrol has necessitated the withdrawal of the Tramway Committee's motor-'bus service to Siddal, and threatens a similar fate for Wainstalls ; there is a great outcry in these isolated places, which are dependent on the 'buses as the only means of conveyance.

Lancashire.—Tramway Wages.—The Committee on Production has decided, in connection with the application for a war bonus of 10s. a week made by the Amalgamated Association of Tramway Workers on behalf of employés in various towns in Lancashire and Cheshire, to grant an increase of 2s. 6d. a week on the war advance now being paid to workers (male and female) 18 years of age and over, and 1s. 3d. a week to those under 18. The amounts are to be regarded as war wages, dependent upon the abnormal conditions now prevailing. The tramway authorities affected by the award include the Corporations of Accrington, Ashton, Bolton, Bury, Birkenhead, Blackburn, Burnley, Manchester, Colne, Darwen, Oldham, Preston, Rochdale, Salford, Stockport, Wigan, Wallasey, and Warrington.

Leicester.—Year's Working.—The total revenue of the tramway department for the year to December 31st last was £216,270, as compared with £188,520 for the previous year. The working expenses, £152,953, compared with £122,142 for 1915, leaving a gross balance of £63,316, a reduction of £3,061 on the previous year.

After meeting interest, sinking fund, and other charges, and war allowances amounting to £12,044, or, roughly, £5,000 in excess of the previous year, the net balance remaining was £2,157, as against £11,961 for 1915. The balance has been placed to reserve. During the year 42,232,638 passengers were carried, an increase of 1,792,480, and the car-mileage was 4,108,303, an increase of 203,364 miles on the previous year.

Manchester.—Year's Working.—During the year ended March 31st last the Corporation tramway undertaking carried 219 million passengers, as against 209,900,000 in the previous year, the car-mileage, 18,388,302, however, showing a decrease of nearly 100,000. The total revenue was £978,678, and, after deducting working expenses, £598,741, and war allowances, £91,023, the gross profit remaining was £288,910. Adding bank interest, &c., and deducting interest, £61,091, sinking fund charges, £63,359, tramway rent, £27,426, and street improvement and leasehold charges, there remained £159,007. From this £39,525 was placed to renewals, income-tax absorbs £5,407, and the balance of £100,000 is contributed in aid of the rates. It is pointed out that after paying £100,000 in rate aid, the renewals contribution was limited to £39,525, instead of £99,500, which would normally be provided. The revenue represented ·575d. per car-mile increase ; working expenses increased by ·525d. per car-mile, and the balance of 4·959d. per car-mile showed an increase of ·051d. The tramway department purchased 28,684,389 units from the electricity department at 1·151d. per unit, and used 1·56 units per car-mile. During the year 1,112,180 parcels were carried, an average of 21,388 per week, the total receipts from this service being £14,418. The 'buses operated by the department ran 180,956 miles and carried 1,416,760 passengers ; the cost per mile run, including depreciation, was 9½d., and the earnings nearly 9¾d.

New Zealand.—According to the Australian newspapers dated April 21st, just to hand, it appears that as a result of the strike of coal miners against the Military Service Act the Auckland tramways would have to cease running within ten days, "unless supplies of coal are forthcoming." It was stated by a Member of Parliament at a Labour meeting at Greymouth that, although the New Zealand miners numbered 17 per cent. less than before the war, the output was 25 per cent. more, and the output per miner was "a world's record."

Southend-on-Sea.—Year's Working.—The expenditure on the tramway department during the year ending March 31st, 1917, was estimated at £40,150, while the actual expenditure was £42,490. The income was estimated at £40,300, whereas it was actually £45,452.

Southport.—Tramway Purchase.—An expert has been appointed by the Corporation to survey and value the Southport and Birkdale Tramway Co.'s undertaking in connection with the negotiations for purchase.

TELEGRAPH and TELEPHONE NOTES.

Canada.—The earnings of the cable, telegraph, and wireless companies and the Government telegraph service of Canada reached $6,255,740 in 1916, as compared with $5,536,337 in 1915. The pole mileage of telegraph lines in Canada in 1916 was 40,251, and the wire mileage 206,551. In 1916, 10,835,936 land messages and 1,134,905 cable messages were transmitted.—*T. and T. Age.*

Russia.—An All-Russian Congress of professional military radio-telegraphists will be held in Petrograd on June 30th.—*Times.*

Spain.—Compania Iberica de Telecomunicacion is the style of a company newly formed to work in Spain and Portugal the De Forest wireless patents. The company is in negotiation with the provincial authorities of Vizcaya with a view to establishing a wireless system in that province.

All Spanish merchant vessels of 500 tons, or over, are to be provided with wireless telegraph apparatus with a minimum range of 100 miles.—*T. and T. Age.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—August 22nd. N.S.W. Government Railways and Tramways. Thirty-six induction motors (Specification No. 488). September 19th.—One 225-h.p. synchronous motor (Specification No. 489). Particulars from Electrical Engineer's Office, 61, Hunter Street, Sydney.

Melbourne.—July 25th. Victorian Railways. Step-down transformer and sub-station equipment for Sandringham-Black Rock electric tramway. Particulars from the Chief Storekeeper, Railway Offices, Spencer Street, Melbourne.

Erith.—June 23rd. Electricity and Tramways Department. One water-tube boiler with superheater, economiser, automatic stoker, &c. See "Official Notices" June 15th.

Exminster.—June 28th. Electrical appliances for a year, for the Devon County Lunatic Asylum. Mr. C. Masters, Clerk.

Glasgow.—Electricity Department. Boiler-house plant. E.H.T. switchgear (20,000 volts). See "Official Notices" June 15th.

Newport (Mon.).—June 30th. Electricity Department. Induced-draught plant, additions and extensions to fuel economisers and cooling towers. See "Official Notices" June 15th.

Salford.—June 25th. (1) Coal supplies for 12 months. (2) Motor wagon for coal transport. (3) Steam boiler housing. Borough Electrical Engineer, Electricity Works, Frederick Road, Salford.

Sleaford.—June 29th. 250 tons of best hard steam coal for the U.D.C. Electricity Works. Mr. G. Horry, Electrical Engineer.

Spain.—Tenders are being invited for the electrification of a portion of the railway system in the Asturias belonging to the Compania del Norte. The section in question is 62 km. in length, extending from Puerto de Pajaxes to Busdongo, and includes 79 tunnels. The principal features are :—Train speed, 30 km. per hour, up and down ; weight of trains, 330 tons gross, without hauling machinery ; number of locomotives, 12 at first, nine in service ; maximum weight per axle, 14,000 kg. ; supply system, single or three-phase in feeders and working lines, or three-phase between central and sub-stations and continuous in working line ; voltage, 15,000 in working line, single-phase current, or 2,000—3,000 volts continuous current. If three-phase current, at option of contractors. The installation comprises all buildings, such as central stations, sub-stations, &c., transformers, feeders, working cables, &c.—*Industria e Invenciones.*

Warrington.—July 4th. Motor tower wagon for Tramway Department. Borough Electrical and Tramway Engineer.

Wolverhampton.—June 22nd. Reinforced concrete coal-bunkers and skeleton structure, for the Electricity Department. Mr. S. T. Allen, Engineer and Manager.

June 30th. Electricity Department. Cooling towers, motor-driven pumps. See "Official Notices" June 15th.

CLOSED.

Australia.—N.S.W. Public Works Department. Accepted tender for switchgear, cables, wiring, transformers, and lightning arresters, for the Government Power House, Port Kembla, at specified rates : Australian General Electric Co.

Glasgow.—The T.C. has accepted the following tenders for the Tramways Department :—

Armature coils.—British Westinghouse Co.
Trolley cord.—Cookson & Co.

Government Contracts.—List of new contracts placed May, 1917 :—

War Office.

X-ray appliances (protective).—J. L. Hancock, Ltd.; Schall & Schall.
Electric cables.—India-Rubber, Gutta-Percha, and Telegraph Works Co., Ltd.; Siemens Bros. & Co., Ltd.
Ebonite.—India-Rubber, Gutta-Percha, and Telegraph Works Co., Ltd.; C. Mackintosh & Co., Ltd.; Peel-Conner Telephone Works, Ltd.
Electric light fittings and accessories.—Benjamin Electric, Ltd.; Electrical Conduits, Ltd.; Elm Works, Ltd.; Eureka Conduits and Fittings Co., Ltd.; Forward Electric Co., Ltd.; Gabriel & Co.; S. Heath and Sons, Ltd.; Ingram & Kemp, Ltd.; Nettlefold & Sons, Ltd.; Oriental Tube Co., Ltd.; Perfecta Seamless Steel Tube and Conduit Co., Ltd.; Rainsford & Lynes, Ltd.; Satchwell & Gittings; C. J. Thursfield and Co., Ltd.; Veritys, Ltd.; Ward & Goldstone.
Generating sets and accessories.—Coventry Simplex Engines, Ltd.; W. H. Dorman & Co., Ltd.; R. A. Lister & Co., Ltd.; Record Engineering Co., Ltd.
Terminals, electrical instruments.—Davis & Timmins; L. Herve; Houghton-Butcher Manufacturing Co., Ltd.; C. J. Thursfield and Co., Ltd.
Works services electric lighting.—Ellis & Ward, Ltd.
Iron wire.—R. Johnson & Nephew, Ltd.

India Office Store Department.

Carbon cups.—Peel-Conner Telephone Works.
Cells.—General Electric Co., Ltd.
Copper bolts.—Williams, Foster & Co.; Pascoe, Greenfield & Sons.
Copper sulphate.—G. Boor & Co.
Insulator cups.—Bullers Ltd.
Switchboard.—Automatic Telephone Manufacturing Co.
Telephone sets.—Peel-Conner Telephone Manufacturing Co.
Voltoids.—Brunner, Mond & Co.

Post Office.

Telegraph apparatus.—Automatic Telephone Manufacturing Co., Ltd. H. White & Co.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; Gent & Co., Ltd.; Sterling Telephone and Electric Co., Ltd.; Western Electric Co., Ltd.
Air line arms.—T. Gabriel & Sons and Burton.
Bolts for arm combiners.—Guest, Keen & Nettlefolds, Ltd.
Cast-iron brackets.—Bullers, Ltd.; A. Kendrick & Sons, Ltd.; Ley's Malleable Castings Co., Ltd.
Submarine cable.—Telegraph Construction and Maintenance Co., Ltd.
Telegraph Cables.—British Insulated & Helsby Cables, Ltd.; W. Geipel and Co., Ltd.; Henley's Telegraph Works Co., Ltd.; New Gutta-Percha Co., Ltd.; Telegraph Construction and Maintenance Co., Ltd.; Union Cable Co., Ltd.; Western Electric Co., Ltd.
Cases for telephones.—Siemens Bros. & Co., Ltd.
Dry cells.—British Ever-Ready Co.; J. C. Fuller & Sons, Ltd.; General Electric Co., Ltd.
Telephone cords.—London Electric Wire Co. & Smiths, Ltd.
Earth plates.—Walls, Ltd.
Stay rods.—Bullers, Ltd.
Air line saddles for arms.—Bayliss, Jones & Bayliss, Ltd.; C. Richards and Sons, Ltd.
Insulator spindles.—Bullers, Ltd.
Steel wire.—Dorman, Long & Co., Ltd.
Galvanised iron wire.—Rylands Bros., Ltd.

London.—Stepney. Electricity Committee. Accepted tenders :

Cleve & Co.—80-90 tons D.S. nuts at 27s. 6d. a ton; E. Foster & Co., 100 tons West Cannock ¾-in. slack, at 19s 4d. a ton.

The Committee recommends the renewal of the contracts for a further 12 months with the Reason Manufacturing Co., Ltd., for meters, at an increase of 10 per cent., and for demand indicators, at an increase of 5 per cent. on the present contract prices, and with the Venner Time Switches, Ltd., for time switches, at an increased price of 10 per cent.

The Committee has accepted the offer of the B.T.H. Co. for three earthing switches, at £55 10s.

Woolwich B.C.—Bruce Peebles & Co.—Motor converter, £3,825.

Marylebone.—The Electricity Committee recommends the Council's acceptance of the offer of the British Westinghouse E. and M. Co., Ltd., for two air-pump motors, at £329, and the offer of Edison Accumulators, Ltd., of £216 for a special battery for the electric vehicle.

Hammersmith.—The Electricity Committee recommends :

That no tender be accepted for fitting mechanical stokers to three of the oldest boilers, but that the boilers in question be disposed of as soon as possible ;

That the tender of Messrs. J. P. Hall & Sons for a boiler feed pump (plunger type), at £359, be accepted, and also that of Mr. E. C. Berridge of £145 for a strainer for condensing water.

Poplar.—Electricity Committee. Accepted tender : 3,500-kw. turbo-generator, with G.E.C. machine, £20,389.—Messrs. Willans and Robinson, Ltd.

G.P.O.—The General Electric Co., Ltd., have again secured the contract for Osram lamps—until March, 1918.

Sunderland.—T.C. Electricity and Lighting Committee :

C. C. Wakefield & Co.—Transformer oil.
Staveley Coal and Iron Co.—Cast-iron piping.
George Angus & Co.—Pipe joints.

Swindon.—T.C. 300 tons of East Cannock screenings coal for the Electricity Works.—Bowater, Ltd., of Birmingham ; 22s. 6d. per ton net.

Wolverhampton.—Corporation Electricity Committee. Accepted tenders for fuel :—

Holly Bank Co.—Washed fine, 30,000 tons; 13s. per ton delivered.
Holly Bank Co.—D.S. nuts, 15,000 tons; 16s. per ton delivered.
Mid-Cannock.—Fine slack, 8,000 tons; 13s. 9d. per ton delivered.
Coombes Wood.—1½-in. slack, 10,000 tons; 12s. 9d. per ton delivered.
Brownhills.—1½-in. slack, 10,000 tons; 14s. 9d. per ton delivered.
Bowater.—East Cannock, 50 tons per week; 15s. 6d. per ton delivered.
Brentnall & Cleland.—East Cannock, 50 tons per week; 15s. 6d. per ton delivered.
Brentnall & Cleland.—Coke dust, 5,000 tons; 5s. 6d. per ton delivered.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, June 22nd. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Ordinary meeting.

Incorporated Municipal Electrical Association.—Friday, June 22nd. At the Institution of Civil Engineers, Great George Street, S.W., at 10 a.m., Council meeting; at 10.30, Annual general meeting.

Association of Supervising Electricians.—Tuesday, June 26th. At 7.45 p.m. At St. Bride's Institute, Ludgate Circus. Annual general meeting.

Tramways and Light Railways Association.—Friday, June 29th. At 3 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Annual congress.

OUR HALF-YEARLY INDEX.

As it is necessary to effect every possible economy in paper consumption, the Index to Vol. 80 of the Electrical Review, which will be printed in the course of a few weeks, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d. post free. Any reader or advertiser at Home or Abroad who requires a copy for binding, or for other purposes, is asked to make application therefor promptly to : The Publisher, Electrical Review, 4, Ludgate Hill, London, E.C. 4.

NOTES.

Redistribution of Coal Available for Steam Boiler Purposes.—The Controller of Coal Mines recently circulated a large number of forms asking for information regarding coal used by steam boiler owners throughout the country. Many of these have not yet been returned, and firms who have received such forms are, therefore, requested to forward the particulars asked for to the Controller at once, otherwise it may not be possible for their requirements to receive consideration in connection with a scheme which is being prepared to enable a suitable supply to be maintained for all concerned. Any firms or persons using coal for land boilers who have not received a copy of the form should apply to the Controller of Coal Mines, Box D.S.R., 8, Richmond Terrace, Whitehall, S.W. 1.

Illuminated Signs in Scotland Prohibited.—The *Times* states that sky sign lights, illuminated advertisements, and other lights used outside, or at the entrance to, shops or places of amusement are prohibited in Scotland, as from June 15th.

Bosch Magneto Co.—We stated in our issue of April 13th that the British interests in the Bosch magneto had been purchased by Messrs. Vickers, Ltd. It is now announced that Messrs. Vickers have formed a new company—the British Lighting and Ignition Co., Ltd.—which is making highest grade magnetos known as the "B.L.I.C." The company has its offices at 204, Tottenham Court Road, London, W. 1.

Institution and Lecture Notes.—Institution of Electrical Engineers.—At a special general meeting of corporate members on Thursday, last week, the resolution altering the articles of association to provide for voting by proxy, which was passed at the meeting on May 17th, was duly confirmed.

Sterling Athletic and Social Club.—On Saturday last the sports ground of this club, which has been provided by the directors of the Sterling Telephone and Electric Co., Ltd., for the use of their employés, was formally declared open by Sir John H. Bethell, chairman of directors, and a very full and interesting programme was carried out under ideal weather conditions. The president of the club, Mr. Guy Burney, briefly introduced Sir John Bethell, who, in performing the opening ceremony, expressed the regret of the directors that they were not permitted to erect a pavilion and carry out the improvements in canteen and cloakroom accommodation that they contemplated, until the close of the war. He emphasised the necessity for closer relations between capital and labour, and the earnest desire of the directors to promote the welfare of their employés in every possible way.

The ground, which covers about six acres, and adjoins the works at Dagenham, has been laid out for games of all sorts. There was a very large attendance of employés and their friends, and the arrangements made by the Executive Committee were admirably complete and efficient. The principal event was the one-mile running championship, for which a handsome challenge cup was presented by Mr. Burney ; it was won by Mr. A. E. Elliott in 5 min. 32 sec., Mr. R. Miles running second. The ladies' events were particularly popular, and well contested. The numerous prizes were handed to the winners by Lady Bethell and Mrs. Burney, and during the evening a musical programme was performed by members of the club, the proceedings ending with a dance.

Electrical Accessories Association, Ltd.—The second annual ordinary general meeting of this association will be held at the registered offices of the association, 50, Cannon Street, E.C., on Thursday, June 28th, at 6.30 p.m.

Foreign Trade.—The May Figures.—The official returns of imports and exports during last month contain the following electrical and machinery figures :—

	May, 1917.	*Inc. or dec.*	*5 months,* 1917. *Inc. or dec.*
Imports.			
Electrical goods ...	99,774	— 86,715	— 41,132
Machinery	788,379	— 98,467	— 242,718
Exports.			
Electrical goods ...	237,098	— 144,053	— 157,571
Machinery	1,695,284	— 225,566	+ 1,008,295

Volunteer Notes.—County of London Engineer Volunteers (Field Companies).—Headquarters, Balderton Street, Oxford Street, W.

Orders for the week, by Lieut.-Colonel C. B. Clay, V.D., commanding :—

Monday, June 25th.—Technical instruction for No. 3 Company, Right Half Company, at Regency Street. Drill, No. 3 Company, Left Half Company. Signalling Class. Recruits' Drill, 6.30.

Tuesday, June 26th.—Lecture, 6.30. Company Commander Castell. Physical drill and bayonet fighting, 7.30.

Wednesday, June 27th.—Drill, No. 1 Company, Right Half Company.

Thursday, June 28th.—Drill, No. 2 Company, Right Half Company. Ambulance Class, 6.30. Signalling Class.

Friday, June 29th.—Technical instruction for No. 3 Company, Left Half Company, at Regency Street. Drill, No. 3 Company, Right Half Company. Recruits' Drill, 6.30.

Saturday, June 30th.—Commandant's Parade, 2.45; uniform, for drill in Hyde Park. Recruits' drill, 2.30.

Sunday, July 1st.—Parade Clapham Common (Tube Railway), 9.45 a.m., for work at Bombing School. Uniform. Rations to be carried.

Macleod Yearsley, *Adjutant.*

Piece-Work Rates.—The adjustment of piece-work rates of wages and other systems of payment based on output, necessitated by alterations in manufacturing methods, has been a fruitful source of difficulty in the industrial world. But very satisfactory results are now expected to flow from the friendly discussions of the questions which have been included in the negotiations on the Munitions of War Bill conducted by Dr. Addison and Mr. Kellaway, with the Engineering Employers' Federation and with representatives of the A.S.E. and the Federation of Shipbuilding and Engineering Trades. An agreement on this point would probably do more than any other single amendment of the Munitions of War Acts to remove suspicion and prevent misunderstandings in future, and all friends of industrial peace will share in the hope that the important agreement which is being negotiated will be attended with complete success.—*Daily Telegraph.*

Peat Utilisation in Ireland.—A Joint Committee has been appointed in Dublin of the Institution of Electrical Engineers, the Institution of Civil Engineers of Ireland, and the Engineering and Scientific Association of Ireland, with the object of investigating and reporting upon the utilisation of the peat deposits of Ireland.

The Board of Trade Electricity Supply Committee.—We understand that 27 municipal authorities have supported the resolution passed by the West Ham T.C., and 34 authorities that passed by the Bradford City Council, urging the necessity of increased municipal representation on the above Committee. Mr. Finney, the member for North-West Staffordshire, asked a question in Parliament, last week, which drew from the President of the Board of Trade, in reply, an assurance that the representation of local authorities on the Committee would be increased.

Bradford Fuel and Food Control.—The Corporation has appointed a Committee to set up immediately machinery for the probable control and distribution of coal and foodstuffs. It is proposed to use the city tramways for transport, particularly during the night. The idea is not immediate competition with traders, but preparation for emergency—compulsory rationing, grave shortage, or other eventuality. It is held that large supplies of coal could be stored at the gasworks yards, for retailing when necessary at reasonable prices. The Committee is to exercise an influence to steady prices and prevent profiteering. There is yet some doubt as to the legality of the proceeding, and as to whether the Committee would have any power to enforce its decisions.

Labour Unrest Commissioners.—According to the *Times*, several corrections need to be made in the list of Commissioners published on page 655 of our last issue. The third member for the West Midlands Division is Mr. J. W. Ogden, J.P.; the third member for the South-West Division, Mr. T. Chambers; and the third member for the Scottish Division, Mr. A. G. Cameron. Our contemporary adds that Mr. G. M. Hodgson, of the offices of the War Cabinet, has been appointed secretary to the Commission.

Tasmanian Electrolytic Zinc.—It is officially reported that, provided no delays are experienced in regard to the delivery of the equipment, the first unit of the electrolytic zinc plant at Risdon, near Hobart, will be in commission in August. The estimated output of this section is 10 to 11 tons of high-grade zinc per day.—*Sydney Daily Telegraph.*

Electricity in Agriculture.—Mr. W. T. Kerr, electrical engineer to the Hereford T.C., has been invited to give evidence before a Government Committee on the Use and Distribution of Electric Power for Agriculture.

In a report to the Aylesbury T.C., Mr. W. A. Turnbull, the electrical engineer, says an electro-culture experiment on a small scale is being carried out on an allotment at the electricity works, and he hopes to fix up a further installation in the near future.

Russian Government Electrotechnical Section.—At the Ministry of Trade and Industry, a special electrotechnical section has been formed under the guidance of V. M. Speransky, the object of which is to study the needs and interests of the Russian electrotechnical industry and to work out the problems affecting its development. This Committee in its turn has formed a special body, to deal with the most important questions, chiefly legal suggestions, made up of representatives of Government Departments, economic societies, &c. At a recent meeting of this Council, it was decided to approach the Provisional Government with a project for the temporary control of the use of the country's water power.

L.C.C. Employes' Wages.—The Court of Arbitration has decided that shift workers and certain other persons employed at the Greenwich generating station, including senior, junior and sub-station switchboard attendants who work overtime only when additional assistance is required, are to be paid an extra overtime rate of time-and-a-quarter on the six week-days, and double time on Sundays and Bank Holidays; no extra overtime rate is to be paid where overtime is worked owing to the absence of workmen.

Appointments Vacant.—Assistant electrical engineer (£240), for the Eastern Command; chief clerk (50s.), for the Beckenham U.D.C. Electricity Department; charge engineer (40s. to 45s.), for the Bedford Borough Electricity Works; station engineer (£250), for the Didcot Ordnance Department; fitter (50s.), for the Leek U.D.C. Electricity Department. See our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Marylebone Electricity Committee has increased the salary of Mr. T. C. Bacon, chief mains assistant, from £5 7s. 6d. to £5 15s. per week; that of Mr. W. Harper, chief assistant to secretary and accountant, from £4 12s. 6d. to £4 17s. 6d. per week; and that of Mr. G. H. Evans, meter superintendent, from £4 12s. 6d. to £5 per week. The Committee recommends that Mr. F. B. Leonard, chief station superintendent, who has satisfactorily carried out the duties of station superintendent during the sick leave of Mr. T. K. Richardson, be appointed from June 1st station superintendent at a salary of £400 per annum. The Committee has received a communication from Sir Arthur Duckham, K.C.B., expressing his appreciation to the Council for lending Mr. Seabrook's services in connection with the experiments on the economical use of coal.

The L.C.C. Highways Committee recommends that Mr. T. E. Thomas, commercial superintendent of the Metropolitan District Rly. Co. and L.G.O. Co., &c., be appointed development superintendent in the traffic branch of the Council's tramway department at a salary of £800 a year.

Mr. R. N. Cole, formerly assistant to Mr. A. Blake, engineer at the Fareham U.D.C. electricity works, has been appointed to the charge of an electrical station under the Indian Government. He has been on military service in India since the outbreak of hostilities.

Mr. F. Hosken, tramways manager at Darwen, has been offered an Admiralty position as a technical officer in the Midlands. The appointment will not preclude him from supervising the working of the local tramways by periodical visits.

The salary of the electrical engineer and tramway manager at Kilmarnock has been advanced by £100 per annum. Those of Mr. Bexon's assistant, Mr. W. Upton, and Mr. V. Allan, the station superintendent, have been raised to £200 per annum.

Mr. R. Allan Brown, chief electrical engineer to Falkirk Corporation, prior to leaving to take up a commission in the R.N.A.S., was presented by the employés of the department with a gold wristlet watch as a parting gift. Mr. Climie, station superintendent, made the presentation.

Mr. Ernest G. Sanford, resident engineer and secretary to the Burnham & District Electric Supply Co., Ltd., has been appointed resident engineer and secretary to the Minehead Electric Supply Co., Ltd.

General.—Mr. J. S. Highfield has removed his office to 36, Victoria Street, S.W. He continues his connection with the Metropolitan Electric Supply Co., Ltd., as consulting engineer.

Messrs. Couzens & Brown, consulting engineers, are removing from 50, Queen Anne's Gate, and their address will be 9, Old Queen Street, Queen Anne's Gate, Westminster, S.W. 1, dating from June 24th. Telegraphic address and telephone number unaltered.

Roll of Honour.—Cleveland and Durham Electric Power, Ltd., of Middlesbrough, have released from time to time 79 of their employés to join the Colours. The following have laid down their lives for their country :—

Corpl. A. Barnes, Durham L.I., junior engineer, Grangetown power station.
Pte. W. Bracegirdle, R.N.D., Weardale power station.
Gnr. W. Cadman, H.R. Heavy Batt., junior engineer, Ayresome power station.
Sergt. T. Lewis, Northum. Fus., Clarence power station.
Pte. J. Rowlands, Durham L.I., Bishop Auckland district.
Pte. W. Tague, Durham L.I., Bishop Auckland district.
Corpl. Woodward, Durham L.I., linesman, Bishop Auckland district.
Acting P.O. T. Hodgins, R.N.D., fireman, Weardale power station.
Sec.-Lieut. E. J. Rapp, 2nd Yorks. Regt., junior engineer, Grangetown power station.

In addition, 10 employés have been more or less severely wounded. The following honours have been won:—Sec.-Lieut. T. Walton, Albert Medal, Second Class; Sergt. C. Hindle, Military Medal. Several other employés have earned their commissions.

Major A. W. Vignoles, the Grimsby borough electrical engineer, has been decorated with the D.S.O. He is at present acting Lieutenant-Colonel, and is in command of a battalion.

Captain H. Kember, South Lancashire Regiment, who has been killed, aged 32, was with the Westinghouse Co., at Trafford Park.

Lance-Corporal G. W. Batchelor, Bedfordshire Regiment (from the staff of Messrs. Rogers & Gowlett, electrical engineers, Watford), who has been gassed at the front, has gained the D.C.M. for bravery and good work on April 10th.

The Military Cross has been awarded to Temporary-Captain E. A. Barker, R.E., borough electrical engineer at Barnsley.

Sergeant B. Plant, Lancashire Fusiliers, reported missing, was an employé of Messrs. Taylor & Tunnicliffe.

Second-Lieutenant Norman R. de Pomeroy, R.F.C., reported killed, after being missing since October 20th, 1916, was in the test department of the B.T.H. Co., at Rugby.

Private G. W. Hipwel, Oxford and Bucks L.I., formerly at Rugby, with the B.T.H. Co., and recently listed as missing, was killed in action on May 3rd.

Private C. S. Inwood, Worcester Regiment, who has died in a French hospital for wounds, was an electrical apprentice with Mr. S. P. Marsh, electrical engineer, of Rugby.

The Military Medal for gallantry in action has been awarded to Sapper J. Wratten, Signal Section, R.E., who was on the staff of Mr. A. J. Bessant, electrical engineer, of Eastbourne.

Private W. T. Rolfe, Royal Fusiliers, who was with Messrs. Crompton & Co., Ltd., Chelmsford, has fallen in action.

The D.C.M. was presented last week to Private Bertram Watson, Royal Warwickshire Regiment, who was employed by the Manchester Corporation in the electricity department.

We regret to announce the death of Captain B. J. Moore, M.C., R.F.C., which took place on Sunday, June 10th, at Gosport. When flying at a great height his machine nose-dived to the earth through some unknown cause, and he was instantly killed. Captain Moore was an Associate Member of the Inst. of E.E. He was the grandson of the late Mr. John Fuller, and the nephew of Mr. George Fuller, the managing director of John C. Fuller & Son, Ltd., of Chadwell Heath. He was associated with that firm in business. Being engaged in the manufacture of mechanical and electrical matters connected with the working of internal-combustion engines, his interest went in that direction, and at the outbreak of the war he at once offered his services to the Royal Flying Corps. On account of his age, it was not easy to quickly get a commission, and rather than wait he took his flying certificate and enlisted as a private. After some service in England he went to the Front, and eventually received his commission as captain. He was awarded the Military Cross, which was presented to him by the King in February last. Captain Moore was of a very winsome disposition, and had a very large circle of friends.

Second-Lieutenant J. M. Clark, Royal Irish Rifles, wounded in action on 7th inst., is a son of the Rev. Canon Clarke, Kilead, Co. Antrim, and by profession an electrical engineer.

Marylebone Electricity Committee reports that one of the youngest employés in the department serving with the Army in France has been awarded the Military Medal for capturing an enemy machine gun and team:—Rifleman John Norris, who volunteered in May, 1915, when only 17 years of age, and has seen much service in France.

Second-Lieutenant G. A. M. Leathem, Royal Irish Rifles, wounded in action on 7th inst., was on the staff of the Belfast Corporation electric station.

Sergeant H. Bramah, Acting Company Sergeant-Major of the 1st Battalion Gordon Highlanders, has gained further distinction on the battlefield. Two men of the R.A.M.C. were buried in a dug-out by a gas shell, and all the passages leading to and from the dug-out were blocked. In gallantly attempting to rescue these men under shell fire, the R.A.M.C. doctor and Sergeant Bramah—the latter being at that time severely wounded by shell splinters—were themselves rendered unconscious. Sergeant Bramah has now been awarded a bar to the Military Medal which he gained in July last. He is on the resident engineer and surveyor's office staff at the County Asylum, Hellingly, and is at the Summerdown Camp, Eastbourne.

Obituary.—Mr. M. O. Teague.—A *Times* advertisement records the death on June 14th, after a long illness, of Mr. Morice Ord Teague, A.M.I.E.E. Another advertisement in the same paper states that Mr. Bertram Henry Hewett, A.M.I.C.E., died in Bombay on June 11th. Mr. Hewett, we believe, was electrical and mechanical engineer to the Bombay Municipality.

Will.—The late Sir W. Macdonald left £200,000 to Macdonald College, which is affiliated to McGill University.

NEW COMPANIES REGISTERED.

Veritys Founders, Ltd. (147,638).—Private company. Registered June 2nd by Slaughter & May, 18, Austin Friars, E.C. Capital, £100,000 in £1 shares. To acquire all or any part of the deferred ord. shares of Veritys, Ltd. Agreement with G. Verity, J. F. Lister, B. C. Evans, and T. Lons. The subscribers (each with one share) are: G. Verity, Plume Works, Aston, Birmingham, engineer; B. C. Evans, Plume Works, Aston, Birmingham, company director. The first directors are: G. Verity, J. F. Lister, B. C. Evans, and T. Lons. Solicitors: Slaughter & May, 18, Austin Friars, E.C.

C. E. Falconbridge, Ltd. (147,691).—Private company. Registered June 9th. Capital, £2,000 in £1 shares. To carry on the business of electrical engineers and contractors, suppliers of electricity, carriers of passengers and goods, &c. Agreement with C. E. Falconbridge. The subscribers (each with one share) are: C. E. Falconbridge, 114, Mansfield Road, Nottingham, electrical engineer; J. T. Kamp, 19, Highfield Road, West Bridgford, Notts, electrical engineer; H. E. Crommard, 126, Radcliffe Road, West Bridgford, Notts, electrical engineer. The first directors are not named. Solicitor: A. Barlow, 1, High Pavement, Nottingham.

Moul & Co., Ltd. (147,715).—Private company. Registered June 12th. Capital, £2,000 in £1 shares. Manufacturers of, and importers of and dealers in, all kinds of speed-indicating apparatus and parts thereof and accessories thereto, metallurgists mechanical and electrical engineers, &c. The subscribers (each with one share) are: J. C. Moul, 186, Turner Road, S.E. 21, engineer; W. A. Landan, 115, Westbourne Terrace, W. 2, merchant. Registered office: 1, St. Anne's Chambers, Orchard Street, Westminster.

British Barimar-Thermit Welding Co., Ltd. (147,739).—Private company. Registered June 15th. Capital, £5,000 in £1 shares. Welders, annealers, metal founders, casters and workers, wire drawers, tube makers, japanners, enamellers, engineers, boiler makers, electrical engineers, motor vehicle, cycle, motor boat, and aeroplane manufacturers and repairers, &c. The subscribers (each with one share) are: C. W. Brett, The Bee Hive, Bridge Road, Maidenhead, engineer; H. E. Lamplough, Brampton, Rickmansworth, engineer. The first directors are: H. A. Blackwell, C. W. Brett, H. E. Lamplough, and W. L. Turner. Qualification, £250. Solicitors: Kenneth Brown & Co., Lennox House, Norfolk Street, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

San Luis (Mexico) Tramways, Ltd.—Particulars of £10,000 prior lien debentures created May 14th, and secured by trust deed dated 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, amount of the present being £1,000. Property charged: 2,997 shares of a Mexican company, referred to in a trust deed of July 15th, 1912, and the company's undertaking and property, present and future, including uncalled capital. Trustees: H. C. Walters and A. Naylor.

Keswick Electric Light Co., Ltd. (28,820).—Capital, £20,000 in 15,000 pref. and 5,000 ord. shares of £1 each. Return dated April 14th, 1917. 3,420 ord. shares taken up; £3,420 paid. Mortgages and charges: £10,100 5 per cent. debentures.

CITY NOTES.

Anglo-Portuguese Telephone Co., Ltd.

Mr. Herbert Allen, presiding at the annual meeting, said that in 1916 they did a record business, with a record increase of subscribers, income, and profit. The current year promised to show equally satisfactory results. The gross income in 1916 was better by £11,655 than for 1915, but the net profit increase was only £2,493, owing to increased cost of materials and labour, and chiefly to loss on remittances. The loss on exchange for the current year might be anything from £20,000 to £25,000, or possibly even more, and that was one reason why they had adopted on this occasion a rather more conservative dividend policy, although they expected some set-off in the normal growth of the business. They also had to take into account further capital requirements. The end of the war was not yet in sight, but even a victorious ending would not necessarily herald a sudden loosening of the purse strings of capital. They must, therefore, be prepared to rely to a considerable extent, and for some time to come, upon their surplus revenues for meeting capital requirements. It was well to be on the safe side and husband their cash resources, and so they were recommending a curtailment of the dividend until they could see their way ahead a little more clearly. A special resolution was passed at the meeting increasing the authorised capital from £150,000 to £200,000.

Birmingham District Power and Traction Co., Ltd.

Mr. C. S. B. Hilton presided at the annual meeting on June 11th. He said that the traffic receipts of the tramways were nearly £7,000 better than in 1915, and the total revenue was better by £7,900. The expenses showed a considerable increase. Only £515 was expended on renewals, owing to the impossibility of obtaining materials and labour. The wear and tear of the track and rolling stock was becoming more and more accentuated day by day, and the ultimate cost of renovation would inevitably be increased, so that it was necessary to accumulate as large a fund as possible for this purpose. Briefly stated, they had, after providing fully for reserves, held their own, and increased the carry-forward by £3,000. They were paying 4½ per cent. on the preferred ordinary shares, and carrying forward £5,569. The Shropshire Power Co., in which they were interested, had paid a dividend of 4 per cent., compared with 3½ per cent. for 1915. The output of that company was more than doubled (increase 115 per cent.), and it was still growing. The Birmingham & Midland Motor Omnibus Co. was adversely affected by the petrol restrictions and labour shortage. The tramway companies in which they were interested had in almost every case paid slightly larger dividends, and carried increased sums to reserve.

United River Plate Telephone Co., Ltd.

Sir John Gavey presided at the annual meeting on June 12th. He said that the accounts were extremely satisfactory, notwithstanding the difficult times. The rate of progress as measured by subscribers' stations showed a distinct improvement, though they had not, of course, reached the annual rate of increase which they had attained before the war. The net profit was £231,855, as against £193,771 for 1915. Their capital expenditure during 1916 was appreciably less than in 1915, a large amount of work having to be held over owing to the non-arrival of material, and some even might not be in their hands this year. Their trunk line system giving connection to the city of Buenos Aires remained as at the outbreak of war. Small exchanges had been opened at Bernal, Ituzaingo, Castelli, Fisherton, and Dionisia, and the common battery switchboard installation in the La Plata exchange referred to last year had been brought into service with good results. A considerable amount of underground plant had been laid in Buenos Aires, as well as in Mar del Plata, the Argentine Brighton, and they had also completed an aerial cable scheme in Rio Cuarto, an important town in the province of Cordoba, which had greatly improved the service. In Buenos Aires only two exchanges remained to be converted to the common battery system. For one of these (Belgrano) the new building was now practically completed, the switchboard was in course of manufacture, and they hoped early next year, if all went well, to have the exchange working. For the other, and last, exchange (Barracas), they had recently purchased a site for the new building at a favourable price, but it would not be possible to proceed with the manufacture of the switchboard until after the war. When these were completed the city of Buenos Aires would be wholly provided with telephone plant equal in efficiency to that of any other great city in the world; but, of course, the general development to meet the anticipated growth of subscribers that would have taken place in normal conditions had been arrested. Careful surveys made in Buenos Aires in the years 1912-1913, and fully studied by the board in personal communication with the general manager, the engineer-in-chief, and the consulting engineers, had shown the need for at least three large additional exchanges to meet the anticipated requirements between the years 1918-1922, and the site for one had been actually purchased when the war broke out. Owing to the lack of materials the proposals originally agreed to had had to be deferred, due to the fact that subsequent to the year 1914 manufacturers of the plant they used became increasingly and, finally wholly, engaged on war work, so that great difficulty was experienced in obtaining stores, even for maintenance and renewal purposes. Fortunately, the ample provision made for growth in the shape of spare plant, which must always be provided in a progressive telephone service, had enabled the company to meet the increase of subscribers up to now, although should the war last for a considerable period much difficulty might be experienced later. The results for the current year promised to be as good as those that were before them that day.

A French Supply Company.

The Société d'Energie du Sud-Ouest, which has an ordinary share capital of £960,000, and loan capital of £545,000, reports that the production of the company's works in 1916 experienced a considerable increase, owing to the growing demand of the many industries engaged on work for the national defence in the district of Bordeaux. It was possible to cope with the emergency by the utilisation of the available hydraulic power to a greater extent, and by the more active working of the Tuilière steam power station. The latter, which was established principally to work only during the rises from periods of low water, had to be kept in operation every day, and had yielded increasing quantities of energy as a result of the starting of a new unit of 10,000 kw. in March, 1915. The complete utilisation also of the Tuilière hydraulic power, together with the advance in the prices of coal and the growing increase in the demand for energy produced at the steam power station, rendered it urgently necessary for the company rapidly to construct one of the hydro-electric works which had been investigated for the Dordogne above Tuilière. The Mauzac fall, where an existing dam is to be used, and for the utilisation of which the necessary administrative authority had been obtained, was first to be taken in hand; and it could be equipped with six units, each of 2,000 h.p. The second, which would be situated between Mauzac and Tuilière, could be established subsequently, and be provided with six units, each of 3,300 h.p. It is estimated that the expenditure on the first station, and on the feeders and distributing works, will amount to £840,000, and it is proposed to raise a loan of £640,000 for this purpose in the first place, and to increase the share capital by £240,000 at a later period. The company's accounts for 1916 show net profits and balance forward amounting to £67,000, and a dividend at the rate of 6 per cent. has been declared.

South Wales Electric Power Distribution Co.

Mr. W. G. Dalziel presided at Cardiff recently over the annual meeting of the company. [A full report of the meeting appeared in the Cardiff and South Wales *Journal of Commerce.*] He first referred to the death of Mr. S. Boulter, who was appointed debenture agent under the 1908 Act, and who represented large interests and rendered valuable services during their very troublous times in 1908. Mr. G. Collis had been appointed to fill the vacancy. Seventy-two of the company's 200 employés (36 per cent.) had joined the Forces, and seven had laid down their lives. All the working expenses were borne by the Treforest Electrical Consumers' Co., Ltd. The units sold increased by 1,090,805 to 30,058,461. Under the circumstances this was satisfactory. Remote as the connection between the business of an electrical supply undertaking and shipping might appear to be, yet their output was affected to a considerable extent by the supply of tonnage at the coal shipping ports in that district. During the period under review, for reasons of which they were well aware, the shortage of tonnage, combined with the Government restrictions on the export of coal, had naturally reacted on the working of the colliery undertakings which took their power supply from them, with the result that they had experienced considerable fluctuations in their output from week to week and month to month. This condition of things was bound to affect their revenue, and particularly the costs, because, with the exception of the coal cost, practically the whole of the working expenses and standing charges remained the same whether the output was above or below the average. After payment of all working expenses, interest on prior lien debenture stock, and making provision for depreciation of new plant, there was a surplus of £8,555, an increase of £1,796. This surplus, together with the balance of £3,999 in hand at the end of 1915, enabled payment to be made of the full year's interest, £10,000, on the original debenture stock, leaving £2,554 to be carried forward. Here, again, the heavy increase during last year in the cost of stores and material of every description and the ever-increasing cost of labour had materially tended to reduce the profit they should otherwise have made. Nine years ago, when the company was reorganised, the net revenue of the Treforest Co. was short of the amount necessary to meet prior lien debentures interest by £3,342. In the past year, the net revenue was sufficient to meet prior lien debenture interest, and was within £1,506 of meeting ordinary debenture interest. The company's system had grown steadily, its mains now extended to over 130 miles; the public utility of the supply had become established, and it was reasonable to believe that it would in due time form the heart and arteries of the industries of South Wales. The supply was in demand for driving every description of machinery at collieries, steel works, chemical works, ropeworks, and numerous other works, and for public and private lighting and domestic uses. The additional electrical plant connected to the company's mains during last year amounted to 7,422 h.p. The total h.p. now connected was nearly 40,000, and further additions were coming on.

The adoption of the report was seconded by Mr. T. O. Callender, who said that the whole position of the company was steadily improving, and at a time not far distant the company would be able to pay its way. Those of them who had looked somewhat closely into the position of electrical supply now, and what might be expected in the future, when the war came to an end and peace reigned once more, were thoroughly impressed with the position which electrical energy would hold in the country, and they had every reason for believing that they were at the beginning of great developments in the use and extension of electricity throughout this country. Knowing the forces which were at work in the development of the new England, he had great confidence in the future, and especially with regard to their company.

In replying to complimentary remarks respecting his valuable services, Mr. W. A. Chamen, the general manager, said that never in our history had the prospects of the electrical industry in this country shown so much promise as now. He indicated a new departure which was likely, in his opinion, to come about within the next few years, and that was the application of electricity to agricultural purposes, not merely in ploughing and performing agricultural operations of that kind, but in the actual stimulation of the growth of crops. Experiments were being carried on actively at Hereford, and he saw no reason why, as those experiments promised so well, a great deal of the same kind of thing should not be developed in the rural districts of South Wales; for instance, in the Vale of Glamorgan and other parts of the Cowbridge rural district. Of course, their largest output was given to collieries and steel works, and what they might call heavy industries of that kind. It might be a little difficult to say at the moment how at such prices as they received for those supplies, agricultural supplies could be made to pay, but that was a difficulty which could be got over by charging for electricity in a different way. He mentioned that matter because it was already engaging the attention of a considerable number of people throughout the country.

London and Suburban Traction Co., Ltd.

Lord Stuart of Wortley presided at the annual meeting, on June 13th. He said that the conditions due to the war had seriously affected the prosperity of all the companies in which the London & Suburban Co. was interested, but it was doubtful whether, even if there had been no war, the expectations of the net revenue derivable from the London United Tramways Co. which were formed at the time of the amalgamation effected by the London & Suburban Co. could have been realised. The cost of maintenance and repair of the permanent way and rolling stock had been greater than expected, and the elimination of competition had not been carried out to the extent hoped for. Discussions between their company and the Underground Railway Co. had taken place with a view to the better co-ordination to the traffic facilities in Greater London, and it was hoped that these would lead to better understandings, and would result in improved profits to their company. The unfortunate results of the past year's working of the London United Tramways Co. were entirely due to the increase in the cost of working, for which the abnormal conditions caused by the continuance of the war must be held accountable. The present crisis in the fortunes of the London United Tramways need not cause anxiety as to the future of their own company, but the board would have to do all they could in the coming negotiations with the first mortgage debenture holders of the London United Co. to safeguard the £68,000 which they owed to the London and Suburban Traction. In view of the increase in the wages bill of certain of their subsidiary companies, and other difficulties which the continuance of the war must bring about, shareholders could hardly expect him to express optimistic opinions as to the prospects of the present year's operations, but it was to be hoped that the genial weather which had been experienced since May 1st might continue for the rest of the summer. In view of the abnormal increase in the costs of operation of their various enterprises, the board had for some time past been devoting their efforts to increasing where possible the price of its commodities. They were considering proposals for a general increase of fares.

Southern Brazil Electric Co., Ltd.—The year 1916 was one of considerable trouble as regards the development and extension of the company's interests in Brazil, owing to the difficulty of obtaining the requisite materials from abroad, and the restrictions and delays attending their shipment. These difficulties are more likely to increase than diminish, and the progress of all new work must therefore necessarily be slow. General conditions in the State of Sao Paulo continue prosperous, and the rate of Brazilian exchange, which at the end of December last stood at 12d., has lately risen to 13½d. The operations of the various undertakings in Brazil continue to show satisfactory progress, the gross revenue from all sources being 16 per cent. higher, and the net revenue 14 per cent. higher, than in the previous year. The balance to the credit of profit and loss account, after deduction of all charges in London and Brazil, and of interest on debentures and loans, is £1,199, plus the amount remaining to the credit of this account, £3,073, making £4,271, which the directors propose to carry forward.—*Financial Times.*

Altrincham Electric Supply, Ltd.—During 1916 the number of consumers increased by 36 to 1,699. After providing for debenture interest and charges, &c., the profit is £4,903, plus £918 brought forward. The preference dividend is paid, and there is put to general reserve £500, to depreciation reserve £1,500, and to excess profits duty £447, carrying forward £975. The reduction in profits is due to the Daylight Savings Bill, increased price of coal, and higher working costs generally. £10,357 was expended on additional plant, mains, &c., including a new turbo-generator. Under the circumstances, this expenditure has had to be temporarily provided out of the company's resources. It is not considered desirable to declare a dividend on the deferred shares.

Singapore Electric Tramways, Ltd.—For 1916, after charging debenture interest, depreciation, and royalty to the Municipality of Singapore on tramway profits for 1915, the accounts show a profit of £9,913, plus £6,033 brought forward. It is proposed to transfer £3,000 to depreciation reserve account, and to carry forward £7,946. The power expenses amounted to £17,005, as against £12,319, the increase being principally due to the cost of coal. Sales of energy for lighting and power show a slight decrease, being £13,530, as against £13,789 for the previous year.

James Keith & Blackman Co., Ltd.—The accounts show, after providing for debenture interest, excess profits duty, and allowing for depreciation and reserves against doubtful debts, a net profit of £33,699, against £32,520. Dividend 10 per cent., same as for 1915, free of tax, on the ordinary shares; £20,000 placed to reserve account, against £10,000; carried forward £14,102, against £10,515

London United Tramways, Ltd.—According to the *Times*, the committee of debenture-holders appointed to investigate the company's affairs consists of Messrs. David A. Bevan, R. H. Benson, J. C. L. Coward, M. W. Mattinson, and Albert G. Scott, and this committee will report to the debenture-holders at a meeting to be held on July 25th.

Russia.—The Telephone Construction Co. has been formed to take over and exploit the E. A. Englund concern in Moscow, capital 2,000,000 roubles.

The General Electrical Co., formed to continue the business of the Russian General Electrical Co., capital 24,000,000 roubles, has begun operations.

The United Electrical Engineering Works has been formed, with a capital of 750,000 roubles, to take over the Weinstein, Vishnyak & Co. electric concern in Petrograd.

Richardsons, Westgarth & Co., Ltd.—The accounts for 1916 show a profit of £119,377, against £76,241; depreciation written off £35,000, against £25,000. The question of reconstruction has engaged the attention of the directors. They are of opinion that the position can only be met by a reduction of capital, and a resolution will be submitted to the shareholders "that it is desirable that the capital should be reduced and re-arranged."—*Times.*

Tata Hydro-Electric Power Supply Co., Ltd.—Interim dividend at the rate of 7 per cent. per annum on preference and ordinary shares.

Calcutta Electric Supply Corporation, Ltd.—The number of units sold to consumers during the four weeks ended April 27th, 1917, amounted to 2,174,348, compared with 1,917,213 units in 1916.

Waygood-Otis, Ltd.—For the year ended March, 1916, the profit was £23,501. After providing for depreciation of plant and paying the preference dividend, the balance is to be carried forward.

Heenan & Froude, Ltd.—A petition for confirming the reduction of capital from £200,000 to £100,500 is to be heard on July 3rd.

STOCKS AND SHARES.

Tuesday Evening.

For some occult reason, the air raids are supposed to be exercising a check upon Stock Exchange business; but if we had to make a wager on the point, we would back the weather and the time of year as being the most potent influence of the moment. People do not feel energetic, either physically, mentally, or financially, with the thermometer standing in the neighbourhood of 90; and although there is a fair amount of investment business going on, this is not enough to stir prices to any particular extent.

The industrial market continues to command what remains of interest in the Stock Exchange; but, even here, the volume of trade passing is small. Marconis have held their rise well; not quite at the best, they are still substantially above the price of a month ago; and a wide circle of interest is agog as to the amount of bonus which the company is expected to receive from the Government so shortly.

In the Home Railway market there is nothing stirring. Undergrounds keep their improvements, and the income bonds remain at 84. The 6 per cent. income debenture stock has risen to 100. From various sides the directors of the company are being urged to put up the fares; and were they to do so, it is probable that the travellers who use the system would only feel that they had been lucky to have travelled so cheaply throughout nearly three years of war. The storm of last Saturday in the Thames Valley and the West End of the town did a good deal of temporary damage; but what remains of the British workman buckled to with a will on Sunday, and in a surprisingly short space of time traffic was resumed—at any rate, in part—over the areas, both on the roads and railways, where the floods had been most pronounced.

The electric lighting market shows no change as regards its list of prices. There is a growing scarcity of shares, however; and the tendency is to quote prices against possible buyers. In other words, it is easier to sell at middle prices than it is to buy. Edison Swan £3 paid are another 6d. to the good at 16s. 3d., making a rise of 5/16 in a fortnight. But the fully-paid shares are still unchanged at 27s. 6d., and the 4 per cent. debenture stock continues at 71½.

Eastern Extension shares at 13¼ show ⅛ rise, and are amongst the few first-class issues in this market, where there is a moderate supply of stock still available for the buyers. Those who fancy Eastern Telegraph ordinary stock find it is extremely difficult to get the offer of as much as £100 of it. Globe Telegraph preference at 10¼ are better. United River Plate Telephones are ex dividend, and have recovered all the deduction. Callenders at 13¼ are ex their dividend and bonus. Henleys remain at 15½.

Marconis have given way a trifle to 64s. 6d., although the official quotation is left unchanged at 3¼. There is some little activity in Canadians and Americans, the former being a good market at 11s. 3d., while the latter keep about 16s. The last report of the Canadian Marconi Co. was disappointing, but it is quite sufficient for the parent shares to go ahead for the subsidiaries to sympathise; and various favourable rumours are afloat to account for the buying of the Canadian shares.

Nothing official has transpired in regard to Mexico, but rumour is busy. Stagnation once more rules in the markets for Mexican industrials, while the railway stocks of the country are moving irregularly. Amsterdam is trying to buy Mexico Tramways bonds; maybe this has significance. Brazilian Tractions have risen ½ to 48, the exchange continuing to favour Brazilian issues. Rio de Janeiro Tramway first mortgage 5 per cent. gold bonds have hardened to 88½; and the 5 per cent. 50-year mortgage bonds are a firm market at 75¾. San Paulo Tramway 5 per cent. debentures came in the other day at 88. Rangoon Electric preference have changed hands between 4 7/16 and 4½, these carrying the dividend of 3s. per share due at the end of June. British Columbia stocks are quiet, pending the arrival of the papers from the other side, to which reference was made here last week.

Anglo-Argentine Tramways second preference fell to 2½, which is half their par value. No dividend has been paid on the shares since December, 1915; and as this is cumulative, there is 18 months' dividend included in the price, when it can be met. The distribution is 5s. 6d. per annum. Shares have changed hands during the past few days at 47s. 6d.; and the first preference are on offer below £3. The 5 per cent. debenture stock can be bought at 66.

British Insulated have risen 5s. to 12⅞, and it is difficult to find shares at all. The iron, armament, and steel group shows a good deal of strength, but rubber shares have given way. The principal reaction has come in those shares which attracted most attention a month ago, the buyers of that time now being ready—not to say willing—to take profits where such are available. The price of the material is dull at 2s. 9d. per lb. Tin was rushed up because of the submarine figures, though without stimulating business in shares of tin-producing companies. In mining markets, as in other sections of the House, business at the moment in travelling on very quiet lines.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend		Price		
	1915.	1916.	June 19, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	9	6½	—	£6 18 6
Charing Cross Ordinary ..	5	5	8½	—	7 2 10
do. do. do. 4½ Pref..	4½	4½	8¼	—	6 18 6
Chelsea	4	3	2⅞	—	5 4 4
City of London	8	8	12	—	6 13 4
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10⅜	—	6 11 9
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	7	10	5½	—	5 11 7
London Electric	8	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	8¾	—	5 6 8
Metropolitan	8	8	2⅛	—	6 0 0
do. 4½ per cent. Pref.	4½	4½	8⅛	—	7 4 0
St. James' and Pall Mall ..	8	8	6½	—	6 3 1
South London	5	6	2¾	—	7 5 6
South Metropolitan Pref. ..	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	5¾	—	6 1 9
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	98	—	6 2 0
do. Def.	33/6	1½	22½	—	6 13 4
Chile Telephone	8	8	7	—	5 14 4
Cuba Sub. Ord.	5	5	8	—	6 5 0
Eastern Extension	8	8	13¾	+ ⅛	*6 16 6
Eastern Tel. Ord.	8	8	139	—	*5 15 1
Globe Tel. and T. Ord.	7	7	12¾	—	*5 9 10
do. Pref. ..	6	6	10¼	+ ⅛	5 17 1
Great Northern Tel.	22	22	36½	—	6 0 7
Indo-European	13	13	51	—	6 7 5
Marconi	10	10	3¼	—	8 1 6
New York Tel. 4½	4½	4½	99	—	4 11 0
Oriental Telephone Ord. ..	10	10	2⅜	—	4 4 1
United R. Plate Tel.	8	8	6¾	+ ⅛	*5 18 6
West India and Pan.	6d.	6d.	1 3/16	+ 1/16	2 2 1
Western Telegraph	8	8	14	—	*5 14 4
HOME RAILS.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	24½	— ½	4 1 8
do. District	Nil	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A" ..	Nil	Nil	5/9	—	Nil
do. do. Income	6	5	84	—	*5 19 1

FOREIGN TRAMS, &c.

	Dividend				
	1915.	1916.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	2⅞	—	9 11 4
do. 2nd Pref. ..	5½	—	2½	— ⅛	—
do. 5 Deb. ..	5	5	66½	+ ½	7 10 5
Brazil Tractions	4	4	48	+ ½	—
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	57½	—	8 13 10
do. do. Preferred	Nil	Nil	87½	—	Nil
do. do. Deferred	Nil	Nil	32½	—	Nil
do. do. Deb.	4½	4½	58½	—	7 1 8
Mexico Trams 5 per cent. Bonds	Nil	Nil	37	—	Nil
do. 6 per cent. Bonds	Nil	Nil	30	—	Nil
Mexican Light Common ..	Nil	Nil	14½	—	Nil
do. Pref.	Nil	Nil	21½	—	Nil
do. 1st Bonds ..	Nil	Nil	37½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	3	—	5 0 0
British Aluminium Ord. ..	7	10	27/3	—	7 6 10
British Insulated Ord.	17½	20	12⅞	+ ¼	7 15 0
British Westinghouse Pref. ..	7½	7½	2⅜	— 1/16	6 6 4
Callenders	20	20	13¼ xd	—	7 11 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	22	22	8⅜	—	6 10 2
Edison Swan, £3 paid	—	—	16/3	+ /6	Nil
do. do. fully paid ..	—	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	71½	+ 1	5 12 0
Electric Construction	7½	7½	15/16 xd	—	8 0 0
Gen. Elec. Pref.	6	6	10	+ ¼	6 0 0
do. Ord.	10	10	15	—	6 13 4
Henley	25	25	15½	—	8 1 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12⅛	—	*8 5 0
Telegraph Con	20	20	87½	—	*6 8 2

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, June 20th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£75	..
a Ammonia. Muriate (large crystal)	,,	£54	..
a Bisulphide of Carbon	,,	£23	..
a Borax	,,	£38	..
a Copper Sulphate	,,	£61 10	..
a Potash, Chlorate	per lb.	2/6	..
a ,, Perchlorate	,,	2/-	..
a Shellac	per cwt.	215/-	..
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers ..	,,	£35	..
a ,, Lump	,,	£25	..
a Soda, Chlorate	per lb.	10½d.	..
a ,, Crystals	per ton	120/-	..
a Sodium Bichromate, casks ..	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c ,, Tubes (solid drawn) ..	,,	..	..
c ,, Wire, basis	,,	..	..
c Copper Tubes (solid drawn) ..	,,	1/8½ to 1/9	..
g ,, Bars (best selected) ..	per ton	£165	..
g ,, Sheet	,,	£165	..
g ,, Rod	,,	£165	..
d ,, (Electrolytic) Bars ..	,,	£142	..
d ,, ,, Sheets ..	,,	£167	..
d ,, ,, Wire Rods	,,	£150	..
d ,, ,, H.C. Wire	per lb.	1/5⅞	..
f Ebonite Rod	,,	3/-	..
f ,, Sheet	,,	2/6	..
*n German Silver Wire	,,	2/3	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	3/1	1d. dec.
i Iron Pig (Cleveland warrants) ..	per ton	Nom.	..
l ,, Wire, galv. No. 8, P.O. qual.	,,	£42	£2 inc.
g Lead, English Pig	,,	..	..
g Mercury	per bot.	Nom.	..
e Mica (in original cases) small ..	per lb.	6d. to 3/-	..
e ,, ,, ,, medium	,,	3/6 to 6/-	..
e ,, ,, ,, large ..	,,	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/9½	..
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	,,	..	..
n ,, Wire, Nos. 1 to 16	per lb.	3/6	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Diesel Engine Users' Association.—At the May meeting of this Association, a very instructive and interesting paper on the subject of "Tar Oil Fuel and Diesel Engines" was read by Mr. Geoffrey Porter, A.M.I.C.E. (president), in which he dealt at length with the question of tar oil specifications and the quality of the oils offered by distillers, and, further, with facts observed and inferences to be drawn from actual experience. In view of the present high prices ruling for imported residual petroleum oils, which have until lately almost exclusively been used in this country as fuel for Diesel engines, and of the increasing difficulty of obtaining sufficient supplies of this class of oils in present circumstances, the problem of the successful use of tar oils produced at home is not only of the greatest interest to users of Diesel engines, but is of national importance as well. Mr. Porter's statement of the experience gained up to the present in connection with this class of fuel will be of great assistance to many users and prospective users, and the discussion on the subject which is to take place at a meeting this week should be of very considerable interest. We hope to deal with Mr. Porter's paper in a later issue.

Assessment for Income-Tax—Allowance for Depreciation of Diesel Engines.—After protracted negotiations, an agreement has been concluded with the Inland Revenue Authorities to increase the rate of depreciation upon Diesel engines to 10 per cent. per annum, with the proviso that this increase shall remain in force for three years after the cessation of the war, when either party shall be at liberty to claim a revision. The appeals have been in the hands of Mr. Arthur D. Bird (of Humphreys-Davies & Co., Ltd.) and Mr. Percy Still (hon. secretary of the Diesel Engine Users' Association).

Having regard to the present high level of taxation, this increased allowance represents no inconsiderable saving to those companies and corporations entitled to the concession, and the Diesel Engine Users' Association is to be congratulated upon its enterprise in the matter.

About two years ago the Association took up the question of insurance of Diesel engines against breakdown, and was successful in bringing about a very substantial reduction in the premiums which had been previously charged in connection with that class of risk. The result of its activity in connection with income-tax assessment will now confer a further very important benefit on the firms and undertakings with which its members are connected

AUXILIARY MOTORS AND CONTROL GEAR FOR STEEL WORKS.

The conditions under which the motors for driving the auxiliary machinery in rolling mills and steel works have to operate are extremely severe. They have to be started, stopped and reversed with the greatest rapidity and frequency, and are subjected to heavy and rapidly fluctuating overloads. Moreover, motors for this class of service are often located in confined spaces where facilities for ventilation and the radiation of heat are extremely restricted, and on account of the large amount of dust and fine particles of mill scale suspended in the air, it is necessary that their working parts should be totally enclosed.

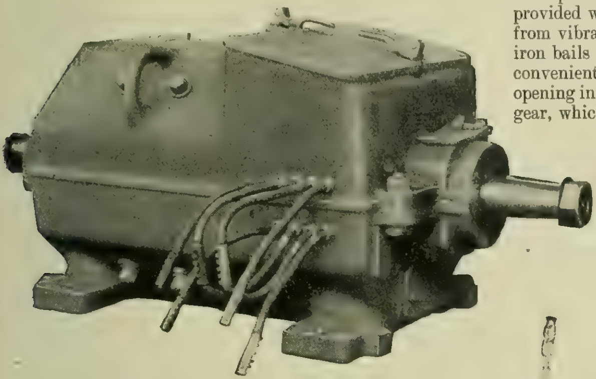


Fig. 1.—B.T.H. Mill Type Motor, 30 h.p.

To meet these and other conditions, familiar to steel works' engineers, a complete line of new mill type (MD) motors has been specially designed by the British Thomson-Houston Co., of Rugby.

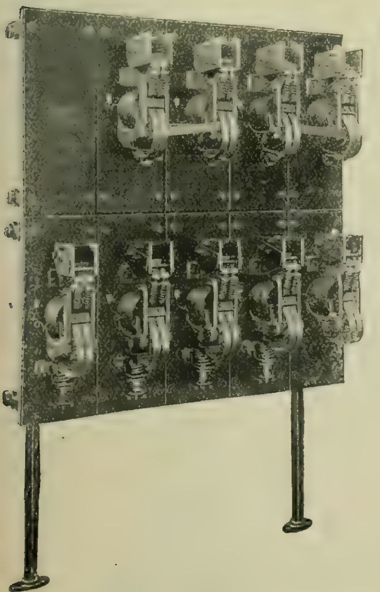


Fig. 3.—Automatic Control Gear.

The new mill type motors range in capacity from 3 to 150 h.p., and are designed for use on both 230 and 550-volt continuous-current circuits. They are rated for a temperature rise of 75° C. after a continuous run of one hour at full load, and will carry loads which vary instantaneously between light load running and 100 per cent. overload with black commutation, and much greater overloads may be carried without injurious sparking or the development of unduly high mechanical stresses. Their design embodies a number of special features to facilitate rapid replacement of any part that may be damaged, and the nature of the insulating material used is such that they can be run safely at temperatures up to 150° C. for considerable periods.

The general appearance of these motors is indicated by fig. 1, which shows one of the smaller machines. It will be seen that they are totally enclosed in steel frames, which are split horizontally. The lower half of the frame is provided with four heavy feet, and stability and freedom from vibration are ensured by their wide spread. Wrought-iron bails cast into the upper half of the frame provide a convenient means of handling the motor. There is a large opening in the frame directly over the commutator and brush-gear, which are thus easily accessible. In the larger sizes other openings are provided; and the malleable iron covers are held in place by locking levers. The frames of the 40, 60, and 80-h.p. motors are hinged, so that the upper parts may be turned back; this is a valuable feature where space is restricted, as it generally is about a mill.

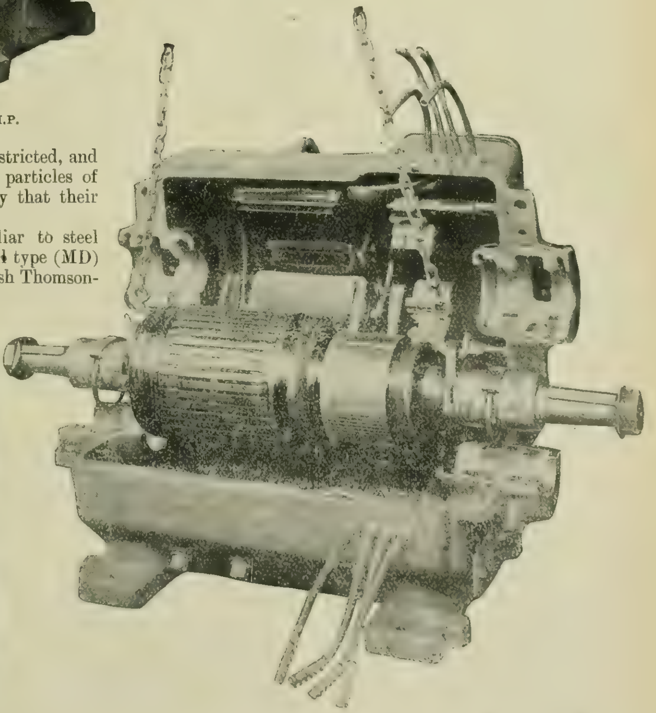


Fig. 2.—B.T.H. Mill Type Motor, with Cover Lifted, showing Method of Handling Armature.

The bearings are cast with the frame, and are therefore always in true alignment. The bearing liners are of cast-steel filled with best Babbit metal, and the two halves of each liner are bolted together. The upper half of each liner is cast with a lifting ring, as shown in fig. 2, and it is thus possible to remove the armature and shaft, and replace them immediately with a complete spare unit without delay or the provision of any special lifting tackle. Each bearing is provided with two oil rings to ensure continuous lubrication.

The poles and frame are so arranged that it is not necessary to slacken or remove any of the bolts or disturb the poles in any way when lifting the upper half of the frame. This is clearly shown in fig. 2. Neither is it necessary to disconnect any leads inside the motor, for all connections between the two halves are made by sleeve couplings outside the frame.

In the smaller motors the field coils are made of asbestos-covered wire, while in the larger machines they are of copper strip wound on edge with sheet asbestos between the turns, the entire coil being covered with sheet mica and a heavy wrapping of asbestos tape. All main and commutating coils are duplicates, and may be put on the pole pieces either side up without any chance of confusion or wrong connections; it is only necessary to connect alternate coils oppositely in an entirely obvious manner.

In view of the extremely heavy service for which these motors are designed, the shafts and bearings are exceptionally large, and the mechanical construction of the armatures is of the most substantial description. The armatures are built up on heavy spiders; the front flange is held in place by a shoulder on the spider, and the rear flange by four or more fitted bolts with nuts and special locking devices; the spacer blocks in the armature cores are of small channel steel, each welded to the adjacent punching. In order to secure an absolutely tight core the punchings are assembled so as to vary the lay of the iron in such a way that the last punching will be true, and the pressure on the core will, therefore, be uniform when the flanges are secured in position. The insulation on the punchings is a special varnish which will not powder or flake off.

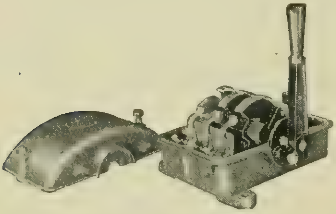


Fig. 4.—Master Controller.

The armature coils of the smaller motors are formed of asbestos-covered wire wrapped with mica and a covering of asbestos tape, after which the slot insulation is put on and the whole then compressed to size in steam-heated moulds. The result is a strong and solid coil free from air spaces and not easily injured. In the larger machines the coils are formed of copper bars, continuous at the rear end, and the soldered clips used on ordinary motors are thus eliminated.

An important feature of these motors is the use of the two circuit series drum or wave winding, which makes possible the use of two brush holders in every case where the current is such as to allow of this, and in the case of the larger 230-volt machines, where it is necessary to use more than two brush holders to collect the heavy currents, does not involve the use of any equaliser rings or cross connections between commutator segments.

The commutator bars are of hard drawn copper, and are formed with ears which extend to the full diameter of the armature. The armature conductors extend straight into the ears, so that separate commutator leads are eliminated, and there is only one hard solder joint for each connection between armature winding and commutator. The commutator shell is mounted on an extension of the armature spider, so that the shaft may be removed when necessary without breaking the connections between the winding and commutator.

The armature coils are secured in the slots by metal wedges, and the ends of the coils are secured by solid metal bands with cottered joints.

The ends of the armature windings are protected from injury by the commutator ears at one end, and at the other by an extension of the end flange.

In view of the importance of extremely rapid acceleration the armatures have been made small in diameter, and the peripheral speeds are low as compared with those of other continuous-current motors. As a result, the power required to accelerate an MD motor to full speed in a given time is only one-third to one-fourth of that required for a direct or alternating-current motor of ordinary design and the same power.

The brush holders are of the clock-spring type, with phosphor-bronze springs, and are quite accessible.

The special features of these motors are:—(*a*) Heavy mechanical design throughout; (*b*) large foundation area covered by spread of feet; (*c*) ease and rapidity of replacement of the various parts; (*d*) small stored energy in rotating parts; (*e*) non-combustible insulation; (*f*) great overload capacity.

Although primarily intended for driving live roller gear, lifting tables, and similar exacting duties, these motors may be used with advantage for ingot-stripping and ladle cranes, charging machines, and in other cases where reliability and continuity of service are essential.

The use of ordinary tramway-type or other hand-operated non-automatic controllers for the motors which drive live roller gears and similar machinery, results in excessively severe current rushes which sooner or later cause injury to the armatures or breakage of shafts or pinions.

The disadvantages attendant on the use of the hand-operated controller can be avoided entirely by the use of the automatic contactor control gear, with current-limiting attachments, which has been specially designed and developed for this class of service. This gear relieves the operator of all responsibility for slow and careful handling of the controller, and limits the current at all times to the maximum value the motor can safely carry. The acceleration or reversal of the motor is, therefore, effected with absolute safety at the maximum rate consistent with the mechanical and electrical capacity of the motor, and very much quicker than is possible with the most highly skilled manipulation of the ordinary type of controller. In short, the use of automatic contactor control gear enables the attendants to work the mill at the maximum rate of output possible.

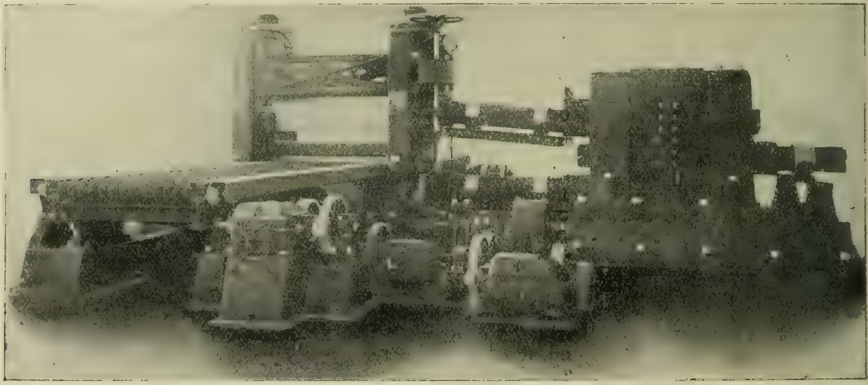


Fig. 5.—Three-high Plate Rolling Mill with Auxiliaries Driven by B.T.H. Mill Type Motors.

A set of control gear of this type includes a contactor panel, as shown in fig. 3, and a suitable set of resistances, together with the controller shown in fig. 4.

The controller, although small and light, is of the same substantial construction as the larger tramway type controllers made by the same firm, and has three points for each direction of motion, viz., a checking point on which a comparatively large resistance is connected in circuit to limit the rush of current when the motor is checked or reversed, a slow running point used for manipulating the ingots or billets, and a full-speed point.

The controller may be thrown instantaneously from the full forward to the full backward running position without fear of damaging either the motor or the gear to which it is connected. At the same time, the motor will be stopped and reversed in the shortest time possible.

Only the small current required for the magnet coils of the contactor passes through the controller, and the wear and tear of the fingers is therefore very small. The current supplied to the motor is controlled entirely by the contactors, which are fitted with heavy renewable copper contacts, and provided with powerful blow-out coils.

The design and construction of both motors and control gear is regarded by the makers as a triumph of the mechanical and electrical arts, and we understand that the combination is accepted by rolling-mill engineers as one that fills a long-felt want, and is, at the same time, an effective insurance against those annoying failures and delays which have such a marked effect in cutting down the output of rolling mills and steel works.

A three-high plate rolling mill with auxiliary plant driven by B.T.H. mill-type motors is shown in fig. 5.

CLEANING DIRTY INSULATORS.

[From a Telegraph Engineering Correspondent.]

It does not appear to be generally known that there is in existence a splendid method of restoring serviceable insulators, brought into stock, to their former efficiency.

No matter how blackened they may have become through long exposure in murky surroundings, the treatment hereafter described will bring about a remarkable improvement, without lowering the insulating value of the porcelain.

A further recommendation lies in the fact that excellent results are obtainable at small cost, and with a minimum of labour. This statement is made after an experience of two years with hundreds of dirty insulators recovered from the most grimy parts of England.

The usual method of restoring a semblance of cleanliness to blackened insulators is to rub the porcelain vigorously with a rag and moistened sand, or to soak them for several days in a barrel of dilute H_2SO_4. Either of these methods gives disappointing results, as may readily be judged if an inspection be carried out after a workman has done his best to make a good job.

In connection with the approved system, it is necessary to provide an iron tank partly filled with water, together with an admixture of quebracho extract and caustic soda. Into this tank of liquid are placed the dirty insulator cups, and a steam jet is applied until the liquid boils. The insulators are then taken out and rinsed in clear water.

Perhaps it would be best in submitting further details, if particulars were furnished of the actual arrangement which the writer has in mind.

An iron tank $\frac{1}{8}$ in. thick and 2 ft. × 2 ft. × 18 in. deep, capable of holding 120 insulators, is mounted on wooden supports 2 ft. high, so that a workman can perform his duty comfortably.

An ordinary steam pipe without a nozzle is made to enter the tank at a convenient corner, the lower end of which pipe terminates 1 ft. from the top, thus allowing for a space of 6 in. between the end of the steam pipe and the base of the tank.

As soon as it is desired to commence operations this space is filled with water. Quebracho and caustic soda are then added in the proportion of two to one. A tank of the before-mentioned size will require 3 lb. of quebracho extract and $1\frac{1}{2}$ lb. of caustic soda. The insulators are then inserted and steam is turned on at the valve.

The whole process does not occupy more than 45 minutes from start to finish. The liquid is brought to boiling point by the steam in about 15 minutes, and the insulators are withdrawn from the boiling solution after a period of 10 minutes.

An old pair of smithy tongs is used for recovering the insulators one by one from the tank, and though this may be regarded as a somewhat crude procedure, mention is made of the fact only to show that no elaborate precautions need be taken. As each insulator is brought out it is thoroughly rinsed in clean water, after which it is placed on a drip board; it is afterwards stacked in the stores depôt, ready for further service as and when required.

Experience has shown that an ordinary coal fire under the tank does not give such satisfactory results as a steam jet applied as directed. It will be obvious, therefore, that wherever steam is available this process of cleansing telegraph, telephone, or power insulators has much to recommend it.

The solution should not be allowed to stand in the tank after the work has been completed, but drained off and placed in a barrel for later use. When needed again the liquid would, of course, require strengthening in the tank with quebracho and caustic soda in the proportion already given.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electric Power in a Cotton Mill.

Our attention has been drawn to a descriptive article published in your issue of the 25th ult., entitled "Electric Power in a Cotton Mill," which includes the following sentence :—

"The whole of the electric plant, lamps, cables, &c., was supplied by the General Electric Co., Ltd."

As all the cables for this power installation were supplied by us. we can only conclude that the person responsible for the publication of the above statement had incomplete knowledge of his subject and that he failed to take ordinary precautions to ensure its accuracy.

We hope you will publish this letter in your next issue, and thus give equal publicity to our correction.

For **W. T. Glover & Co., Ltd.,**
G. E. Partington,
Business Manager.

Trafford Park, *June* 16*th*, 1917.

LEGAL.

General Electric Co., Ltd., *v.* Ossawa, Ltd.

In one of the Australian Courts, on April 17th, Mr. F. Leverrier. K.C., and Mr. G. E. Flannery appeared for the plaintiffs ; Mr. F. R. Jordan appeared for the defendants, J. Ossawa & Co., Ltd.

According to the following report in the *Sydney Morning Herald*. the plaintiffs, a few days earlier, on an *ex parte* motion, obtained an interim injunction restraining the defendant company from infringing the plaintiff company's exclusive trade mark, a magnet for certain switches and electric lighting apparatus. "The plaintiffs allege that the defendants, who were Japanese merchants, carrying on business in Sydney, had imported into Australia electrical apparatus bearing the plaintiffs' said trade device. Counsel for the plaintiffs now asked for the continuance of the injunction till the hearing.

"Mr. Jordan, for the defendant company, asked that the interim injunction be dissolved on the ground that the *ex parte* application on which it was granted suppressed certain material facts that were known to the plaintiffs. His clients had written to the plaintiffs stating they would discontinue selling the apparatus bearing the plaintiffs' trade mark, and mentioning that they had only indented consignments from England of the said apparatus for their customers. The full facts of the case had not been placed before his Honour when the *ex parte* application was made, and therefore the order was improperly obtained, and there was no justification for it.

"Mr. Leverrier, in reply, stated that the defendants had distributed a number of the plaintiffs' electric switches bearing their trade device. He read an affidavit from the plaintiffs' solicitors, which stated that the omission of the letters which had passed between them and the defendants' solicitors had occurred entirely through inadvertence as to their materiality in the application for the interim injunction.

"His Honour, while unreservedly acquitting the plaintiffs' solicitors of wilfully withholding the letters, said that he must, on the facts, dissolve the interim injunction, and he ordered the plaintiffs to pay the cost of obtaining it. He also dismissed the motion for an injunction to the hearing, with costs. The defendants, by their counsel, were to undertake not to infringe the registered trade mark of the plaintiffs."

Compensation Case.

At Preston County Court, last week, the National Electric Supply Co., Ltd., agreed to pay compensation to Nancy Norris, a switchboard attendant in the company's employ, in respect of an accident on February 9th of last year. Settlement was arrived at on the payment of 10s. 6d. per week from the date of the accident, with costs.

Breaking Insulators.

At Croston Police Court, three boys were each fined 10s., and ordered to pay the damages, for damaging telegraph insulators at Tarleton. Mr. Cornelius Coward, the district inspector of telegraphs, said the damage done last year over the whole of his lines, carrying main trunk wires and war traffic, was £400. Taking the same basis for the whole country, it would mean £100,000. This year, so far, 900 insulators had been broken in his area, and the men had sometimes to walk miles in order to detect the breakages.

Tungsten Filament Patent Litigation.

The hearing of the appeal by the Osram-Robertson Lamp Works, Ltd., was continued on the Thursday and Friday of last week, and has again occupied the House of Lords during the present week.

Mr. Walter, K.C., on June 14th, at the request of the Lord Chancellor, read the judgments before referring to the evidence. He was occupied with the evidence until the afternoon of the 19th, explaining how it bore on his proposition that the process invented by the appellants by which the finely divided tungsten was bound together by mixture with an organic binder, the carbon removed by wet hydrogen and heat, and the tungsten reduced to a pliable paste, capable of being made into fine filaments for lamps, was infringed by the respondents' process.

Of their Lordships present, Lords Haldane and Parker evinced the greatest interest in the learned counsel's statements, which at times took more the form of an instructive lecture than a legal argument.

Mr. Colefax, K.C., was expected to follow on Thursday (yesterday), and as Mr. Terrell, K.C., and Mr. Kerly, K.C., both propose to address their Lordships on behalf of the respondents, the case is likely to continue during the whole of next week.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

7,961. "Preparation of sensitised paper, &c., for obtaining direct X-ray photographs or radiograms." G. W. K. Crosland & T. P. K. Crosland. June 4th.

7,971. "Shade-carrier and lamp lock for electric lampholders." J. Macey. June 4th

7,973. "Magnetic separators." Hardy Patent Pick Co. & G. J. M. Smith. June 4th.

7,979. "Treatment of hides and skins prior to and during tanning." Electro Leather Industries & L. A. Groth. June 4th.

7,984. "Production of solutions of nitric acid in sulphuric acid or in fuming sulphuric acid by electrolysis." T. S. Moore. June 4th.

7,986. "Electric dynamos." H. Lucas & W. C. Turner. June 4th.

8,001. "Shade carriers." C. G. M. Bennett. June 4th.

8,012. "Collectors for trolley wheels of electric tramways and railways." W. C. Ashbury & W. D. King. June 5th.

8,058. "Electrical power transmission for motor vehicles." E. Boughton, Daimler Co. & F. W. Lanchester. June 5th.

8,089. "Motor to drive vehicle on its own inducted electric current." G. E. Harfield. June 6th.

8,100. "X-ray apparatus." British Thomson-Houston Co. & General Electric Co. June 6th

8,109. "Electric switches." M. J. Quinn. June 6th.

8,147. "Electrical appliance for inspection of interior of casks, jars, &c." W. Downs & J. M. Fitt. June 7th.

8,150. "Driving power-looms by electric motors." E. Preece. June 7th.

8,158. "Arc lamps, searchlights, &c." A. R. Culmer. June 7th.

8,176. "Electric furnace regulators." H. Etchells, H. A. Greaves, and T. H. Watson & Co. June 8th.

8,185. "Manufacture of alkali products by electrolysis." E. A. Ashcroft. June 8th.

8,228. "Electrodes for arc soldering, &c." A. B. Pescatore. June 8th.

8,232. "Radiotelegraphy and radiotelephony." J. Bethenod. June 8th. (France, May 26th, 1916.)

8,271. "Alternating current machinery." R. Pohl. June 9th.

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

6,893. Electrical Fuse Boards or Systems. A. Crawford & W. Preston. May 15th, 1916. (Cognate application, 12,043/16.) (106,305.)

6,945. Telegraph Systems. J. F. Parris & C. J. Baumgartner. May 15th, 1916. (106,312.)

6,983. Magnetic Compasses. E. C. Weilbach. May 16th, 1916. (106,317.)

7,003. Flashlight Signalling Apparatus. E. Ceretti. May 16th, 1916. (106,319.)

7,187. Electric Heating Devices. F. C. E. Burnett & E. J. Brunning. May 19th, 1916. (106,332.)

7,380. Electric Lamps. J. Mersing. May 24th, 1916. (106,339.)

9,702. Electric Controllers for Vehicles. C. P. Elieson & E. G. Payne. July 10th, 1916. (106,358.)

9,797. Mine Signalling Apparatus. J. Davis & Son, G. Dearle and P. Holmes. July 12th, 1916. (106,360.)

11,956. Electrical Stop Motions for Knitting Machines. W. H. C. Spencer & H. Collins, Ltd. August 23rd, 1916. (106,380.)

13,221. Method of Producing the Contacts of Contact-breakers of Magnetos for Firing Internal-combustion Engines. G. A. Rignon. September 18th, 1916. (106,397.)

16,201. Armatures of Magneto-electric Machines. G. F. Cooke. November 11th, 1916. (106,421.)

4,337. Automatic Block Signal Systems for Railways. National Safety Appliance Co. June 30th, 1915. (100,779.)

6,772. Mariner's Compass. J. L. H. Hand. May 11th, 1916. (106,139.)

8,516. Gyroscopic Compasses. J. Perry & S. G. Brown. June 16th, 1916. (106,170.)

1917.

1,437. Electrical Pushes. E. A. Graham. January 29th, 1917. (106,446.)

4,937. Telephone Appliance. F. Mayer. April 5th, 1917. (106,457.)

The National Physical Laboratory: Report for 1916-17.—The annual meeting of the General Board of the National Physical Laboratory was held at the laboratory, on the 19th inst. The president of the Royal Society, Sir J. J. Thomson, is chairman of the Board; Lord Rayleigh is chairman of the Executive Committee.

During the past year the laboratory has been closely engaged, with a largely-augmented staff, of whom more than one hundred are women, with a variety of researches and investigations arising out of the war, and has dealt with a greatly-increased volume of test work for Government Departments.

The outstanding feature of the year has been the growth of the gauge-testing work, the number examined averaging about 10,000 weekly. A new building has recently been erected to accommodate the work, the space otherwise available having become quite insufficient for the purpose. There has been a great increase also in the number of optical and electrical instruments tested for the Government; a new branch of work is the testing of luminous dials for instruments of various kinds.

The investigations carried out have been, in the main, of confidential character, and no details are given in the report. It has only been possible to make progress with a very few of the researches undertaken prior to the war, and these are almost entirely closely connected with war problems. Aeronautics research has continued to be of great importance. The William Froude National Tank has carried out much work for the Admiralty, and has been visited by members of the Board of Admiralty—including Mr. Balfour when First Lord—who have expressed much appreciation of the results attained. In the Metallurgy Department researches on light alloys and on optical glass have been continued, while a number of special problems have been dealt with. Various investigations have been in progress in the Engineering Department; hardness tests, methods of impact-testing, the fatigue resistance of materials under combined bending and twisting stresses, the transmission of heat from surfaces to fluids flowing over them—as in the flow of air over an aeroplane engine—are among the questions examined. The observations on the rate of growth of cracks in the buildings of the Tower of London have been continued. No serious disturbances have been detected.

The laboratory is at present under the control of a General Board and an Executive Committee appointed by the Royal Society and the great Technical Institutions, and the researches are assisted by a grant from the Treasury. The income during the past year was over £70,000, an increase of nearly £20,000 over that of the preceding year. The major part of this total is received in payments for work done, and this involves a serious financial liability. Much attention has been given recently to the question of the future of the laboratory, and in particular to its relations with the Department of Scientific and Industrial Research, and a scheme will, no doubt, be arranged whereby close relations with the Department will be established.

A Sensitive Selenium Cell.—Having a sensitiveness a thousand times greater than the ordinary types, the new selenium cell developed by Fay C. Brown, of Berkeley, Cal., is of more than passing interest. In his patent Mr. Brown states that the chief feature of his cell is in the production of the crystals by sublimation, and then allowing the crystals to absorb the gas argon, helium or neon at a temperature below that of the crystal formation. Both large and small crystals produced by this method have been investigated, and the inventor states that the crystals, even those of microscopic size, have shown no signs of deterioration, even after being exposed to most intense light 24 hours a day for 35 days in succession. One of his selenium cells was subjected to ordinary conditions, and showed the same sensibility after a period of a year.—*Scientific American.*

THE

ELECTRICAL REVIEW.

VOL. LXXX. JUNE 29, 1917. No. 2,066.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: June 29, 1917. [No. 2,066.

	Page
Wanted: a Policy ...	689
A Government Register of Export Manufacturers ...	690
High-pressure Rectified Alternating Currents ...	690
The Meeting of the Incorporated Municipal Electrical Association, 1917.—II. ...	691
Individual Interest in Municipal Enterprise ...	692
Electric Steel (*concluded*) ...	695
Correspondence—	
"Cross-talk" and "Secrecy." ...	695
Industrial Fatigue and Maximum Output...	695
Salaries in the Electrical Industries ...	696
New Electrical Devices, Fittings and Plant (*illus.*) ...	696
War Items ...	696
Business Notes ...	698
Notes ...	700
City Notes ...	704
Stocks and Shares ...	708
The Control of Alternating-Current Locomotives ...	709
Precipitation of Smoke and Fumes, by Linn Bradley ...	710
The Future of the British X-Ray Industry ...	711
Foreign and Colonial Tariffs on Electrical Goods ...	712
New Patents Applied for, 1917 ...	712
Abstracts of Published Specifications ...	712
Contractors' Column ...	Advertisement page xxii

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

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OFFICE 1–4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson, & Co., Gresham Street.

AUCKLAND N.Z: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.

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MILAN: Fratelli Treves.

NEW YORK: D. Van Nostrand, 25, Park Place.

PARIS: Boyveau & Chevillet, 22, Rue de la Banque.

PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Loescher & Co., Corso Umberto 1° 307.

SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.

TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

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WANTED: A POLICY.

DURING the 22 years which have passed since its formation, the Municipal Electrical Association has enjoyed the distinction of being the only organised body in the country which can boast of having as its single aim the bringing of electricity supply within the reach of every class of consumer. Admittedly, municipal control has been found wanting in some respects—there are limitations in a system of government "by the people, for the people," and past legislation has by no means tended to give electricity suppliers a broad view of their responsibilities—but this has not deterred the Association from steady purposeful effort with a view to furthering electricity supply under municipal auspices, and it is only fair to admit that the excellent work thus far accomplished under the guidance of the Association has to a large extent disarmed biased criticism of municipal control. Such being the case, the abrupt demand by Mr. Roles, at the annual general meeting of the Association on Friday last, that the Council should formulate a definite policy, and especially the darksome hints as to the future, which accompanied the demand, together with other remarks let fall during the meeting, "give one furiously to think."

The established methods of electricity supply in this country are admittedly inadequate to the future needs of its population; that this has been realised is shown by the formation of the Board of Trade Committee and the terms of reference to the latter. While no fault can be found with these terms, it is obvious that the constitution of the Committee which is "to consider and report, &c.," may be open to considerable criticism, which it has, in fact, received, the municipal authorities claiming with considerable justice that they were not adequately represented, and having now secured further representation. Whether this change will restore the confidence of all parties we do not know. It is possible that the Committee has given the impression that it is a tribunal with a partiality for private enterprise, and, therefore, a strong distaste for municipal trading in any shape or form; such an assumption would be justified by the composition of the Committee, which includes too many governmental representatives and too few central-station men.

It would be a matter for regret if the idea that electricity supply methods were on their trial was interpreted to mean that municipal supply methods were the culprits! In any case, not the system, but its originators are deserving of blame, and they, in fact, belonged to the class which has supplied a considerable proportion of the present committee.

The fundamental, though unwritten, policy of the municipal fraternity, as we have understood it, has always been the supply of electricity at the lowest possible price; such a policy necessarily involves a somewhat visionary profit margin, even in normal times, and is thereby differentiated from private control in which the profit margin must naturally be the first consideration.

Leaving aside the alternative evils of possible political jobbery in municipal control, and equally possible financial juggling in private enterprise, it should not be a matter of difficulty to determine which type of control has most nearly ensured—in the terms of the Committee's reference—" an adequate and economical supply of electric power for all classes of consumers."

If it be acknowledged that a cheap supply of electricity is a basic necessity of modern industry, that it is an indispensable factor in the prosperity of the country—and the formation of a Government committee to consider the question leaves no doubt on this matter—then it is difficult to recognise any other conditions than those of public service as applying to it, and it remains to be seen whether private enterprise can entertain such conditions. Municipal control is " too public," and company control " too private " to invite all-round confidence. It may be many years before the latter will find in cheap electricity supply a source of dividends; nevertheless, cheap electricity is the need of the hour, and " for all " should be the motto of the supply industry of this country.

A Government Register of Export Manufacturers.

An interesting announcement is made by the Board of Trade. In the first instance it relates to boots, clothing, fancy goods, and so forth — in all seven classes of manufactures are mentioned—but presumably it is not the intention to stop at these. The Board of Trade is compiling (in its Department of Commercial Intelligence) an Index or Directory of British and Irish manufacturers which it is proposed to forward to Consular Officers, Trade Commissioners, and other correspondents of the Board abroad for use in dealing with inquiries which they may receive for the supply of British and Irish goods both now and for delivery after the war. That there was room for something of this kind on a large scale has long been recognised by us, as reference to our pages several years before the war will testify. We endeavoured to meet the want so far as the electrical engineering and allied trades were concerned by communicating with all the principal consuls, commercial attachés, and trade commissioners on the matter, and, as one result of the very interesting correspondence which ensued, we placed the Electrical Review on file in the offices of these officials for their own use as inquiries arose concerning electrical manufactures for which a name of maker was required, and for the use of callers who wished to see what British manufacturers were making, and able to make, from their own announcements, and from editorial articles. The advantage of having access to such records is that they are, speaking generally, kept well up-to-date. The Board of Trade scheme is to publish a Directory which will presumably contain information which does not appear in the ordinary trade directories, of which, of course, there is no dearth. But it will only be complete, apparently, if every British manufacturer interested in the export trade sends in his particulars. The present invitation to him, in regard to the trades named, is to supply a detailed list of the articles which he manufactures: a list of the markets abroad in which he is more particularly interested; particulars of his agents abroad and of his terms of business; also any other information that would be of use in enabling inquiries from prospective purchasers to be adequately dealt with. We believe that while traders generally will agree that such a record should have been prepared years ago, it will be very necessary for after-the-war operations if Government Departments are going to adopt an active policy of assistance for our export industries. We believe that such is the national desire and the Departmental intention, but everything depends upon the reliability of the list, and the enterprise and activity displayed in using it. It will also require revision from time to time, both as to firms and as to the details of their manufactures. But however complete and reliable the list in these respects, it will not take the place of the direct intimacy that our national commercial representatives abroad should have with our actual industries at home. Nor will it in any way lessen the necessity for the advertiser giving all the information possible in his advertisements in such trade organs as find their way to colonial and foreign markets. As we have frequently said in these pages, the buyer—often right beyond the reach of Government offices, and almost out of touch with ordinary civilisation—looks to advertisements for telegraphic addresses, codes employed, and so forth, and for illustrations of types of manufactures or actual works carried out. Government directories are an excellent idea, and, as a foretaste of good foreign trade policy to come, we welcome them, but, after all, they will be but a small instalment of the organisation that is necessary to inform the purchasing world of the ability of British manufacturers to make practically anything that is required, to make it well, and to sell it without undesirable Hunnish methods.

High-pressure Rectified Alternating Currents.

Amongst the newer applications of electricity to technology there is an interesting, but remarkably diversified, group connected together by one dominant characteristic—the use of rectified alternating current at very high pressures. The three applications which comprise this group all happen to be referred to in this issue of the Electrical Review; they are electroculture, the precipitation of fumes, and X-rays. The pressures required range from 50,000 to 200,000 volts, the powers from 5 to 50 kw., and in each case a transformer is employed, in conjunction with either an A.C. supply or a D.C. interrupter in the primary circuit. Rectification may be effected either by a mechanical rectifier or an electrical " valve." The commercial importance of the X-ray industry is already obvious; that of the precipitation process has been fully established by the admirable work done mainly in the United States; that of electroculture is continually gaining in appreciation, and bids fair to leave its rivals far in the rear.

Here, then, is a singularly promising field for development, combining the certainty of immediate returns with the possibility, and probability, of enormous expansion in the early future, together with wide scope for the invention of improved apparatus and methods. Several British firms are admirably equipped with plant and organisation to handle this class of business successfully, and we trust that they are fully awake to the splendid prospect which it offers to energetic and enterprising exploitation.

THE MEETING OF THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION, 1917.—II.

In our last issue we referred to the meeting of the I.M.E.A., which took place at the Institution of Civil Engineers, on Thursday and Friday, last week. Although of such brief duration, and with many familiar faces absent, the gathering was a representative one, and served a useful purpose.

The **President**, Mr. F. M. Long, in opening the proceedings, suggested that the meeting should send congratulatory messages to Major W. A. Vignoles, of Grimsby, on being awarded the D.S.O., and to Captain Barker, of Barnsley, who has received the Military Cross; also that a message of remembrance be forwarded to Major H. Richardson, of Dundee, and others on active service, and this was agreed to.

Then followed the reading of the presidential address, to which we referred at some length in our last issue; a vote of thanks to the President was proposed by **Ald. Leese**, Stoke-on-Trent, and seconded by **Mr. W. A. Chamen**, who, touching on the address, said he thought the proposed Electricity Bill should go forward in any case, as it might be a considerable time before a Government Electricity Board or Department came into being.

Mr. Bowden then explained briefly the scope of his paper on "Individual Interest in Municipal Enterprise," and the discussion which followed occupied the remainder of the morning; abstracts of both paper and discussion are appended.

After an adjournment for lunch, the reading and discussion of **Mr. Robertson's** paper on "Fuel Economy" occupied the afternoon; both papers were well received, the speakers being generally in agreement with the authors, though possibly some misgivings may be felt as to the attitude of labour in regard to bonus schemes, and some doubt as to the present and future values of by-products and the cost of obtaining them—and these are, after all, fundamental matters in profit sharing and coal economy.

The general business meeting of the Association took place on Friday morning, and the question of coal economy was again brought forward, this time by **Mr. Guy Calthrop**, Controller of Coal Supplies, who took the opportunity of briefly addressing the meeting on the subject.

Mr. Calthrop said no interference with industry was intended, unless it was essential in the national interests, but it was desired to co-ordinate the use of coal, and the two problems to be faced were the supply of London during the coming winter and the general transport of coal. He pointed out that the war was largely a transport problem. They had a scheme in hand with the object, as far as possible, of consuming coal near the place of origin, which affected some 40 million tons, and would save 700 million ton-miles in transport. He agreed that electricity producers were expert coal economists, but though the seven million tons annually used by electric lighting, tramway, and railway undertakings was a small proportion of the 240 million tons consumed, even in this economies were advisable, and he urged them during the summer to economise for winter use. The transport difficulty would not end with the war, and difficulties were anticipated next winter. He realised the necessity of their work, but appealed to them to assist him if possible. As far as he was able, he intended to see that the Price of Coal Limitation Act was carried out.

The **President** assured Mr. Calthrop of their willingness to assist him, and a number of questions were asked. **Mr. Ellis** (South Shields) pointed out the difficulty of getting the appliances which would enable them to economise in fuel, and suggested that some arrangement between the Coal Controller and Ministry of Munitions might be made to get over the difficulty, while **Mr. Yeaman** (Stoke-on-Trent) touched on the question of reduced quantities of local coal under contracts, necessitating using distant coal at increased cost. **Mr. F. Ayton** (Ipswich) pointed out the disadvantages in the way of cost, labour, haulage, and decreased plant efficiency, of the dirty coal now supplied, and asked whether this matter could be remedied; and **Mr. Clothier** (Bootle) said they could not agree that the Board of Trade decisions conformed with the Price Limitation Act, and asked whether the matter could be opened again.

Mr. Calthrop, in reply, briefly assured them that he would endeavour to obtain reasonable priority for new fuel plant, and would assist them in the matter of dirty coal and reduced quantities supplied under contract, if particulars were given. Mr. Calthrop then withdrew.

The annual report, an abstract of which appears below, then came up for discussion. With reference to the Council's recommendation that the resolution of 1913, in regard to the "Model general conditions of contract," should be rescinded, and the matter be left in the hands of the Council, **Mr. Purse** (Carlisle) moved an amendment, in the form of an addition, to ensure that no action should be taken in the matter until it had been brought before the Association again, and the amended recommendation was agreed to.

Considerable discussion took place on the question of municipal representation on the Board of Trade Committee on Electricity Supply.

Mr. Faraday Proctor (hon. sec.) said he presumed that the Committee on Electrical Trade After the War was prohibited from dealing with municipal trading, and he believed that was one reason why the later Committee on Electricity Supply was formed; the Board had agreed to give them more representation, and he believed the names of three additional members were to be submitted by them. They had also heard that one of their members was to be invited to give evidence.

Ald. Pearson (hon. solicitor) stated that the Council had adopted a resolution that the President of the Board of Trade should accept the nomination by the I.M.E.A. and the Association of Municipal Corporations of the three new members.

Mr. Clothier (St. Anne's) mentioned that the Urban District Councils' Association had been asked to nominate somebody on the Committee.

Mr. Thos. Roles (Bradford) suggested that if the Board of Trade refused to accept their decision on representation, they should consider whether evidence should be given before the Committee.

Councillor Walker (Manchester) pointed out that originally it was desired to have witnesses, now a witness, and the Committee would decide the points on which evidence was wanted. He thought this was suspicious, and was prepared to consider the previous speaker's suggestion.

Ald. Pearson (hon. solicitor) suggested that the Council's resolution be passed, and that a further resolution could be put to the meeting in regard to the representation of the U.D. Councils' Association, but after further remarks by **Ald. Smith** (Barrow), who urged that two of the representatives should be engineers, and **Mr. Faraday Proctor**, who pointed out that the Association of Municipal Corporations was putting forward evidence from three localities of large, medium and small population, an amendment was agreed to that the Association of U.D. Councils be included in the resolution.

Mr. Thos. Roles (Bradford) urged that a definite policy should be subscribed to by the I.M.E.A., this being a matter of great importance at the present time, and, after a brief discussion, a resolution instructing the Council to formulate such a policy was passed.

Mr. Purse raised the question of plant extensions by municipalities being refused by the authorities, while power companies appeared to be favoured in that matter, and suggested that the Council should obtain full particulars as to sanctions given and refused to municipal authorities.

Mr. Faraday Proctor agreed that rumours had reached them, and that the Council would take action, if facts were submitted to it.

The proposed revision of the Articles of Association, with a view to giving the smaller undertakings more representation, was agreed to after a short discussion with a view to obtaining a representative of an Urban District Council on the Council, an amendment to this effect being lost.

The result of the ballot for officers and Council for 1917-1918 was as follows:—

President.—S. J. Watson (Bury).

Vice-Presidents.—F. Ayton (Ipswich) and Thomas Roles (Bradford).

Past Presidents.—H. Richardson (Dundee), A. C. Cramb (Croydon), and F. M. Long (Norwich).

Council.—New members elected are Messrs. J. A. Robertson (Salford), S. E. Fedden (Sheffield), W. T. Kerr (Hereford), and Aldermen Robinson and Jeffrey; the members of Council remaining in office are Messrs. Britton (Chester), Lackie (Glasgow), Pearce (Manchester), Councillor Barge (Poplar), Alderman West (Coventry), Messrs. Allen (Wolverhampton), Bowden (Poplar), Christie (Brighton), Councillor Sinclair (Swansea), and Alderman Walker (Manchester).

Messrs. Edgcome (Kingston-on-Thames), Alderman Pearson (Bristol), and H. Faraday Proctor (Bristol), were respectively re-elected as hon. treasurer, solicitor, and secretary.

The decision as to the locality of the next annual meeting was left in the hands of the new president.

TWENTY-SECOND ANNUAL REPORT (*abstract*).

After allowing for resignations, removals, and lapses due to members leaving municipal employment, there is a decrease of two in the total membership, now standing at 374, the decrease being in the Associates' class.

Model General Conditions of Contract.—At the last annual general meeting of the Association, it was pointed out that for two years previously the Council of the Association had been in negotiation with the Council of the Association of Municipal Corporations on what were then known as the "Beama" Clauses of the Institution Model General Conditions. As no report was received from the Association of Municipal Corporations on the subject, and as that Association did not respond to the repeated applications of the I.M.E.A. Council to complete their consideration of the matter, it was suggested by the Council of the I.M.E.A. at the annual general meeting held last June that the resolution of the annual general meeting of 1913 should be rescinded and the conditions provisionally adopted.

Further recent inquiries by the I.M.E.A. have resulted in a reply from the Association of Municipal Corporations admitting that the subject is in a position that cannot be regarded as altogether satisfactory.

The present deadlock can only be removed by the generel meeting rescinding the resolution of 1913, and so enabling the Council of the Association to move in the matter independently.

The Council therefore recommend to the general meeting that the resolution referred to be rescinded, and the matter left in the hands of the Council.

Supply of Electricity Bill.—Immediately after the business meetings last June, a joint meeting of representatives of the Council of the Association and of the Association of Electric Power Companies was held, and it was decided to form a Joint Committee to deal with the Supply of Electricity Bill now in draft, and to invite the I.M.E.A. to appoint three representatives in addition to Mr. H. Faraday Proctor, who had been appointed joint honorary secretary of the Committee with Mr. de Turckheim. Mr. F. M. Long, Alderman Walker, and Mr. J. W. Beauchamp were appointed to represent the Association.

As the outcome of the work of the Joint Committee several new clauses have been embodied in the Bill. These new clauses deal with the granting of wayleaves over, under, or through private property, the construction of lines over ground, the re-drafting of the clause dealing with the giving of partial supply in certain cases (stand-by), the supply to districts where there are no authorised undertakers, obligation of undertakers to furnish a supply, methods of charging, charging and maintenance of electric vehicles, &c., &c.

The various clauses in the Bill were gone through, and evidence in support of the same was given before the Board of Trade Committee on Electrical Trade after the war.

Linking-Up.—On the same day at a similar meeting, the I.M.E.A. was invited to appoint five representatives on a Joint Committee in addition to Mr. H. Faraday Proctor, who was appointed joint honorary secretary with Mr. de Turckheim. The I.M.E.A. representatives are Messrs. T. Roles, S. L. Pearce, R. A. Chattock, W. W. Lackie, and J. H. Bowden.

Several meetings of the Joint Linking-up Committee have been held, and local Committees have been appointed in various districts throughout the country, all of whom have had meetings and are getting out statistics and other information, and in some few instances considerable progress in the matter of linking-up has actually been made.

Eastbourne and the Board of Trade.—In view of the fact that the recommendations of the Officer of the Board of Trade were not adopted by the Board Trade, and bearing in mind that the Electrical Adviser to the Board of Trade is retiring from office in June, 1917, and that therefore it was difficult to take up the question of detail with him, further consideration of this matter has been deferred.

Summer Time Act, 1916.—At the request of the Home Office Committee appointed to inquire into the working of the Summer Time Act, 1916, and its renewal in 1917 and subsequent years, the I.M.E.A. circulated a *questionnaire* on the subject, and the honorary secretary, Mr. H. Faraday Proctor, and other members, gave evidence before the Committee.

Reserved Occupations.—A considerable amount of correspondence has taken place with the Reserved Occupations Committee; and representatives of your Council, acting in conjunction with the Institution of Electrical Engineers and the Incorporated Association of Electric Power Companies, waited as a deputation upon the Reserved Occupations Committee with a view to pointing out the necessity of reserving to electrical undertakers a sufficiency of of qualified employés to carry on the undertakings in a reliable manner for the maintenance of munition supplies, &c.

Training of Disabled Sailors and Soldiers.—At the invitation of the Institution of Electrical Engineers, the I.M.E.A. nominated Mr. J. W. Beauchamp to serve on the Committee formed by the Ministry of Labour to make inquiries into the question of the employment of disabled sailors and soldiers in the electrical industry, and the training necessary for this purpose. Mr. Beauchamp also represents the Association on a similar but distinct Committee formed by the Ministry of Labour.

Engineering Standards Committee.—The Association has received its contribution of £21 to the funds of this Committee, and continues to be represented on many of its Sectional Committees, Sub-Committees, and panels.

Research on Buried Cables.—At the request of the Institution of Electrical Engineers, the Council of the I.M.E.A. issued an appeal to undertakings represented in the Association to support financially the Institution in the work which it was carrying on in this matter.

British Trade after the War.—Following the resolution passed at the last annual general meeting which was communicated to the Prime Minister, the engineering members of the Association were circularised, and the honorary secretary, Mr. Faraday Proctor, attended on several occasions before the Board of Trade Committee on electrical trade after the war. The president, Mr. F. M. Long and Mr. Thomas Roles, of Bradford, also gave evidence. The report of the Committee has not yet been published.

As previously mentioned in this report, evidence was given at great length in support of the various clauses of the Supply of Electricity Bill, and also in connection with various recommendations put forward as to the constitution, duties, and limitations of Government departments, concerned in the regulation of the actions of electrical undertakers, and the supply of electricity generally.

Alleged Preferential Charging at Hackney.—The members will be aware that the Gas Light and Coke Co. are bringing an action against the Hackney Borough Council on a case of alleged preferential charging. The Council considered that Hackney had a very good case, and strongly recommended the members of the I.M.E.A. to contribute towards their defence.

Articles of Association.—The Council have given very careful attention to the question of the revision of the Articles, providing for postal ballot, and also for an altered constitution of the Council. The effect of the alterations is that while the number of the Council, viz., 25 members, is not increased, there will be only one vice-president and only one past president, thus adding three to the number of ordinary engineer members of the Council, without increasing the total number, or altering the present proportion between engineer and Committee members. As regards the question of the definite representation of all sizes of undertakings, the Council are of opinion that this will be better dealt with by a resolution of a general meeting. The resolution is in the following form:—

"That whereas by Article 28 there shall be 18 ordinary members of Council, 12 being engineer members of the Association, and six representing municipalities, and, by Article 29*a*, four engineer members of the Council and two municipal representatives of the Council shall retire annually, it is resolved that annual elections be so arranged that there shall, during each year, be nine engineer members on the Council from undertakings owned by local authorities where the population of the area of supply exceeds 50,000; and three engineer members from undertakings owned by local authorities where such population does not exceed 50,000."

The Electric Vehicle Committee.—During the past year the scope of the Electric Vehicle Committee has been widened, as is indicated by its new title, "The Electric Vehicle Committee of Great Britain. Formed under the auspices of the I.M.E.A."

Honorary Treasurer's Report.—The total expenditure is £545, or £50 more than last year. The income from subscriptions is normal, and the revenue from proceedings £154, an increase of £50. The receipts from members' and delegates' fees are normal, and the total income is £554, as against £506, leaving a balance of £10 as surplus for the year.

The total surplus of assets over liabilities is £936, so that the Association continues to be financially sound; but there is no margin for expansion, and it is a question whether the subscriptions should not be raised so as to enable the Association to deal with more advantage with questions affecting the interests of that section of the industry represented by the Association.

Agricultural Development.—During the year a Committee on the Development of Electricity in Agriculture has been formed to deal with this subject, with power to add to their number, both from the ranks of the Association and from other sources, and to present a report in due course on the matter generally for future action.

It is proposed to invite representatives of Government Departments, Agricultural Societies, and Electrical Associations to serve on the Committee, so as to co-ordinate co-operative effort in carrying out the objects of the Committee.

Individual Interest in Municipal Enterprise.

Abstract of paper by J. Horace Bowden, *Poplar.*

To successfully control a municipal undertaking, concentration of thought during an undisturbed period of a number of years is necessary on the part of those responsible for the management, and in order to secure this, not only should the municipality pay sufficient remuneration to prevent distraction from undivided attention by their official staff, which striving after increased remuneration engenders, but should also offer inducements to the staff whereby the desired results might be attained, to the material benefit of those responsible for their attainment. It is therefore incumbent upon every municipality to give consideration to any scheme which would induce the members of each of its trading staffs to concentrate their whole energy on producing certain results, and, in giving consideration to any such scheme, the varied interests connected with the supply should essentially have equal prominence.

The primary interests of the consumer and the ratepayer are linked indissoluably together. Low charges for supply to the consumer produce the asset to the municipality, but the price paid for the supply should be such as to amply provide for the guarantee given by the municipality on the security of the rates. Cheap prices and participation in profits may appear to be diametrically opposed, but it must always be borne in mind that the ultimate result of low charges means that all ratepayers would become consumers, and therefore any apparent injustice by contributing to rates out of profits would eventually disappear.

Consumers' and staff interests are linked, inasmuch as satisfactory working conditions, adequate remuneration, and security of tenure tend to ensure continuity of supply and efficiency of service. Low prices to the consumer and participation in profits by the staff can be made of identical interest by the introduction of proper safeguards to the consumer into any profit-sharing scheme.

The interests of the ratepayers and the staff have everything in common respecting security of guarantee; judicious capital expenditure is the most effective medium of profit production.

The interests of the ratepayers and staff are also common in respect of profit sharing, and the author is of the opinion that the scheme submitted in this paper will ensure the best results to the ratepayer, and at the same time secure for an undertaking a sound financial footing.

It is of paramount importance that every municipal electricity undertaking should be placed upon a sound financial basis in priority to any other consideration.

For a number of years prior to the introduction of a profit-sharing scheme at Poplar, and before any contribution whatever was made to the rates, a drastic policy of writing down and scrapping obsolete plant was adopted, together with a system of payment out of revenue for all assets for which loans could not be raised for periods of 20 years or over. All existing loans were converted from the annuity or annual instalment to the quarterly instalment system.

To-day the statement of loans outstanding comprises only :—Lands, buildings, mains, and machinery, with £3,500 for services and £750 for accumulators. Both of the latter will be wiped out during the course of the next three years under the scheme adopted. No money for machinery has been borrowed since January, 1914, all new plant having been purchased out of amounts written down in respect of obsolete plant.

All machinery of any description laid down prior to 1905, with the exception of two boilers and the original L.T. switchgear, has been entirely written out of the books of the undertaking. The war has temporarily suspended this financial policy, but the author is convinced in his own mind that it is absolutely correct, and, after the war, will advocate the scrapping of the major portion of the plant laid down between 1905 and 1913, in order to bring the machinery right up to date without increasing the present liability on that account.

In furtherance of this policy, therefore, it was necessary, before considering the disposal of surplus profits, to lay down a schedule of first charges upon surplus profits, as follows, viz. :—

Minor improvements to buildings and plant.
New meters and services.
Wiring, cooking, and heating installations.
Showroom and test room fixtures.
Instruments, office furniture and tools.
Cost of reclaiming disused cable.
Removal and re-erection of machinery.
Sundry expenses connected with capital work and plant.
Lay aside £1,000 per annum over and above requisite amount of redemption for reducing the debt on account of services, instruments, and accumulators.

Working balance at end of each financial year to be made up to 10 per cent. of the total income for that year.

After payment of the foregoing charges on surplus profits, the available balance (if any) in any year is apportioned as follows, viz. :—40 per cent. is placed at the disposal of the Finance Committee of the Council ; 20 per cent. of a sum up to £6,000 available for disposal, and 10 per cent. on available sum over and above £6,000, for division amongst the members of the permanent staff. Remaining balance is placed to the credit of capital machinery account for writing down obsolete plant.

The amount placed at the disposal of the Finance Committee may or may not be utilised for relief of rates, but preference is given to its utilisation for works which would have a beneficial effect upon the rates.

The bonus to staff is apportioned as follows, viz. :—A moiety to the principal officers of the staff, and the other to the junior officers and workmen permanently employed *pro rata* to the normal salaries and wages paid in the year in which the bonus is earned.

The proportion payable to the principal officers is divided as follows, viz. ;—One-half to the chief engineer and manager ; one-fourth to assistant manager ; one-fourth, in equal proportions, to the station and mains engineers and sales manager.

The financial soundness of this scheme must commend itself to all concerned, as, no matter how rapidly an undertaking may develop, the cost of new connections, and all improvements to the existing system, must be taken from revenue before any sum is available for bonus.

On January 6th, 1915, the Poplar Electricity Committee finally approved the scheme on the lines indicated in this paper, subject to a general reduction of 25 per cent. in charges to private lighting consumers. The following results will indicate in some measure whether the scheme has been justified or not :—

Year ending March 31st.	Units sold.	Per cent. of bulk supply at 0·25d.	Average price.	Average cost of coal per ton.			Net profit.
			d.	£	s.	d.	£
1913	12,014,794	1·3	1·122	0	14	4½	3,170
1914	16,716,705	16·0	0·971	0	14	2	8,010
1915	16,889,048	8·0	1·043	0	12	5½	14,749
1916	21,505,614	11·9	0·988	0	17	11½	11,815
1917 Estd. ...	23,265,000	14·8	1·06*	1	1	6	11,500

* Increase of 10 per cent. on power charges.

The saving aimed at is not in labour, but on materials used—viz., coal, water, oil, &c. The most important point affecting bonus, however, is the promulgation of business, each man being a potential canvasser of the undertaking.

Increase in business means the employment of a larger number of hands for various extensions, services, and wiring installations, a greater number of men being required for these purposes than merely for attention to generating plant.

Allocation of Bonus to Staff.—The proportions payable, as set out in the Poplar scheme, may not appeal to every municipality, and, as an alternative, the distribution may be made wholly as a percentage of annual salary or wages. To illustrate the difference between the two systems, the author submits the payments made by the Poplar Borough Council as a result of last year's trading—viz., 1915-16 :—

Amount available for distribution, £1,262 3s. 10d.

Principal officers ... £631 2 0 or 36·6 per cent. of salaries.
Junior officers and workmen ... ... £631 1 10 or 6·09 per cent. of salaries or wages.

Had the alternative proposition been in force, the whole of the staff would have received 10·43 per cent. of their annual salary or wage.

When the facts are taken into consideration that private lighting supply was reduced by 25 per cent., that coal cost 3s. 9½d. per ton more than in the year prior to the introduction of the profit-sharing scheme, and that a full year of war conditions was experienced, carrying with it war bonuses, payments to dependents of those on Active Service, and a general all-round rise in price of materials, yet the net profit was increased by £3,800, it is fairly obvious that remuneration under the alternative scheme to those officers primarily responsible for the results would have been inadequate.

The logic underlying the Poplar system is that, by application, economies can be effected in both the generating and distributing departments, and an energetic and properly-controlled sales department can influence the revenue of an undertaking to a considerable extent.

Judicious management brought to bear on each of these departments produces results nearest approaching the ideal, therefore it is reasonable to allow the assistant manager a share equal to each of the shares allotted to the heads of departments, whose efforts extend to their departments only.

As the general manager is the responsible officer over all departments, upon whose judgment the decision in all matters must finally rest, it appears an equitable arrangement to allot double the amount received by his chief assistant, which is usually the proportionate difference in salary.

Investment of Profits on behalf of the Staff.—It is a debatable point whether compulsory investment in an undertaking should be insisted upon, and much can be advocated for and against compulsion.

In most well-ordered municipalities, superannuation and pension funds have been established, and sick benefits have been offered to the staff, which are supported by compulsory contributions by the staff and the municipality, therefore the necessity for compulsory thrift does not appear to be nearly so great in municipal undertakings as in private enterprise. On the other hand, it may be anticipated that, by investing savings in the business in which he is employed, a greater interest in the working of the business would be engendered, and it would appear that every facility for investment should be given as a means to that end. Furthermore, pension schemes, as a rule, provide for the employé only in old age, but not for his family, and should he die immediately after his retirement, his family gain nothing therefrom.

In the Poplar profit-sharing scheme, provision is made for a working balance of not less than 10 per cent. of the annual income of the undertaking, and as no provision has been made for working capital in any of the Electric Lighting Acts, it is reasonable to assume that no legal objection would be raised to the municipality accepting deposits from the staff up to the stated amount, and interest allowed thereon not exceeding the rate at which money could be obtained from the usual sources. It may also have been noted that the Poplar scheme allows for a 20 per cent. bonus on available balances up to £6,000 per annum, and 10 per cent. on any sum available over £6,000.

A line of demarcation between voluntary and compulsory investment suggests itself, and the author submits that the benefits of any profit-sharing scheme would be enhanced if the amount accruing at the rate of 20 per cent. were to be handed over to the staff to be invested in the undertaking or otherwise at the option of the employé, and that accruing at the rate of 10 per cent. be compulsorily invested in the undertaking, all on terms suggested.

There can be no doubt that current events indicate that in the near future labour will command a much greater share in the profits of all enterprises, whether national, municipal, co-operative, or private, and the greatest evil to be feared from this much-to-be-desired state of affairs is the misapplication of the prospective enhanced income of the worker.

Assuming that the opinion of the author is correct, it would be necessary for the employé to enter into an agreement with the employer that the sum invested should not be withdrawn except after a period of not more than 12 months, on retirement or at death, in order to guard against the impulse of the improvident to withdraw at any time merely for the purpose of squandering any accumulation of profit and interest. The Council would, of course, exercise its discretion in paying out immediately in cases of manifest necessity on the part of employés.

Sliding Scale to Adjust Bonus with Charges for Supply.—Seeing that the work of the undertaking was carried out under more arduous conditions than appertaining in previous years, the author has been forced to the conclusion that no profit-sharing scheme would be complete without a sliding scale to adjust profit-sharing applicable to increase as well as decrease in charges for supply.

The "point-five" system of charging (which originated at Poplar) is admirably adapted for working in conjunction with a profit-sharing scheme. As most of the members are aware, this system comprises an annual charge based upon the probable demand of each consumer, plus 0·5d. for each unit used. The author proposes to recommend that this system shall become permanent, and when it becomes necessary to increase charges, a pre-determined percentage would be added to each account, but if it is found, after balancing the books for any year, that a rebate of 2½ per cent., or multiples of 2½ per cent. can be allowed to consumers, the determined amount shall be allowed on the following year's accounts.

The advertising effect of the rebate system in connection with small consumers must appeal to every electricity supply manager.

The present bonus scheme would hold good under the normal point five system, and the following scale applied for advanced prices :—

Increase in charges. Per cent.	Per cent. of bonus up to £6,000 available surplus.	Per cent. of bonus over £6,000 available surplus.
5	18	9
10	16	8
15	14	7
20	12	6
25	10	5
30	8	4
35	6	3
40	4	2
45	2	1
50	Nil	Nil

A sliding scale applicable to decrease in charges appears to be a much more difficult problem, firstly, because the cost of production is likely to steadily decrease for many years to come, and finality in this respect is difficult to anticipate ; secondly, a financial policy carried out on similar lines to that in vogue at Poplar would eventually wipe out machinery entirely from the loans account, thus reducing capital charges to a large extent ; and thirdly, because the interests of the consumer, the ratepayer, and staff should receive equal consideration.

After mature deliberation, the author has arrived at the following conclusions, viz. :—

That a minimum available sum for profit-sharing, contribution to rates, and reserve for displaced machinery should be fixed, which in the case of Poplar the author has earmarked at £6,000. That is to say, if the amount for disposal reaches £6,000, the following division would be made, viz. :—

Finance Committee, 40 per cent.	£2,400
Bonus, 20 per cent.	1,200
Reserve for displaced plant	2,400
	£6,000

In the event of a greater sum being available, which would allow of a rebate of 2½ per cent. or multiples of 2½ per cent., then the minimum amount for disposal should be increased by £1,000 for every 2½ per cent. granted as rebate. Any balance after allowing for the minimum sum according to scale, to be carried forward for the purpose of allowing further rebates. Upon this system the following sliding scale would apply, viz. :—

If rebate granted at Per cent.	Minimum sum for disposal, plus necessary amount of rebate. £	If rebate granted at Per cent.	Minimum sum for disposal, plus necessary amount of rebate. £
2½	7,000	27½	17,000
5	8,000	30	18,000
7½	9,000	32½	19,000
10	10,000	35	20,000
12½	11,000	37½	21,000
15	12,000	40	22,000
17½	13,000	42½	23,000
20	14,000	45	24,000
22½	15,000	47½	25,000
25	16,000	50	26,000

Discussion.

Mr. Littler (West Ham), in opening the discussion, said he agreed to the general principle indicated by the author ; a direct interest was a great incentive for extracting the best from a man. He rather doubted whether security of tenure was an altogether good thing ; it might be a handicap in both municipal and Government work. Labour was secure in its position and a bonus did not carry with it the same risk as in the case of the higher staff. He doubted whether, with the proposed allocation of surplus, the engineer might not find his remuneration seriously reduced, due to the effect of his own industry, in increasing assessments. He could not agree with the arbitrary handing over of 40 per cent. of the surplus to the Finance Committee ; the ratepayers had a right to some return, but did they not get a sufficient return in the benefit conferred on the town by a sound undertaking ? He was afraid that labour would be opposed to the idea ; the profit-sharing schemes in the London gasworks had not given the expected results. The suggested division of the bonus might also not be acceptable to labour, and any interference with its disposal would be resented. The bonus must be over and above the fair remuneration of labour.

Mr. Mundy (Secretary, Co-partnership Association) disagreed with the suggestion that profit-sharing had been a failure in the gas industry ; despite the war and more attractive labour conditions, the profit-sharers had fallen off very little in number, and Dr. Carpenter, of the South Metropolitan Gas Co., had emphasised the great benefit obtained *during* the war from the co-partnership scheme, which had been in existence 25 years, and was a good example. He agreed that the Trade Unions were antagonistic, but in works where it was in existence it was welcomed. The bonus was a dividend on labour—a share in the profit—and he contended that it should remain in the form of capital, and thus have a permanent influence, whereas a cash bonus was spent and forgotten.

Mr. C. H. Wordingham (president Inst. E.E.) said, personally, he had always found municipal engineers keen on their work, but the bonus might make them more careful in the case of doubtful experiments with tariffs. He was afraid that if the State stepped in it would mean that the State would be paramount, and its influence was all in the direction of private enterprise. Profit sharing appealed strongly to him, but the workman did look on it with suspicion, and would certainly resent the bonus being invested for him ; he doubted whether compulsion was advisable in any way.

Alderman Barge (Poplar) said this was the third year of operation of their bonus system ; the bonus was not regarded as wages—it was an addition, and was favoured by the men. The division of the bonus was a knotty problem, but he thought the management deserved special consideration in the matter.

Alderman Walker (Manchester) said the proposal was a good one if it promoted efficiency, but he thought the author might be on doubtful ground in proposing a scheme which, by increasing prices, allowed of a bigger contribution to the rates. Personally, he believed in contributing to the rates a definite percentage on the outstanding debt, as at Manchester. The bonus would not remove a man's desire to get to the top of his profession, and, personally, he would not care to eliminate that desire. If the proposal were generally adopted the question would arise as to what extent labour would demand a hand in the management of the funds and eventually of the department.

Alderman Thompson (Wolverhampton) said the idea behind the scheme was to make the workmen into capitalists. He had had some years' experience of a profit-sharing scheme in his own works, and found it a success. They practically allotted a man capital equal to his year's earnings, and guaranteed him certain interest on it ; last year the interest was 12½ per cent. If anything, the trouble was that the men wanted to increase their holdings. When the war came, a number of men agreed to 10 per cent. of their earnings being deducted and invested in a thrift fund, and it was intended eventually to invest this in the business and give the men a representative for their capital on the Board.

Mr. L. L. Robinson (Hackney) said there were other troubles in municipal work beside those hinted at by the author ; he commented on the lack of cohesion of municipal authorities, and said he felt that the time would come when existing undertakings would have to be taken over by a number of large statutory companies under Government control. There was a good deal of justice in the higher proportion suggested for the staff bonus, but it was likely to result in jealousy, also if those who helped most towards efficiency were to receive most bonus, then the boiler house would get a larger proportion. They had a bonus scheme in view for the Hackney undertaking, but it was not yet quite matured.

Mr. T. Hall (Burton-on-Trent) explained the bonus system in operation for three years in his town, which was based on the saving in works costs below 1d. per unit. This scheme had worked well, but he felt that the bonus should only be applicable to items which could be controlled by the worker, and not on rates and taxes. He confirmed the author's view that the staff became direct canvassers, naively remarking that there was hardly a public house which had not electric light. There was no enthusiasm for the investment of the bonus amongst the men, and he understood that a municipal authority had no power to invest money in this way.

Mr. Bowden, in replying, agreed that security of tenure had a two-sided effect, but he claimed that the bonus system would do away with the objectionable side. The effect of the assessment was not quite such as might be thought, at least in the London area. The bonus scheme would not deter a man from moving, but he would give the matter more consideration if he had to relinquish some other benefit. When the Poplar scheme was started, they could find no other undertaking with a similar scheme, though partial schemes had been in existence for some years. He believed that Parliamentary powers were under consideration to allow of investing employés' money in municipal concerns.

The 1886 Company: More Resolutions.—A note from Moscow says that a conference held there to consider the problem of the 1886 Company declared decisively against the formation of a new share company with the participation of representatives of the town on the board of the company. The conference once more affirmed that the company should be liquidated in due course. The property should be valued on the basis of prices existing before the war ; whilst the interests of the shareholders of Swiss nationality should be respected.

A note in the *Novoye Vremya* says that at a meeting of town councillors on the liquidation of the 1886 Company and of the Peredatch (Electrical Transmission Co.) a mixed board, consisting of representatives of the town and of shareholders which would keep the German element concealed, was considered undesirable. Both concerns should be liquidated.

ELECTRIC STEEL.

(*Concluded from page* 672.)

A VERY elaborate paper on the "Electric Characteristics of Electric Furnaces" was presented by MR. A. A. MEYER, of the Detroit Edison Co., giving the results of an electrical investigation of a Heroult and of a Grönwall electric steel furnace, covering their construction, operation, load fluctuations, power factors, unbalancing effects on the three-phase system, and wave distortion as determined by the oscillograph. The oscillograph data were studied closely, to draw from them deductions as to the self-induction of the furnace and connections. The effect of these considerations on the accuracy of the customer's watt-hour meters was also discussed.

MR. C. H. VOM BAUR, with Messrs. Hamilton and Hansell, read a paper giving further information on the Rennerfelt electric furnace, supplementary to a former paper. The principal improvements, since made, were as follows :—

1. The furnace hearth is now circular, with one set of electrodes, and oval shaped with two sets.

2. The side electrodes are adjustable in a vertical plane, allowing them to dip toward the bath.

3. The available power, or instantaneous available heat, has been largely increased.

The operating results obtained by making these three changes had not only kept up the quality of the steel, but the cost had been reduced materially.

With a circular hearth and the flame in the centre, the heat distribution was equal at the slag line ; there were, consequently, no cold corners, obviating overheating when melting, which was so detrimental to both side-walls and roof. The side-walls, slag-line, and roof, especially the latter, now dome-shaped, were easier to repair. Often, only the centre portion of the roof bricks needed replacing, the other roof bricks lasting twice as long.

The second feature, viz., tipping the side electrodes down from a horizontal position, had several advantages. When smaller charges than normal were made, the most efficient height over the metal, when melted, could be had. During melting, the electrodes at the start, whether for partial or full heats, were usually only an inch or so (2·5 cm.) over the bath. As the charge melted, the electrodes were continually lowered, thus keeping the flame about 2½ to 3 in. (6·2 to 7·5 cm.) over the bath. Bringing the flame closer to the bath accomplished two things : the melted steel more readily absorbed the heat, and the large flame being farther away from the roof, the life of the roof was lengthened. This was proved by the shorter time to make a heat from a cold charge, and by a longer life of the roof.

The possibility of tilting the electrodes up and down helped when slagging off, and lessened the breakage of electrodes.

The flame being nearer the bath, and with the same potential, had a tendency to circulate the slag faster. This could easily be observed, and was of the greatest importance. A more shallow bath facilitated the refining, as the metal came in contact with this slag on a larger surface.

The flame itself, depending on the size and electric power of the furnace, seemed to make a circular patch on the thinned slag directly beneath the flame about 8 or 10 in. (20 to 25 cm.) in diameter, and then mushroomed out. The hotter the furnace, the better the conductivity of the gases and the greater the spreading of the flame. In a two-flame furnace, this flame at times seemed to spread over the entire bath. This appearance was, no doubt, due to incandescent gas. The hearth was made more shallow, and thus the rammed-in bottom, coming up at the sides, made the sides less steep. This shallow bath shortened the time of melting down, and the lining was less affected at the slag line.

The regulation of the heat applied to the bath was made easier by the variable position of the flame above it, and it also lessened the danger of overheating, which was apt to become so detrimental with an acid bottom. The almost invariably clean steel produced, with the absence of inclusions, was obtained by careful handling, yet the ease of avoiding overheating was of first importance. Metallurgists who had operated the Rennerfelt furnace had particularly noted this point, and the avoidance of worry which thus ensued.

Having the electrode tips never more than 3 in. (7·5 cm.) above the bath, had materially reduced the time of melting (so far no Rennerfelt furnace in the United States was using fluid charges). With basic bottom the dephosphorising time had remained unchanged, and the desulphurising period, with the aid of calcium carbide slags, had been reduced. When refining and reducing sulphur with a built-up slag from ferro-silicon and lime, as used in the induction furnace, this was accomplished with good effect.

With furnaces having 300 KW. power per ton of output, heats had been made on basic bottoms, taking off one slag in 2½ hours with 670 KW.-hours per ton when operating continuously. With acid bottoms and 200 KW. power per ton of output, taking off one slag, good steel and full heats had come off in 3¼ hours, with 635 KW.-hours per ton.

The electrode consumption was less than 6 lb. (3 kg.) per ton of steel made, operating continuously. Even with the present excessively high cost of refractories, their cost had been reduced in the smaller furnace of one ton from $2·91 per ton of steel made to less than $0·80 per ton. Roofs were lasting over 100 heats, and approximated the longer life made in Europe with better refractories. With a higher power input, the heats were shortened, due to the smaller melting period (the heat being considerably reduced during the refining time), thus roofs were lasting more heats than formerly, though the actual time was not much changed. Side-walls of brick outlasted two or more roofs, while the bottom lasted a year or two.

The third change, to higher powered furnaces, besides lowering the cost per ton in every way, steadied the consumption of electricity, which had already been very constant. For instance, a 3-ton furnace operating with 600 KW., with hand-regulated electrodes, would reduce in four or five minutes to about 550 KW. without any fluctuation (except during the first part of the melting period) and without touching the electrode regulating mechanism. With smaller furnaces the steadiness was not so marked, whereas with still larger ones, the effect was but little improved. The power factor was about 90 per cent., with 60 cycles. All sudden strains on the power supply were avoided. The arc voltage had been raised, and was now 110 to 120 volts.

In general, too much stress could not be laid on the various small details—such as tight doors and tight openings around the electrode cooling boxes. With the latter, besides a small clearance between the cooling box and the electrodes, asbestos washers helped materially.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

"Cross-talk" and "Secrecy."

There has been a certain amount of confusion in the past with regard to the terms "Cross-talk," "Overhearing," and "Secrecy" as applied to telephone systems. With a view to establishing as far as possible a clear understanding as to what is implied by the respective terms, and to frame definitions in such a manner that, while technically correct, they will convey a clear distinction to non-technical purchasers and installers of telephone systems, this Association has adopted the following definitions, which have also been submitted to, and approved by, the Council of the Institution of Electrical Engineers :—

"Cross-talk" in telephone systems is the unintentional overhearing between one circuit and another not due to any such metallic connection as arises from accident or is effected by a user or third party. In practice, the "cross-talk" may be due to disturbances arising from electromagnetic or electrostatic induction, to leakage, or to insufficient conductance in a common portion of circuits.

"Secrecy" in telephone systems is secured by an arrangement of circuits making it impossible for a third party by any normal use of the system to cut in and listen to the conversation taking place between two users—at any rate, without the knowledge of the parties conversing.

The term "secrecy" must not be confused with freedom from "cross-talk."

For **The Telephone Manufacturers' Association,**
E. A. BROWNE, *Secretary.*

London, *June 25th*, 1917.

Industrial Fatigue and Maximum Output.

With reference to the leading article on the conditions of labour in your issue of June 15th, in which you refer to the various causes of labour unrest, apparently no mention is made of the fundamental cause of labour unrest.

Even if all the causes mentioned in Prof. Henry J. Spooner's pamphlet were removed, the workman would not be satisfied, and there is only one way in which he will ever be satisfied, and that is by receiving a share of the profits or wealth which he helps to create. Providing the workman has a share in the prosperity of the firm, he will realise that any improvements in efficiency benefit him also. Deny him this, and he is up against his employer all the time.

General profit sharing is, however, only possible if the whole productive industry is placed on a profit-making basis, and this can only be assured by protection, bonus, or the prevention of unfair competition.

There will be no proper settlement of the labour question until those in power recognise that prosperity depends primarily on successful production, and that the producer should be the master, instead of the servant of the middleman.

Producer.

[It is generally recognised by all students of industrial problems that contented labour cannot be secured without reasonable wages, also that higher wages cannot be paid unless increased efficiency and productivity render such practicable. The leaderette referred to dealt mainly with the causes of fatigue, and of course did not cover the whole of the author's comments. We advised those interested to read the pamphlet for themselves. In justice to Prof. Spooner it should be stated that in a brief section on "Psychology and Fatigue," he shows that fatigue may be due to anything that affects the nervous system, including worry, and of that inadequate wages may well be a cause. He shows too how re-classification of trades would secure higher wages and low production costs. The author also refers to the effect of interest or incentive on output in increasing a man's capacity—"it may be a bonus, or a share in the profits as a co-partner, that quite naturally spurs the worker to almost unconsciously increase his output." There is no fear of this aspect of labour problems being overlooked; we have dealt with it exhaustively in these pages. Indeed, in our leaderette we quoted Mr. Clynes's foreword to the effect that in order to secure increased production, the worker or producer asked for a fair share of the increased reward.—Eds. Elec. Rev.]

Salaries in the Electrical Industries.

I should like to draw your attention to a fact not particularly noticed. The salaries of electrical men in this country do not share the increases allotted to other trades. An advertisement is now appearing in the *Daily Telegraph* for sewing M/C mechanic, £5 a week; motor-car mechanic, £6 a week; driver, £5, whereas for a qualified shift engineer advertisers offer the miserable amount of 50s.—week by week—telephone faultsman, fitter and repairer, £2; foreman wireman, with A.C. experience, £3; whilst a good electrician, training as a kinematograph operator, can obtain easily £4. What are the Unions doing? Why are men here less skilful—has not the miserable pay something to do with it! Swansea is paying £3, £4, £5 and £6 for good men, but I fail to see any in your columns.

This does not apply to the writer, for I can get my price without being a shift engineer or foreman at 50s.

Bad Pay—Bad Results.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Henley's Terminal Boxes.

A handsome catalogue, recently issued by Messrs. W. T. Henley's Telegraph Works Co., Ltd., of Blomfield Street, E.C. 2, gave full particulars regarding a very wide range of terminal boxes to suit all conditions. One of these, a small inverted box for outdoor use, is illustrated herewith (fig. 1); it is suitable for three or four-core cables up to 0·05 sq. in. (32 mm.²), and is fitted with Henley's patent lead cone gland, or a brass wiping gland, as desired. In addition to those included in the list, the makers have standardised some other patterns, one of which is shown in fig. 2. This is a right-angle box for a three-core cable at 11,000 volts (tested to 35,000 volts), each core being ·3 sq. in. (194 mm.²); the length overall is 52¼ in. (1,327 mm.), and the weight 168 lb. (76 kg.).

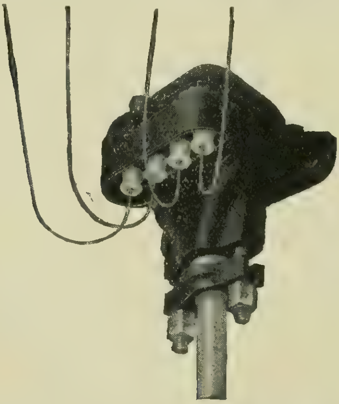

Fig. 1.—Henley's Outdoor Terminal Box.

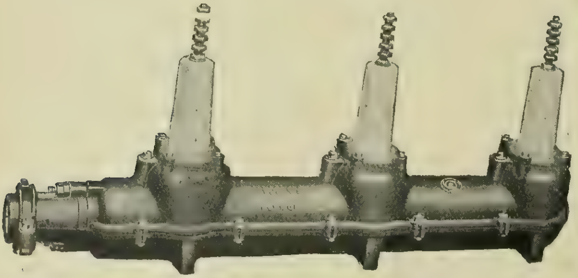

Fig. 2.—Right-Angle Terminal Box.

Another box not included in the list has been specially designed for three-core split-conductor work (fig. 3), and withstood a test of 100,000 volts between conductors and between conductors and earth, for 15 minutes, and 15,000 volts between splits for 5 minutes; the actual working pressure is 20,000 volts. Full particulars of these new boxes can be obtained from the makers.

A Large Ignition Magneto.

The British Lighting and Ignition Co., Ltd., which has lately been formed under the auspices of Messrs. Vickers, Ltd., to acquire and carry on the British business of the Bosch Co., has recently turned out what is claimed to be the largest ignition magneto so far manufactured. The apparatus was designed and constructed for use on a 1,500—2,000-h.p. stationary engine, having 12 cylinders of approximately 21-in. bore by 24-in. stroke; the engine is of the tandem type, with trunk pistons, the speed ranging from 500 to 2,000 r.p.m., according to duty, although it is capable of being slowed down to 30 r.p.m. Altogether four of the new magnetos, which are throughout of British manufacture, are fitted to the engine, they being arranged in pairs, two to each group of six cylinders, and set shaft to shaft, one magneto thus rotating clockwise and the other anti-clockwise. Each cylinder is provided with two sparking plugs, which are about 14 in. in length overall, both the plugs being arranged to fire simultaneously. The weight of each magneto is 62½ lb., the coil alone weighing 11 lb. The latter measures 14½ in. in length, and the secondary winding, which is built up in four sections, is stated to carry over 4½ miles of wire. A special feature of the magneto is the switch by means of which the coil can be used in conjunction with the magneto, of which it forms an integral part, or with an ordinary accumulator which may be introduced to facilitate the starting of the engine. We understand that the new magneto has been subjected to exhaustive tests, and that as a result of the satisfactory working, the B.L.I.C. undertaking has already received a number of orders for magnetos for ignition purposes on high-powered, heavy-duty, slow-running, internal-combustion engines.

WAR ITEMS.

Electrical Training of Disabled Soldiers.—Rochdale Electricity Committee has received a letter from a Trade Union objecting to the training of wounded soldiers for switchroom work, but the Committee has taken no action in the matter.

Carels Frères Bombed.—German munition works established in Carels Frères factory at Ghent are said to have been totally destroyed after a very lively air attack.—*Times.*

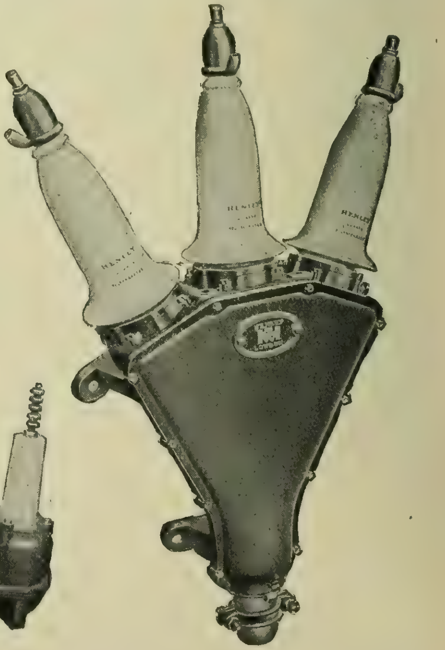

Fig. 3.—Split-Conductor Terminal Box, for 20,000 Volts.

Trading with the Enemy.—The "London Gazette" for June 22nd contains amplified and revised lists of bodies and persons in the following countries with whom trading is prohibited:—Argentina, Bolivia, Brazil, Chile, Greece, Netherlands, Norway, Spain, Sweden, &c.

The Professors of Ghent.—"Les Nouvelles," of Maastricht, states that the German authorities recently deposited £120,000 in a Swiss bank in order to secure an annual income to the professors of Ghent University in the event of their being expelled from Belgium after the war. The sum was obtained from funds of the Belgian Ministry of Sciences and Arts.—*Times.*

Profits on Government Contracts.—A new Defence of the Realm Regulation empowers the Admiralty, Army Council, and the Ministry of Munitions to vary the terms of any subcontract for Government work where it appears to them that the rate of profit is unreasonable or excessive by the substitution of such terms as they may think fair and reasonable.

Electricity Works and Air Raid Warnings.—In reply to a Parliamentary question, Sir G. Cave said it had been customary to give notice to the Metropolitan electricity works of expected air raids between an hour after sunset and an hour before sunrise. Conditions to-day, however, were different, but if power undertakings desired the official air raid warnings communicated to their works by day their applications would be considered.

To be Wound Up.—The Board of Trade has ordered the winding up of the following under the Trading with the Enemy Amendment Act, 1916:—

Fortuna Machine Co., Ltd., Deacon Street, Leicester, manufacturers of machinery and machine tools. Controller: C. J. Pain, 18, Low Pavement, Nottingham.

W. P. Theerman & Co., Ltd., 283, Oxford Road, Chorlton-on-Medlock, Manchester, electrical engineers. Controller: W. Eaves, 15, Fountain Street, Manchester.

Air Raids and Tramcar Lighting.—Writing to West Ham Corporation, the Commissioner of Police states that under present conditions it is considered possible to allow tramcars to resume normal lighting inside, provided that the lighting circuits are so arranged that the whole, except the ordinary traffic lights, can be switched off when "air raid action" is announced, and that if one or more interior lights are kept on to complete the circuit, they must be continually kept shrouded or screened so that no light is visible from outside during the period of air raid warnings.

Wages of Discharged Soldiers.—The Electrical Trades Union has opened a special branch for electric power station and supply men, who have hitherto belonged to a variety of Unions, or to none. Branches have been formed in Manchester and Liverpool, as well as in other leading centres, and a standard scale of wages and conditions has been drawn up. The Union is entering a strong protest against the action of some Corporations in substituting discharged soldiers at lower rates than usual, the men's pensions being taken into account, and, whilst there is no objection to discharged soldiers being employed if the full rates are paid, it is held to be unfair to them, and to ordinary workers, that they should receive wages from which their pension allowance has been deducted.

Excess Profits and After-the-War Trade.—In his speech at the annual meeting of Messrs. Richardsons, Westgarth and Co., Ltd., Mr. D. B. Morison stated (according to the *Times* report) that the nature of the profits tax was such that, by reason of special circumstances, it fell more heavily on some concerns than on others. In the case of their company the scheme of reorganisation and standardisation was very necessary for its future welfare, but it was costly, and so affected their results for the period in question, and therefore their standard under the Act, that they were now, in effect, being penalised for their efficiency. If the burden of taxation was made so great as to render adequate preparation to meet foreign competition impossible, many manufacturers would assuredly be crushed out of existence. As to the profits tax, he urged that the contribution to the Government should be spread over such a period as would allow manufacturers to devote at once such a proportion of the profits they were now earning as might be necessary in order to bring their equipment right up-to-date as far as circumstances and conditions permitted.

Trade Protection Cards not Exemption Certificates.—At Bermondsey, the Town Clerk reported that he had received a reply from the Local Government Board in answer to the question as to whether a man in possession of a certificate under the schedule of the protected trades, and whose Tribunal exemption certificate was withdrawn, had the right to a further appeal to the Tribunal in case the former certificate was withdrawn. The reply, which does not cover the point raised, was that a protection certificate was not a certificate of exemption within the meaning of the Military Service Acts and the Regulations issued thereunder, or the instructions as to voluntarily attested men. Where a protection certificate was withdrawn, it was open to the man, if he was voluntarily attested and had previously held a certificate within the meaning of the instructions, to make an application for renewal not later than seven days after individual notice had been sent to him calling him up for service with the Colours. In the case of an unattested man who had held a certificate of exemption, the time allowed for making an application for renewal was two weeks from the date when the certificate of exemption ceased to be in force. Where a man had not previously made an application to a tribunal, the Tribunal were, of course, empowered to entertain a late application made by him if they were satisfied that there were reasonable grounds for allowing the application to be made.

Engineering Wages and the Cost of Living.—The Committee on Production is considering an application from the engineers for an increase on pre-war wages of 100 per cent. The application is based entirely on the increased price of living and of commodities generally. The contention is that a wage of £2 per week received before the war is to-day worth little more than £1. Since the commencement of the war the engineers have received a bonus of 12s. per week, and this they are prepared to give up if their pre-war wages are doubled.

An application has also been heard from foundrymen and others for an increase of 10s. per week to all workmen above 18 years of age (both for piecework and day rate), and 5s. per week for those under 18. This application is on present wages, which were recently increased by 12s. per week.

Some thousands of Birmingham operatives are affected by these applications, and there were present at the sitting of the Committee on Production the following local representatives: Mr. W. J. Davis and Mr. Ramsden (Brassworkers), Mr. J. H. Simpson (Gas, Municipal, and General Workers), Mr. J. Beard (Workers' Union), and Mr. Firth, National Union of General Workers).

It was stated on Monday that opposition to the engineers' application for a 100 per cent. advance was forthcoming from representatives of lower-paid operators. Their contention was that the doubling of wages of the higher paid men would operate unfairly, and the operative who earned 30s. per week was more in need of £3 than the man whose wages were 50s. of £5 per week. A prominent representative of Labour stated that there would be no finality to these applications for increases of wages so long as the prices of food and of commodities continued to increase. If the Government allowed these price advances, then logically they could not refuse wage increases in order to meet those higher charges.—*Birmingham Daily Post.*

Exemption Applications.—Surrey Appeal Court has refused a Military appeal against exemption granted to J. G. Toonjan (24), shift engineer at the Redhill Corporation electricity works.

A firm of electrical engineers appealed at Brighton for an electrical engineer (35) and an electrician (39, Class B 2), and stated that they had no other men to assist in the business. Sir John Blaker stated that the men were engaged on work which was of the highest importance to the Army, and if they went they would be employed on similar work. The men, it was pointed out, were now engaged on essential work installing apparatus on a farm in Kent. The electrical engineer was given a final two months, and the electrician three months (open).

Exemption until December 1st has been granted to J. W. Gibson (31, Class B 1), manager for the Holsworthy Gas and Electric Supply Co.

At Brighton, an electrician, who is a lieutenant in the Royal Engineers, appealed for an electrician (29, sedentary work at home), who is carrying on the business with the assistance of the appellant's father. Three months were allowed.

At Slough, Messrs. Horlick appealed for J. S. Mepstead (38, Class C 2), electrical engineer, and he was given three months' temporary exemption.

Before the Surrey Appeal Court, Mr. T. H. Hellyer (32, Class A), of Barnes, manager of a limited company of electrical engineers, who is engaged on important experimental work for the Admiralty, appealed. The appeal was respited with a view to appellant securing a protection certificate from the Admiralty.

At Chatham, Mr. W. Jensen, of the Tramway Co., appealed for four motormen, all in Class B 2. He stated that the tramcars running had been reduced from 44 to 25, and if the number of motormen was reduced it would be impossible to run all the workmen's cars. It was added that wounded soldiers had been tried, but they lacked nerve, and would not stay. All were given conditional exemption.

At Worcester, the Electric Traction Co. appealed for seven tram drivers, three in Class A, one in B 1, one in C 1, and two in C 2. One of the A men and the one in C 1 were directed to report for service in 14 days. One A man and the one in B 1 were exempted until substituted; and the others were given conditional exemption.

Before the East Kent Appeal Court, the Military Representative appealed against exemption granted to J. G. Clabburn (29), of Sturry, electrical engineer to the East Kent Road Car Co., Ltd., the only qualified engineer on the staff. The appeal was dismissed, and the exemption confirmed

At Bromley (Kent), G. Matthews (19), electrical fitter with the Beckenham U.D.C., appealed on the ground that he was in a certified occupation, and desired to pass the examination necessary for an electrical engineer. The appeal failed.

At Aldershot, the Aldershot Traction Co. appealed for P. L. Rivett (Class B 2), works foreman, and he was given three months, with leave to appeal again.

Chelmsford Rural Tribunal has conditionally exempted A. Sayer (35, Class C 2), who runs the electric light plant at Danbury Park, and who has served in the Navy, and had had both ankles broken. He is to give two days per week on a farm.

BUSINESS NOTES.

Book Notices.—"Examples in Battery Engineering." By Prof. F. E. Austen. London: E. & F. N. Spon, Ltd. Price 5s. 3d. net.

"Mechanical Handling of Material, and its National Importance During and After the War." By G. F. Zimmer. London: Crosby Lockwood & Son. Price 10s. 6d. net.

The Temple Press, Ltd., have issued the "Cycling Manual" (7d. net), in which a great deal of useful information, fully illustrated, is given respecting the choice, care, and repair of the bicycle.

Glover's Almanac.—The whirligig of time has brought to us once more Messrs. W. T. Glover & Co.'s almanac, which, like their cables, enjoys the privilege of perennial youth. The almanac is unique, in that it provides an unfailing stream of technical information, derived from a wide range of publications, and served up in tabloid form, so that the busy engineer can refresh his memory and absorb mental nourishment in small doses with the minimum expenditure of time and effort—incidentally renewing his acquaintance with the sterling merits of the firm's well-known productions. The sheet for July 1st shows Glover's winged cable drums flying from Lancashire to all parts of the world, thus suggesting the future possibilities of aviation in commerce. May peace soon return and enable this vision to be literally realised. Erecting overhead cables with the aid of an aeroplane is the subject of another illustration, which does credit to the imaginative powers of the artist, whatever may be thought of its feasibility.

Dissolutions and Liquidations.—C. J. Hobbs & Co., 86, Fratton Road, Portsmouth, electricians and contractors. Messrs. C. J. Hobbs and F. Murgatroyd have dissolved partnership.

Steel's Electric and Engineering Co., Ltd., 206, East India Dock Road, Poplar, London.—Winding-up order made in the High Court, June 19th.

Colston Electrical Works, Ltd., Bristol.—First and final dividend 9s. 6½d., payable at Official Receiver's Office, 26, Baldwin Street, Bristol.

Large Bros., electrical and sanitary engineers, &c., Colwyn Bay.—Messrs. C. N. Large and W. W. Large, have dissolved partnership. Both partners will attend to debts, &c.

Birmingham Electrical Accessories Manufacturing Co., Ltd.—Mr. E. Fisher, of 12, Cherry Street, Birmingham, who was appointed Receiver for the debenture-holder, has sold the assets. The amount realised is insufficient to discharge the debentures, but the debenture-holder has agreed to share the proceeds with the other creditors.

Catalogues. — Messrs. Alfred Herbert, Ltd., Coventry.—Coat-pocket edition of their small tool catalogue. It is a finely produced volume of over 600 pages, profusely illustrated with small views of a host of tools of all kinds. The catalogue is really a photographic reduction of the firm's standard catalogue, and the type is, therefore, necessarily small, but it is clear for all that.

Australian Factory Schemes.—The Australian Federal Ministry are considering, according to the *Melbourne Age*, a scheme providing for an expenditure over a term of years of at least £10,000,000 for the establishment of factories under joint private and Government supervision. The scheme includes the creation of a national industrial department.—*Times.*

Registration of Business Names.—Documents filed under the Business Names Act will be available for inspection by the public on and after September 1st. The Act provides that they should become available not before June 22nd and not later than September 22nd. The fee payable for each inspection will be 6d. To the present time the registrations number about 100,000; but it is believed that several thousands more ought to have registered. Prosecutions for default are not likely to commence until the work of indexing is complete, but the Act provides for very heavy penalties, and defaulters who wish to escape these should comply with the law without further delay. Forms can be obtained from any post office. Each form should have a 5s. adhesive stamp attached, and should be posted to or left at the Business Names Registry, 39, Russell Square, London, W.C.

Correction.—In our notice respecting the British Ignition Apparatus Association on page 675 last week, for "L.M. Magneto Syndicate" read "M-L Magneto Syndicate, Ltd."

LIGHTING AND POWER NOTES.

Accrington.—Year's Working.—There has been a loss on the Corporation electricity undertaking of £10,155 during the past 12 months; there was a great increase in the expenditure for the generation of electricity, which cost £8,690 more than in the previous year, the increase being due to the higher price of coal and advances in wages. In addition to this loss, there is a deficit of £4,368 to be brought forward, making a total deficiency of £14,521.

Baildon (Yorkshire).—E.L. Proposals.—At last week's meeting of the Council, the chairman said suggestions had recently been made that Bradford, Shipley, and the Yorkshire Electric Power Co. had approached the Baildon Council with proposals to supply electricity, but this was not true. Baildon had first approached the parties named. The business was not concluded, and disclosure would not be fair to any of the parties; the Council had powers to introduce electric power, but could not produce it as economically as it might buy it.

Birmingham.—Breakdowns.—According to the *Birmingham Daily Post*, about a fortnight ago a large turbine set installed at Summer Lane about four years ago, broke down; the Electricity Committee endeavoured to have repairs effected without a general stoppage, but, owing to the heavy demands, a further breakdown occurred last Monday week. A turbine at the Nechells station, which has only been in service a few months, probably through overloading, also broke down; it is hoped to effect repairs at Summer Lane and commence running within a fortnight, but at least a month will elapse before the Nechells turbine is in working order. Should any further accident occur, the electricity department will have to reduce the supply of electricity to either factories or the tramways.

Brighton.—Year's Working.—The report of the Corporation electricity department to March 31st last shows a total income of £109,059, expenditure amounting to £61,994, and a gross profit of £47,063, which, with £135 for dividends received during the year, totalled £47,200. After payment of £17,662 for interest, £22,592 on loans, and income-tax amounting to £1,804, a total of £42,059, there remains a surplus of £5,140, in comparison with a deficit of £3,989 in the previous year. The capital expenditure to March 31st was £844,490. During the year 9,771,615 units were sold; 16,773 tons of coal were consumed, at a cost of 40s. 9½d. per ton, the coal consumption per unit generated being 3·85 lb.—*Sussex Daily News.*

Continental.—Spain.—The Sociedad Hidraulica Santillana has lately secured a concession to establish a plant to utilise the water power of the river Manzanares, near the town of Manzanares el Real, in the generation of electrical energy for lighting and power purposes.

Switzerland.—Owing to difficulty in procuring other supplies, the Commune of Lutz, on the shores of Lake Geneva, has set up an aluminium network of overhead mains, which serves a number of country houses spread over an area of 13 km.^{2} (5 sq. miles), the line itself being about 51 km. (32 miles) in length, and the diameters of the wire used being from 5 to 7 mm. (·2 to ·276 in.). The system has passed successfully through the ordeals of the winter of 1916 and the snowstorms of January this year, and a hurricane of wind of 90 km. (56 miles) per hour in March last. The engineer in charge attributes his success to the careful elimination of defective wire, and to his method of forming joints, which consists in welding the ends together by pressure in a tool of novel design.

Dundee.—Price Increase.—The Corporation has found it necessary to increase the price of electricity. The department's year closed with a deficit of £2,646, which, with the credit on hand at the beginning of the year of £3,244, made the loss for the period £5,891. The revenue was £1,940 less than last year, while the expenditure showed an increase of £4,360. It has been decided to raise the whole of the prices for current, instead of adding a percentage increase to the consumers' bills, and the increase will amount to ¾d. per unit on lighting and to ⅜d. on power. At the T.C. meeting the convener of the Electricity Committee pointed out that the increase imposed only amounted to 10 per cent., as compared with 27 per cent. in the gas department since the beginning of the war.

Halifax.—In regard to the Electricity Committee's proposal to take advantage now of an option to purchase land for the site of future electricity works at Copley, it was stated that the option had been extended from July 15th to August 4th; there is no disagreement as to whether the suggested site is the most suitable for the purpose.

Hull.—Year's Working.—The report of Mr. J. F. Magoris, acting city electrical engineer, on the working of the Corporation electricity undertaking for the year ended March 31st last, shows that the total revenue amounted to £99,991, working expenses to £60,095, and the gross profit was £39,896. After meeting interest, sinking fund, special and income-tax charges, the net balance placed to reserve was £1,209. The cost of fuel delivered to the works increased by about 35 per cent. During the year four important bulk supply contracts have been entered into, and the engineer reports that energy has been supplied for steel rolling. The total connections to the mains equal 31,960 kw., including 23,584 kw. of power and 8,396 kw. of lighting load. Terms are being discussed for a supply of energy to the tramways department, which will involve laying new mains and installing certain switchgear, at a cost of £4,800.

London. — Lambeth. — A communication has been received from the B. of T. stating that it has approved of the County of London Electric Supply Co., Ltd., and the South London Electric Supply Corporation, Ltd., entering into an agreement for the supply of electricity in bulk by the first-mentioned company to the second-mentioned company.

Luton.—Year's Working.—The accounts of the Corporation electricity undertaking for the year ended March 31st last show a total income of £52,149; working expenses amounting to £35,034; and a gross profit of £17,115, as compared with £16,727 in the previous year. With other amounts brought in, the total available was £17,909, and after deducting financial charges, the surplus for the year amounted to £5,025, as against £6,228 in the previous year. This sum was carried to the appropriation account, which, after allowing for deductions during the year, has a balance in hand of £12,748. The balance of the reserve account stands at £6,489. During the year, 14,227,136 units were sold, as compared with 12,254,529 in the previous year, the maximum load amounting to 4,937 kw.; 7,156 h.p. of motors and 1,929 kw. of heating and cooking were connected.

Morecambe.—At the monthly meeting of the T.C., last week, the chairman of the Electric Light Committee moved that the resolution previously passed by the Council to increase the price of electricity for power to 4d. per unit be rescinded, and that the price be 3d. He urged the importance of the electricity works having a day load. After a long discussion, the lower figure was agreed on.—*Lancashire Daily Post.*

Perth.—The railway companies are to be approached by the T.C. with a view to fixing a new contract for the supply of electricity. The railways are the Corporation's largest consumers.

Shrewsbury.—Year's Working.—After paying interest on loans and sinking fund charges, the electricity undertaking shows a deficit for the year of £921.

The T.C. has, from the June quarter meter readings, increased the price of current by 33½ per cent., instead of by 20 per cent., owing to the great increase in the cost of coal and other material.

Southend-on-Sea.—Price Increase.—The T.C. has decided on an all-round increase in the price of electricity, lighting being approximately ½d. per unit and power ¼d. per unit more.

South Wales.—The B. of T. has extended for a year from July, 1917, the period mentioned in the Cowbridge and Penybont and Abercarn Provisional Orders of the South Wales Electrical Power Distribution Co.

Stowmarket.—Price Increase.—In reply to a petition, the Suffolk Electricity Supply Co. has informed the consumers that it cannot reconsider the decision to increase the price of electrical energy from 8d. to 10d. per unit, as the advance is warranted, and should have been made long ago.

Warrington.—Price Increase.—The Corporation has given notice that the price of electrical energy will be increased by 10 per cent. above the existing scale.

TRAMWAY and RAILWAY NOTES.

Blackpool.—Electric Vehicle.—The Corporation has purchased an electric refuse collecting van. The chassis has been supplied by the General Vehicle Co., and the body built at the Corporation's own works. During the past winter one of the electric street watering vans was altered temporarily, so as to serve for refuse collection, and the experiment was so successful that the Cleansing Committee decided to install a special vehicle for the purpose. The new van will do the same amount of work as would be performed by four horse-drawn vans.

Croydon.—Bonus.—The B.C. has decided to increase the weekly war bonus to the tramway workers to a total of—for drivers and male conductors, 5s.; female conductors, 2s. 6d.; other grades, 7s.

Huddersfield.—The Tramways Committee has informed the local Volunteer authorities that it is unable to grant free tramway facilities to Volunteers travelling to and from drill.

London.—Electric Vehicles.—It is announced that Messrs. J. Lyons & Co., Ltd., the well-known caterers, have decided to expend £80,000 on electric vehicles of the commercial type.

Manchester.—The Corporation Tramway employés of Salford and Manchester, being dissatisfied with the grant of 2s. 6d. per week, instead of their demand for 10s. per week, have decided to refuse to work more than the necessary number of hours, thus stopping all overtime, and also not to allow more passengers on the cars than the legal load. The cutting down of the services owing to war conditions has made overloading frequent. The employés are seeking to reopen negotiations with the Committee on Production, with a view to obtaining the full amount asked for.

The refusal to work overtime or to overload cars is putting the public to an enormous amount of inconvenience during the week. The attitude of the men is described by Alderman Bowes, the chairman of the Manchester Corporation Tramways Committee, as not playing the game, and it is pointed out that the war bonus to Manchester drivers and male guards now amounts to 10s. a week, and women guards 7s. a week. The Manchester employés, however, ignoring their own officials, decided to continue their obstructive tactics, and there is reason to fear that the unrest will spread to other towns. The attitude of the workers is arousing great indignation amongst the public.

Nelson.—The T.C. has decided to grant double pay to tramway employés who work during holidays.

Stoke-on-Trent.—Tramway Lease.—There is strong local opposition to the proposal of the Council to renew the lease of the Potteries Electric Tramways until 1932. After a long discussion at the last meeting of the Council, the matter was adjourned until June 28th. The new agreement proposes that the company should carry out certain improvements in the permanent way and rolling stock, not increase fares, and pay to the Corporation £1,000 per annum during the term of the lease.—*Birmingham Daily Post.*

West Ham.—The tramway manager reports that it is inadvisable at present to proceed with the authorised work of doubling the tramway track in Connaught Road; however, the span-wire system is to be substituted for the present bracket arms. Cars are to be allowed to resume normal lighting inside, provided that the lighting circuits are so arranged that the whole, except the ordinary traffic lights, can be switched off in an emergency.

TELEGRAPH and TELEPHONE NOTES.

Birmingham.—Additional accommodation is to be provided by the Corporation for wireless telegraph students. The P.M.G. states that there is a shortage of wireless operators in the merchant service, and arrangements have been made with the War Office to issue certificates of protection to students training for the P.M.G.'s certificate.

Hull.—After meeting all expenses, there is a surplus of £5,355 on the year's working of the Corporation's telephone undertaking, as compared with £3,645 for the previous year.

India.—The selector telephone system of the Western Electric Co. has been adopted by the G. I. P. Railway, and is already in use on the section between Bhusawal and Nandgaon, a distance of 98 miles, on which there are 31 connections and 58 trains a day. In this system a 200-lb. return copper wire is used, and any station can be called up independently of the other stations.—*Indian Textile Journal.*

Morse Code on Ocean Cables.—Mr. William M. Bruce, president of the United Telegraph and Cable Co., of Springfield, Ohio, announces that he has practically perfected an appliance by which the Morse code can be used on trans-oceanic cables. The company has closed a contract with the Commercial Pacific Cable Co. for equipment for the cable from San Francisco, Cal., to Shanghai, China. Mr. Bruce's work consists of a method for the employment of Morse equipment (key and sounder) on submarine cables. His patents also cover an improved relay for cable work, which can be used not only for the Morse, but for the regular recorder type of signals as well. Actual tests have proved this instrument to be very efficient. Mr. Bruce has operated direct from London to New York by his system, and direct communication between Canso, N.S., and New York is now in regular service, the operator at New York receiving the signals direct from the sounder. This line includes a stretch of cable between Canso, N.S., and Rockport, Mass., on which the siphon recorder system has been employed hitherto. Mr. Bruce is a telephone engineer, and was recently chief engineer and general superintendent of the American Automatic Telephone Co.—*T. and T. Age.*

Spain.—The recently-formed Compania Iberica Telecomunicacion has applied to the Diputacion of the Province of Viscaya for leave to "establish the first installation in all Europe of its system of communication." It proposes to set up a first trial station to transmit weather forecasts from the Observatories to the fishing fleet, on the results of which the Diputacion will base its further course of action.

Telegram Rates.—Telegrams may now be sent to Bagdad at the rate of 2s. 3d. per word, and to Sarawak at 3s. 8d.—4s. per word.

Telephone Traffic.—From time to time the Post Office issues for the use of its staff instructions dealing with telephone traffic subjects, such as:—Standards of operating loads and service (local and trunk working); operating procedure and switchroom rules; service code markings; switchboard markings and colour schemes, &c. As these indicate current practice and procedure, they should be of interest to British contractors and consulting engineers who specialise in telephone exchange construction, and copies may be had on application to the Secretary, General Post Office, London.

United States.—The Western Union Telegraph Co. has placed its facilities at the disposal of the Government to teach 2,500 operators. All cable telegrams to and from the United States must now conform to the censorship regulations, which are practically the same as the British and French regulations.

The American Marconi Co. is erecting a large addition to its works, to cope with the rush of orders, which will employ 1,000 workmen.—*T. and T. Age.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—August 22nd. N.S.W. Government Railways and Tramways. Thirty-six induction motors (Specification No. 488). September 19th.—One 225-H.P. synchronous motor (Specification No. 489). Particulars from Electrical Engineer's Office, 61, Hunter Street, Sydney.

Glasgow.—Electricity Department. Boiler-house plant. E.H.T. switchgear (20,000 volts). See "Official Notices" June 15th.

Newport (Mon.).—June 30th. Electricity Department. Induced-draught plant, additions and extensions to fuel economisers and cooling towers. See "Official Notices" June 15th.

Spain.—Municipal Authorities of Berlanga (Province of Badajoz): Concession for the electric lighting of the town during a period of six years. Town of Villademat (Province of Gerona): Electric lighting concession for 10 years.

Wolverhampton.—June 30th. Electricity Department. Cooling towers, motor-driven pumps. See "Official Notices" June 15th.

CLOSED.

Brighton.—B. of G. Electrical fittings: Adams Bros., £43.

Fleetwood.—Council. Wentworth Silkstone Collieries, Ltd., 2,000 tons of slack for electricity works.

Grays.—U.D.C. Coal for the electricity works: Dinham, Fawcus & Co., Griff steam, 23s. 2d. per ton; deep Griff, 25s. 2d.

Rochdale.—The Council has accepted a tender for a new boiler for the electricity works.

Venezuela.—The Venezuelan "Ministerio de Fomento" has placed contracts for the construction and working of telephone lines as follows:—

Sr. A. J. C. Herrera, of El Callao, Roscio District, Bolivar.—94-mile line.
Sr. C. R. Paredes, of Nirgua, State of Yaracuy.—123-mile line.

The full text of the contracts in Spanish can be consulted at the Board of Trade Department of Commercial Intelligence.—*Board of Trade Journal.*

FORTHCOMING EVENTS.

Tramways and Light Railways Association.—Friday, June 29th. At 3 p.m. At the Institution of Civil Engfneers, Great George Street, S.W. Annual congress.

Royal Institution of Great Britain.—Monday, July 2nd. At 5 p.m. At Albemarle Street, Piccadilly, W. 1. General monthly meeting.

OUR HALF-YEARLY INDEX.

As it is necessary to effect every possible economy in paper consumption, the Index to Vol. 80 of the Electrical Review, which will be printed in the course of a few weeks, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d. post free. Any reader or advertiser at Home or Abroad who requires a copy for binding, or for other purposes, is asked to make application therefor promptly to: The Publisher, Electrical Review, 4, Ludgate Hill, London, E.C. 4.

NOTES.

The British Trade Corporation Prospectus.—The prospectus of this much-discussed corporation was issued on Wednesday last. The issue is of 150,000 shares of £10 each at par. The total capital is to be £10,000,000 in £10 shares, of which 100,000 shares have already been subscribed and allotted at par. Thus the issued capital will be £2,500,000. Applications for shares have to be accompanied by a declaration of the applicant's British nationality. Lord Faringdon is Governor, and the directors include Mr. F. Dudley Docker, C.B., Sir Vincent Caillard (Vickers, Ltd.), Sir Algernon Firth, Mr. J. H. B. Noble (Sir W. G. Armstrong, Whitworth & Co., Ltd.), Sir W. B. Peat, &c.

Patents and Alien Enemies.—Under the heading of "Applications vested in the custodian and licences granted," the Patent Office gives the name of the Paterson Engineering Co., Ltd., as applicants for licences in respect of applications Nos. 3,666/14 and 10,374/14, for which applications were made by Ornstein.

Tyneside Electrical Men and Industry.—A meeting called by the Electrical Section of Newcastle Chamber of Commerce was held in the Guildhall, Newcastle-on-Tyne, on June 19th, Mr. H. W. Clothier in the chair.

The chairman presented the following report, indicating the scope of the Section:—

> The need for national organisation is now well recognised. In pre-war days certain trade organisations existed for the protection of sections of the community. The tendency now is to strengthen the existing organisations, and to promote new ones having a collective interest in the national prosperity. Whilst the war engages our first and urgent attention, the time which can be devoted to prospects of trade after the war must necessarily be limited, but the best opportunity must be taken to secure whatever time is available to help in making the moulds which will give shape to the industry of the future. In view of the prominent place Newcastle has taken in engineering from time to time, it is fitting that in electrical progress it should be an example to the rest of the country. Even though this may not be always accepted outside, the experiences achieved in this district are certainly of great national value, and the variety of these experiences gives a weight to any collective expression of views emanating from the North-East Coast. To put the experiences into concrete and more useful form, it is proposed to consolidate the Electrical Section of the Chamber of Commerce.

The chairman also gave the following as an outline of the work of the Section:—

1. To represent the local electrical industry.
2. To give collective attention to matters of commerce affecting the progress of the electrical industry in this district.
3. To discuss subjects which apply to the national prosperity, and to communicate, where necessary, considered local opinions to Government departments and national industrial associations.
4. To be the channel for communication with Consular officers abroad, and the dissemination of commercial information to firms immediately interested.
5. The question of cheap and unlimited power supply for manufacturers after the war.

On the motion of the chairman, seconded by Mr. C. Vernier, it was agreed to endeavour to strengthen the Section by means of an increased membership.

The Conjoint Board of Scientific Societies.—The fourth meeting of the Conjoint Board was held at the Royal Society, on June 13th, to receive the report of the Executive Committee on the work of the previous six months.

Amongst a number of questions of scientific and industrial importance which have occupied the attention of the Board was an inquiry into the desirability or otherwise of the adoption of the metric system throughout the British Isles. The Sub-Committee on National Instruction in Technical Optics reported that a scheme approved by the Board of Education had now come into operation. A Sub-Committee, having considered special cases of magnetic disturbances revealed by a magnetic survey of the British Isles and their possible connection with the occurrence of iron ores, recommended a detailed investigation of two test areas, in order to ascertain how far, under the conditions of the British iron ores, the magnetic survey was likely to prove of economic value. Arrangements for carrying out the investigation are in progress.

An Agricultural Sub-Committee, with the Earl of Portsmouth as chairman, reported that it was at present devoting itself mainly to engineering questions. It is engaged in collecting information with regard to the transport of raw materials to farms and agricultural products from them, and to the power required for this purpose and for seasonal operations on the land, with a view to comparing the relative advantages and costs of steam or internal-combustion engines and electrically-operated machines. It is dealing also with the possibility of co-operation in repairs and skilled labour, and is considering the various types of tractor most suitable to large and chiefly arable farms and to moderate-sized mixed farms, having regard to the different local circumstances and requirements. A Sub-Committee was nominated to report on what is at present being done to ascertain the amount and distribution of water power in the British Empire. A complete report of the first year's work of the Board will be published in due course.

Legal.—Air Raid Warning: Power Co. Fined.—At the Hertford Borough Sessions the North Metropolitan Electric Power Distribution Co. was fined £5, and £1 5s. costs, for a breach of its conditional exemption as to the obscuring of lights on May 24th, by failing within 15 minutes to answer an official telephone call communicating warning of an air raid.

Mr. E. Zoller, manager of the company, pleaded not guilty. He said that no call was received. In his opinion the cause of the call not being received was the sagging of the overhead wires from the office to the power station, causing them to touch. They had since been strained and overhauled.

Mr. H. W. Swann, the company's engineer at Barnet, gave similar evidence, and the engineer who was on duty at the time said that no call was received.

Electrical Installation at a Picture Palace.—Mr. Muir Mackenzie, High Court Official Referee, on June 16th, delivered judgment in the action of Mears *v.* Weston & Sons, in which damages were claimed for breach of contract in regard to the lighting of a cinematograph theatre at Richmond. The hearing was reported in our issue of June 15th. The Referee gave judgment for the defendant.

The Board of Trade Electric Power Supply Committee.—In reply to a question in the House of Commons, Mr. G. H. Roberts, speaking on behalf of the Board of Trade, gave the names of the members of this Departmental Committee. He said that the chairman (the Right Hon. F. Huth Jackson) had recently resigned on the advice of his doctor. The President was taking steps to appoint a new chairman and to increase the representation of local authorities owning electricity supply undertakings. He hoped to announce the names in the course of a few days. He could not say when the Committee would be in a position to make a report.

Profit-Sharing.—The Archbishop of York, in addressing the Leeds Chamber of Commerce, last week, on "The Industrial Outlook," said that while he believed in co-partnership and profit-sharing, they could only be realised as results, and should not be made the *cause* of better relations between employer and employed. Of course, we must have prosperous industry before there would be profits to share, and prosperous industry would result from better relations being encouraged by just and humane treatment, and by the wise application of "Welfare" effort.

Luncheon.—At the luncheon meeting of the British Empire Producers' Organisation yesterday, at the Savoy Hotel, the Hon. W. A. Holman, Premier of New South Wales, was the guest, and Lord Sydenham of Combe was in the chair.

Hardening Gauges.—The Hardness Tests Research Committee of the Institution of Mechanical Engineers has had some tests carried out at the National Physical Laboratory on samples of steel supplied by the Westminster Electrical Testing Laboratory; two test pieces were hardened "glass hard" in the ordinary manner, while two others of the same steel were hardened by the Wild-Barfield process. The tests showed that while the former gave the higher results under Brinell and scleroscope tests, the latter were markedly superior in resistance to sliding abrasion; as the process is being used for hardening screw gauges in large quantities, resistance to wear is of the first importance. Another valuable feature of the Wild-Barfield process is the fact that the dimensions of the gauges are so slightly changed that they rarely require lapping, so that it is particularly suitable for hardening screw gauges.

Wages of Women in Electricity Works.—The Ministry of Munitions has sent electricity undertakings statutory rules and orders which apply to controlled establishments, and which lay down the following schedule rates of pay for women:—

Workers under 15 years of age	2½d. per hour.
,, 15 years of age and under 16	3d. ,,
,, 16 ,, ,, 17	3½d. ,,
,, 17 ,, ,, 18	4½d. ,,
,, 18 ,, and over	5½d. ,,

National Insurance (Unemployment) Acts, 1911 to 1916.—Contributions are payable in respect of:—

2,318 X. Workmen engaged in the manufacture and assembling of metal parts of electrical water heaters.

2,320 X. Workmen who are employed in establishments which are mainly carrying on any insured trade or munitions work, and who are engaged in the maintenance and repair of railway lines. (Application 495.)

This decision reverses decision B. 1,419 (*Board of Trade Journal* of February 5th, 1914). In accordance with Sec. 3 (2) of the National Insurance (Part II Amendment) Act, 1914, contributions in respect of workmen covered by this decision but previously excluded in virtue of decision B. 1,419, are payable as from June 21st, 1917.

Contributions are not payable in respect of:—

2,319. Workmen employed by railway companies.

In connection with the mechanical engineering establishments:—

1. Employed in works or in yards or stores immediately connected therewith:—
    - (*a*) Persons not employed wholly or mainly by way of manual labour, such as chain examiners and testers, chemists, boiler and engine inspectors, material checkers, storesmen, watchmen, fire station attendants.
    - (*b*) Telephone attendants, gas makers and stokers (for general illumination of works, houses, carriages, stations, &c.), pumpers filling locomotives, saddlers repairing harness, locomotive engine drivers, shunters, platelayers, messroom attendants.
2. Other employés:—
    Electric linemen and wiremen (maintenance of telephone lines and apparatus at railway stations, &c.), locomotive engine drivers, enginemen, crane drivers, excavators, paviors, labourers, and others employed in connection with uninsured trades, water fitters keeping in order pumps about the railway system.

In connection with carriage and wagon works:—

1. Employed in works or in yards or stores immediately connected therewith:—
    - (*a*) Persons not employed wholly or mainly by way of manual labour, spring testers, storekeepers, timber selectors and markers, weighmen.
    - (*b*) Caners making portable chairs, hair carders, horse drivers shunting carriages and wagons in use, carriage washers, laundresses, sheet makers.
2. Other employés:—
    Enginemen, labourers, and water fitters employed in connection with uninsured trades.

In connection with workshops at which steam and other vessels are repaired:

Labourers connected with loading and unloading, or other uninsured trades, ferrymen, sailmakers, and storesmen and watchmen not engaged wholly or mainly in manual labour.

Employés engaged in dredging harbours or entrances to harbours in connection with docks, or in the engineering department of canals; all men engaged in maintenance and repairs of works (excluding repairs of buildings, machinery, vehicles, or ships, and the manufacture of metal goods for the purpose of repair of works or sawmilling and machine woodwork).

Volunteer Notes. — County of London Engineer Volunteers (Field Companies).—Headquarters, Balderton Street, Oxford Street, W.

Orders for the week, by Lieut.-Colonel C. B. Clay, V.D., commanding:—

Monday, July 2nd.—Technical instruction for No. 3 Company, Right Half Company, at Regency Street. Drill, No. 3 Company, Left Half Company. Signalling Class. Recruits' Drill, 6.30.

Tuesday, July 3rd.—Lecture, 6.30. Physical drill and bayonet fighting, 7.30.

Wednesday, July 4th.—Drill, No. 1 Company, Left Half Company.

Thursday, July 5th.—Drill, No. 2 Company, Left Half Company. Ambulance Class, 6.30. Signalling Class.

Friday, July 6th.—Technical instruction for No. 3 Company, Left Half Company, at Regency Street. Drill, No. 3 Company, Right Half Company. Recruits' Drill, 6.30.

Saturday, July 7th.—N.C.O.'s Parade, 2.30; under Platoon Commander Watkins. Map reading.

Macleod Yearsley, *Adjutant.*

The First County of London Engineer Volunteers is the only engineer volunteer corps open to all engineers; it has already furnished to the fighting Forces about 1,200 men, many of whom have obtained commissions. All companies are instructed in infantry drill, and in knotting, lashing, temporary bridge building, raft and other expedients for crossing water; technical instruction is given at the headquarters of the London Electrical Engineers in the working and management of searchlights and internal combustion engines, and all companies are available for the important work of trenching in connection with the London Defences. Musketry and signalling instruction is also provided, and field work is carried on under the supervision of officers of the Royal Engineers. All men who have been granted exemption, or are badged, should train as Volunteers, so that in the event of invasion they could take their share in the defence of the country as soldiers; those who are unable to take an active part in the work of the corps can assist it by becoming honorary members, whose subscriptions are devoted to defraying the general expenses incurred by the corps in carrying out its training. Those of our readers who are willing to further this patriotic movement, which is worthy of their hearty support, may obtain full information from the Adjutant, Balderton Street, London, W. 1.

The A.E.G. and the B.E.W.—A fresh increase of share capital is proposed by the A.E.G. in order to render assistance to one of the company's earliest promotions—the Berlin Electricity Works Co. After the transfer of the latter's supply works to the Berlin Municipal Council, about two years ago, the company became solely an investment company, which, it was hoped, would still be able to yield satisfactory dividends to the shareholders, of whom the A.E.G. is one with an interest of 80 per cent. of the total share capital. One of the investments, which was initiated before the transfer, related to the great power station which was then projected at the lignite mining fields of Golpa-Jessenitz, which belongs to the Electro Works Co., and which, on the outbreak of the war, was requisitioned for the supply of electrical energy to Imperial works for the production of cyanamide. The plant and installations at this lignite station are stated to be technically faultless, but the production of lignite has been beset with difficulties owing to unfavourable earth conditions and the scarcity of labour, whilst the considerable requirements of the boiler furnaces have rendered it necessary for a large quantity of pit coal to be purchased to assist in meeting the needs of the station. Under the circumstances, the cost of production largely exceeds the estimates made in the pre-war period, and as the sale price of energy is fixed by contract, the prospects of the Electro Works Co. proving commercially successful are remote. A total of £2,250,000 has been invested in this company in the form of share capital and loans, one-half having been furnished by the A.E.G., and the other by the Berlin Electricity Works Co. Now the former proposes to take over the latter's interests in the lignite power station, and offers new A.E.G. shares of £800,000 in exchange for the £1,125,000 of shares and loans held by the Electricity Works Co. in the Electro Works. As the new A.E.G. shares are entitled to participate in the dividend for 1917-18, it will be obvious that this company is rendering assistance, which is greatly needed, if the Electricity Works Co. is to continue as prosperous as formerly. At the same time, the latter has the right of re-purchasing the shares within a period of five years.

A Rival to X-rays.—The Patents Court has recently disclosed that the Röntgen rays are no longer the only agency which will enable organic bodies to be examined internally. A remarkable process was discussed when the Trustees of the South Kensington Museum (Natural History Section) applied for licence to use a German patent which imparts to animals a transparency so thorough that every bone, muscle, and artery can be seen distinctly through the skin.

Dr. S. F. Harmer, F.R.S., who made the application, said the transparency was not something vague, like a radiograph, with blurred outlines: it was a transparency vivid and direct as that of glass itself. The supreme advantage of the method was that every specimen treated became a permanent object lesson for study purposes or museum exhibition. He had a rat whose every organ could be seen. The process employed the principle of the refraction of light, and it relied upon chemical solutions, made according to formulæ, to have each a required index of refraction.

The Controller of Patents (Mr. Temple Franks) said he thought nothing should be allowed to stand in the way of the authorities at the British Museum making full use of this process, though he did not see how anyone could very well claim a patent right in the principle of the refraction of light.

A.S.E. Funds.—The annual financial statement of the Amalgamated Society of Engineers shows capital funds worth £1,743,554.—*Times.*

New Patents.—In his report for the year ended 1916 the Comptroller-General of Patents, &c., states that applications for new patents numbered 18,602 ; 13,641 provisional and 10,700 complete specifications were submitted, and 8,424 patents sealed. applications in 1915 having been 18,191, of which 11,457 were sealed. There was an increase of £11,417 in the receipts from patent fees. On the other hand, there was a further decrease in the receipts from design fees and sale of publications. The total receipts amounted to £292,731, being £10,260 more than in 1915. The surplus of total receipts over expenditure was £107,492, as compared with £94,298 in the previous year.—*Financial Times.*

Australian Electricians with the Forces.—The secretary of the Electricians' Union stated that a great many members of the Union had gone to the Front, and tradesmen were rather scarce. Although a decided slump had occurred in the earlier part of the year, and a number of men were still liable to be discharged from State Government Departments, this had been counteracted by a demand in other directions. Large business concerns that depended almost entirely upon electric "drive" had lately applied for men. The labour required was that of electric fitters, armature winders, and for general installation work.—*Sydney Daily Telegraph*, May 21st.

Bonuses for Station Staff.—Owing to the extra work during the past few months in consequence of breakdowns, the West Ham Electricity Committee suggests special bonuses as follows :—Four senior shift engineers, £20 each ; three assistant shift engineers, £4 each ; three junior shift engineers, £3 each.

Coal Concreted from Ashes or Dusts.—In a paper read before the Society of Architects, on June 7th, Mr. R. Goulburn Lovell, A.R.I.B.A., stated that in co-operation with Mr. C. M. Hughes he had evolved a process which would enable a fuel to be made without pressure at any industrial locality from the waste products to be found in that locality which might possess any calorific value. This process was part of a great scheme for the proper utilisation of fuel ; it provided for immediate necessities and utilised a residual product now of comparatively small value.

"Coals" were shown which had been concreted from coal dust, coke dust, destructor ash, destructor ash and coal dust, and from clinker, bar ash, and sawdust. The better grades burnt like Nature's coal, the lower grades like coke ; they all flared, coked, and incandesced. The machinery and plant required practically existed in all industrial centres. The essentials were crushers or breakers, screens, drying tables, mixers, and moulds such as cast-away pails, baths, &c. For the cooking process either ovens or boilers could be used, the main object at the present time being to utilise any existing plant with unskilled labour.

The cost depends mainly upon the value put upon the bases, the cost of the matrices, such as glucose, pitch, and other bitumens, and the cost of the chalk or other calcium carbonates.

The following examples were given for the cost of materials in shillings :—

Calorific values. B.TH.U.	Samples.	Per ton.
7,500	No. 1, Eastbourne destructor ash	11·0
8,040	No. 2, Maples destructor and coal dust ...	4·6
10,320	No. 3, Maples destructor and sawdust ...	9·0
10,540	No. 4, Birmingham destructor and coal dust	8·0
11,840	No. 5. Birmingham coke dust	7·0
12,600	No. 6. London coke dust	10·0
12,820	No. 7, Staffordshire coal dust	10·0

The cost of the labour and establishment charges in the British Isles would not be more than 5s. per ton.

Mr. H. W. Bowden, chief electrical engineer to the Poplar Borough Council, said that from the central station point of view, the removal of ashes and clinkers was a very serious item. He had 150 tons to dispose of per week, and had to pay 3s. 6d. to 4s. per ton to have it removed. In his case, in the riddlings that went through the chain grates there was a considerable amount of useful coal, which went away in the ashes. He had tested this, and found it contained about 4,000 B.TH.U. He had also a destructor which gave about 20 to 30 tons of clinker per day, in which he thought there was no heat value. He was quite sure his Borough Council would be prepared to consider the thing very seriously.

Mr. Lovell said the ash from the dust destructors was the thing that could not be got rid of, whereas the clinker was found useful for road-making purposes. It was the ash that he was anxious to handle in his process, and he would be willing to carry out a test on the ash from Poplar, which he thought would probably produce 4,000 to 5,000 B.TH.U., and could be increased by the process to 10,000 or 15,000 B.TH.U. He proposed to use existing plant, such as concrete mixers, which was lying idle all over the country. The residue from burning this artificial coal could be used up again in the same way. With regard to the licence to manufacture, in addition to the condition that the coal must not be sold at more than 25 per cent. profit, the conditions were that the ash or refuse which was to be used in any particular case should be sent to him for test and for determining the right formula for the mixture. For this test 50 or 60 guineas would be charged ; and further, he asked 7d. per ton as a royalty on the whole of the material produced by the licensee. He had received an estimate from responsible people to make the coal at 6s. per ton for the actual making.

Mr. W. R. Cooper said he was not quite sure whether the author realised what was being done already in the way of briquetting, The assumption was sometimes made that slack and coke breeze could not be used for steam raising that was a mistake, so that all that was left was the fine dust, and he was not sure that there was so much in that as the author seemed to imply. There was a popular idea that there was a great deal of waste coal of a valuable character to be found at the pits, but that was not the case. The author added incombustible matter to the fuel, and he would like to know the percentage of ash in the fuel to start with, and the percentage of ash in the final product. Obviously the higher the ash the less the value of the fuel.

Electricity v. Gas.—At the annual general meeting of the Waverley Association of Gas Managers, held in Edinburgh, on Friday last, Mr. J. D. Keillor (Hawick), the president, in the course of his address, said the opposition of electricity was so formidable that if gas was to maintain an honourable position in the realm of light and power they would have to apply a driving force so great and of such endurance that their place would be for ever assured, and that gas would be a force to be reckoned with. They should remember that they were not monopolists in the supply of light and power. Their rival had received all the care and support that scientific thought and influence could bestow upon it, and speaking generally, had enjoyed an amount of patronage and encouragement never bestowed upon gas. To what extent it might in future be developed was a matter of speculation, but he felt sure that soon its opposition would be more formidable than ever. Their attention had been directed to a movement in which the Board of Trade was taking an active part—the proposal to link-up electric supply undertakings in certain industrial centres. This was a very serious attempt to regulate and foster the resources of an industry in the national interest, and for the gas industry it was a matter of the greatest moment, possibly having a disastrous effect unless they could combat it. If such a scheme was possible with electricity, it should not be impossible to attain similar results with gas.

German Scarcity of Copper.—The following appeared in the "Through German Eyes" column of the *Times* on Wednesday :—

"COPPER FOR THE SUBMARINES.—The *Frankfurter Zeitung* announces that the Government has now requisitioned all electrical machinery and apparatus, and it is no longer possible to buy or sell electric motors without special permission.

"An article in the *Cologne Gazette*, describing a visit to the Imperial yards at Kiel, which are said, like the Imperial yards at Dantzig and Wilhelmshaven, to be mainly, but not entirely, engaged with repairing work, contains the following passage on copper and electricity :—

"Copper is now used in large quantities in all ships, although, of course, consumption is restricted as much as possible. Especially for steam piping there is no substitute for copper, and it is also needed for all purposes where high resistance to sea-water and salt air is necessary. Nothing seems yet to be known at Kiel about a scarcity of copper, and if our enemies think that they can starve us out by cutting off the red metal, they will be just as much deceived in this as in the rest of their starvation scheme. It is pleasant to see how the long, thin copper tubes are formed, snake-like, by skilful hands. . . .

"Over against the boiler shop is the electrical shop, which becomes every day more important with the increased use of electricity. We have already gone a long way in this, although we have not yet gone quite so far as the Americans, who even drive the screw-shafts of large ships by electric motors. As regards our submarines, it is, indeed, much the same with us, for our submarines already consist half of electricity. The submarines are also concerned with the accumulator shop, where accumulators are repaired. Repair is not always possible, for the demands made on the accumulators in war are sometimes too great."

Electric Coal-cutters : Australian Judge's Decision.—An Australian newspaper just to hand (dated May 16th) quotes a Sydney dispatch to the effect that Judge Fitzhardinge, who was umpire in the recent Bulli Colliery coal-cutting case, decided that the practice of using electrical coal-cutters in the Bulli seam of the Bulli Colliery was dangerous, and, in the interests of the miners and of the mine, should be at once discontinued. His Honour directed that the cost of the umpire and arbitrators, and of the Arbitration Court, shall be paid by the owners of the Bulli Colliery.

Fatality.—An inquest was held at Murton (County Durham), last week, upon the body of a 13-year old boy named Joseph Wilson, who died as the result of an electric shock. The child's father found him lying unconscious about 3 or 4 yards away from an electric pole. He was dressed in knickerbockers, but had neither shoes nor stockings on. The knickerbockers were burnt down to the knee of the right leg. He died two days later. A playmate said the deceased climbed the wire support of the electric pole. He was walking on his bare feet along the lower stay wire, and was holding on to the upper wire. She heard a noise, saw a flash, and then deceased fell to the ground. A boy witness said he saw the flash, which extended from one pole to another. The doctor, in giving evidence, said he thought the deceased could not have been holding on to the live wire with his hands, but must have just touched it with his right thigh. On the night following the mishap deceased collapsed and died of paralysis of the heart muscle, due to the electric shock. The fall had nothing to do with the cause of death. A verdict in accordance with the medical evidence was returned, the jury adding that no blame attached to the Newcastle Electric Supply Co., Ltd., owners of the equipment concerned.

Appointments Vacant.—Lecturer in electrical engineering, for the University College, Nottingham. See our advertisement pages to-day.

Decimal Coinage and the Metric System.—A Committee of the Institute of Bankers, appointed to consider the adoption of a decimal coinage and the metric system of weights and measures, has issued a report recommending the change, provided that the coinage be based upon the retention of the present gold sovereign as the unit of value, divided into 1,000 mils. The Committee holds that the existing system of weights and measures is an obstacle to the extension of our export trade, and advocates the adoption of decimal coinage, in the hope that it will be the first step towards the introduction of the metric system. The universal standing of the pound sterling precludes its abandonment as our standard unit, even in name only. The use of the term "cent" is considered undesirable, and the objection that the subdivision into mils involves the use of three places of decimals is met with the reply that, as compared with the system in which the florin is the unit of account, there would be one digit less to the left of the point. The Committee is confident that as regards the gold and silver coinage the transition would present no serious difficulties; the change of 4 per cent. from the value of the penny to that of the four-mil piece would be quickly adjusted, especially as the decrease in the purchasing power of the penny during the war has accustomed the public to such adjustments. The Committee considers that the change cannot be made before peace returns, as it will necessitate alterations in adding and calculating machines which cannot be effected under present conditions, but urges that the necessary legislative steps should be taken, without delay, and that an educational campaign should be organised to habituate the public and the staffs of the banks to the new system.

The British Chamber of Commerce for Italy has passed a resolution emphatically urging the adoption (by the United Kingdom) of the metric system.

Engineering Students.—Under this title the Junior Institution of Engineers has issued a pamphlet embodying a scheme drafted by a Committee, to formulate the conditions under which youths intending to enter the engineering profession, or train for staff appointments, may be admitted to the Institution. Such students will be styled "Cadet" Associate Members, and in the pamphlet full particulars are given as to their proposed qualifications and privileges. The scheme is intended to fill a gap which now exists at the outset of a youth's career. Details may be obtained from the secretary, Mr. W. A. Tookey, 39, Victoria Street, S.W. 1.

The Control of Coal.—At the London meeting of the Institution of Gas Engineers, recently, Mr. Guy Calthrop, the Coal Controller, gave some account of the operations and plans of the Coal Mines Department.

The object of instituting a control of coal mines, he said, was not to interfere with industry, but, as far as possible, to get all to work together in the interest of the nation in the present crisis. Two of the greatest problems he had to deal with were these:—

1. To secure a reasonable supply of coal for London and the counties of Great Britain which were most remote from the coal fields during the next winter.

2. To help, so far as he could, the railway companies in their present difficulties with regard to transport.

Out of the 600,000 men who were in the railway industry in times of peace 160,000 had joined the Forces, and a very great number of engines and a larger number of wagons had had to be sent to the various Fronts in order to deal with the situation there.

A scheme had now been drawn up to secure that coal should be consumed as near as possible to the point of its output. The scheme as far as they had gone dealt with upwards of 40,000,000 tons of coal per annum, and if they could carry it through they would materially assist the railway companies in the coming winter. Supposing the war were over to-morrow, the transport difficulties of England would not be over at the same time. They would continue through the winter. Our losses in ships were common knowledge, and the transport of coal by ship from Northumberland or Durham to the South of England could not be anything like what it was before the war.—*The Times.*

Suppression of Sparking.—At a recent meeting of the Physical Society of London, a demonstration of a method of preventing sparking at a rapid make and break, which incidentally produces colloidal platinum, was given by Dr. A. Griffiths. The device consists of a series of electrolytic cells placed as a shunt across the spark-gap. The electrodes consist of platinum and the electrolyte of strong sulphuric acid. The cells polarise, and on making the gap an E.M.F. is introduced opposed to the E.M.F. of the battery, so that the current rapidly diminishes, decomposing the liquid and doing chemical work.

Mr. A. Campbell communicated the following remarks:—"Many years ago Helmholtz introduced the use of a condenser, shunted by a suitable resistance, across the spark gap for the purpose of suppressing the spark. More recently a better system was employed by the engineers of the G.P.O., who kindly communicated it to the National Physical Laboratory, where it has been used with the greatest success on all kinds of spark-gaps (from 1 break per second up to 1,000 per second). This consisted in putting the resistance in series with the condenser. By adjusting the value of the resistance to suit the particular circuit it is nearly always possible to suppress the spark. There is no leak across the break, as in the shunt system."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Stafford T.C. has increased the salary of the manager and engineer of the electricity department, Mr. Robins, from £200 to £250 a year, rising to a maximum of £300.

The Rochdale Electricity Committee recommends that the appointments of Mr. Wood, of Bolton, as consulting engineer, and of Mr. F. H. Rudd, as acting-engineer, be continued for a further three months.

Coventry Electricity Committee has recommended that the salary of Mr. Geo. Tough, engineer and manager, be increased from £750 to £900 per annum.

The Cheltenham Council has decided to advance the salary of Mr. Bache, the borough electrical engineer, from £450 to £550, with a further advance of £50 two years' hence.

The Grimsby Public Lighting Committee recommends that an additional war bonus at the rate of £50 per annum be granted to the deputy electrical engineer (Mr. A. S. Channon) during the time he is in charge of the electricity undertaking.

General.—Mr. Conrad Cooke underwent an operation upon his left eye at a nursing home in London last week. We are pleased to learn that it was quite successful. We hope that the operation that is being performed on the right eye will be equally so.

In the name of the directors of the Musselburgh Electric Tramway Co., wristlet watches were presented to Miss Bell and Miss Halliday for displaying presence of mind in emergency when on duty as drivers of electric cars of the company.

At the annual meeting of Waygood-Otis, Ltd., Mr. H. C. Walker announced that during the year he had, after 50 years' service, resigned the office of managing director. Mr. D. W. R. Green, at the time of the amalgamation with the Otis Co., was appointed to serve with him as joint managing director. Mr. C. Clarke, for many years the general manager and director of the Otis Co., would in future act with Mr. Green as joint managing director. He (Mr. Walker) would continue to serve as chairman of directors.

Roll of Honour.—Leslie William Caston, a first-class air mechanic in the R.N.A.S., has been awarded a D.S.M. for gallantry in the North Sea. He was a student at the Wandsworth Technical Institute, and, after being in the service of the General Electric Co., Ltd., he joined the L.G.O. Co., at their Streatham garage.

Lance-Corporal W. H. Townley, North Staffs. Regiment, who was with Mr. Leonard Vaughan, electrician, of Hanley, has died at the Front from injuries received in an accident.

The Military Medal has been awarded to Corporal G. T. Bradley, who was an electrician at Markham Colliery, Staveley.

Temporary Second-Lieutenant Fred. Proudfoot, an electrical engineer, son of Mr. Proudfoot, formerly telegraph superintendent at the Carlisle Post Office, has been awarded the Military Cross.

Corporal F. T. Message, who is in hospital, was employed as an electrician with Mr. Teeton, Hanley.

Corporal W. Scott, R.E., who has been awarded the Military Medal, was employed as a foreman in an electrical engineering works in Paisley.

The *Times* states that Sir Henry Norman, who acted as *liasion* officer between the British and French Governments in the matter of war inventions, has been made an Officer of the Legion of Honour.

Private J. M'Kinnon, who has died from wounds, was with Messrs. Fraser & Borthwick, electrical engineers, Glasgow.

Second-Lieutenant N. S. Sim, Cameron Highlanders, an electrical engineer, and a B.Sc. in Engineering (Glasgow University), has been awarded the Military Cross.

Private H. S. Lant, North Staffs. Regiment, now presumed to be dead, after being missing for nine months, was on the staff of Messrs. Siemens Bros., Ltd., Stafford.

Private J. W. Walker, Northumberland Fusiliers, who is reported to have died on April 13th, whilst a prisoner in Germany, had been in the enemy's hands since August 23rd, 1914. He was on the clerical staff of the Phœnix Dynamo Co., Bradford.

Captain R. L. Johnson, R.F.A., who was killed on May 26th, was in Australia when war broke out, with the Sydney branch of Messrs. R. Johnson, Clapham & Morris. He was appointed chairman of the company in 1916, on the death of his eldest brother, also in the war.

According to the *National News*, Mr. Herbert L. Costa, manager of the building and electrical departments of Harrod's, has been personally decorated with the Cross of Chevalier of the Order of Leopold II by the King of the Belgians, near the firing line, for services rendered in connection with building and engineering operations carried out for the Belgians by his firm.

Sergeant J. H. Sivers, Royal Fusiliers, who has died of wounds, was an L.C.C. tramway inspector.

Sergeant-Major A. MITCHELL, Rifle Brigade, formerly in the rubber department of the India-Rubber Co., Silvertown, has been awarded the Military Medal. Private L. NORTH, Royal Fusiliers, formerly in the general office of the company, and Gunner T. W. B. PURCHASE, R.F.A., formerly in the cashier and buyer's department of the same company, have both been wounded in France.

Obituary.—MR. G. D. SEATON.—We regret to record the death, which occurred on June 21st, at Fallowfield, of Mr. Gervase D. Seaton, son of Prebendary Seaton, Vicar of Goodrich. Mr. Seaton, who was 49 years of age, was a familiar figure at conventions of the I.M.E.A. and other meetings, where he was always most excellent company, and a speaker who had the gift of contributing both profitably and humorously to a discussion. He was an expert in the turbine world, and at different periods he had represented in Manchester Messrs. Willans & Robinson, Ltd., the British Westinghouse Co., and latterly Messrs. Richardsons, Westgarth and Co., Ltd. He had been prominently identified with the Manchester Engineers' Club from the beginning.

MRS. TOUGH.—We regret to state that Mrs. Tough, wife of Mr. G. Tough, manager of the Corporation electricity works at Coventry, passed away suddenly last Sunday week while at church.

Will.—The late Sir BENJAMIN C. BROWN, of Newcastle-on-Tyne, left £77,415.

NEW COMPANIES REGISTERED.

British Chamber of Commerce in Brazil (147,749).—(The word "Limited" is omitted from the title by licence of the Board of Trade.) Registered June 16th, by Corbould, Rigby & Co., 1, Henrietta Street, Cavendish Square, W., as an association limited by guarantee, not formed for purpose of profit. For the purpose of registration the number of members is declared not to exceed 1,000, with power to register an increase at any time. In the event of winding up every member is liable for not more than £5 towards the satisfaction of the liabilities of the Chamber, the costs of the winding up, and the adjustment of the rights of contributories among themselves. The Chamber is to consist of British incorporated companies, British merchants, traders, representatives, agents, and professional and business men working or trading in or with Brazil. ("British," as regard individuals, means that such individuals are British subjects. British companies may only be represented at meetings of the Chamber or in correspondence therewith by British subjects.) The objects are to promote and protect British interests in Brazil, to collect and disseminate information, &c. The first directors are: F. W. Perkins (Lamport & Holt), F. Dodd, E. P. Matheson, C. D. Simmons, A. J. Cruickshank, H. L. Wheatley, J. M. Glen, J. F. Shalders, F. H. Walter, J. H. Moorby, H. O Robinson, L. E. Sancean, C. F. Cruickshank (Norton, Megaw & Co., Ltd.), S. L. F. McLaughlan, H. W. Sloper, W. J. Robson, A. H. Roberts, H. C. G. Pullen (Davidson, Pullen & Co.), J. P. Wileman, E. L. Harrison, and R. Whichello, all of Rio de Janeiro. There is to be a "Foundation Fund," the contributors to which are to be called "Founders," but the title of "Founder" carries no privileges. The first trustees of such fund are F. S. Pryor (manager of London & Brazilian Bank, Ltd., Rio de Janeiro), A. Weigall (manager, Rio de Janeiro Flour Mills and Granaries, Ltd., Rio de Janeiro), and A. Mackenzie (president, Brazilian Traction, Light & Power Co., Rio de Janeiro). Each of the following trades is to be represented by at least one member on the Council, viz.: Coffee, shipping, banking, importing, exporting, textiles, coal and oil fuel, machinery, mining, insurance, engineering and railways. The Council may appoint subcommittees to represent the following sections, viz.: (1) Machinery, (2) banks and financial houses, (3) coal and oil fuel, (4) general exporters, (5) textiles, (6) engineering and contracting, (7) railways and tramways, (8) hardware and lumber, (9) insurance, (10) coffee exporters, (11) general importers, (12) refrigerating companies, (13) shipping, (14) mining. These may be added to. Registered office: 1, Henrietta Street, Cavendish Square, W.

James & Shakspeare, Ltd. (147,797).—Private company. Registered June 22nd. Capital, £17,000 in £1 shares. To take over the business of metal brokers and merchants formerly carried on at 1, Metal Exchange Buildings, E.C., and elsewhere, as James & Shakspeare. Agreement with H. H. James and A. F. B. James. The subscribers (each with one share) are: R. H. H. James, 42, Pembroke Square, Kensington, W., gentleman; Mrs. E. H. Christian, 91, Barkston Gardens, Kensington. The first directors are: A. F. B. James, H. H. James, and R. H. H. James. The two first-named may retain office while holding 500 shares. Until otherwise resolved by the company, no person may be a director who is not a lineal descendant of the late K. H. James. Registered office: 1, Metal Exchange Buildings, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

James Clay (Wellington), Ltd.—Equitable mortgage to secure all sums due or to become due to bankers charged on freehold hereditaments and premises in Foundry Lane, Wellington, Salop. Holders: Barclay's Bank, Ltd., Wellington.

Phonopore Construction Co., Ltd.—Particulars of £2,000 debentures created May 15th, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Hexham & District Electric Supply Co., Ltd.—Particulars of £5,000 debentures created November 6th, 1913, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £4,300. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Brilliant Arc Lamp & Engineering Co., Ltd.—Memorandum of satisfaction in full on May 12th, 1917, of charge dated December 7th, 1916, securing all moneys due or to become due thereunder.

Thermo Electric Ore Reduction Corporation, Ltd.—Particulars of £100,000 debentures created June 14th, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Enfield Electric Cable Manufacturing Co., Ltd.—Debenture dated June 8th, 1917, to secure £35,000 charged on the company's undertaking and property, present and future, including uncalled capital, with a specific charge on land at Brimsdown, Enfield, and the factory and other buildings thereon, &c. Holders: London County & Westminster Bank.

A memorandum of satisfaction in full on June 8th, 1917, of mortgage dated December 31st, 1915, securing £10,000, to London County & Westminster Bank.

Faraday & Son, Ltd.—Particulars of £5,000 debentures created January 6th, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

James Keith & Blackman Co., Ltd.—A memorandum of satisfaction in full on May 15th, 1917, of second debentures dated January 6th, 1913, securing £550, has been filed.

U.S. Light & Heat Corporation (1,583F).—Particulars filed June 20th, 1917. Registered in U.S.A. June 30th, 1915. Capital stock, 7,000,000 dols. (3,000,000 dols. preferred and 4,000,000 dols. common stock). Principal office: City of Niagara Falls, U.S.A. British address: 17, Conduit Street, W. 1, where H. H. Powell is authorised to accept service. Directors: J. A. Smith, A. H. Ackermann, R. C. Caples, H. W. Farnum, E. H. Gold, E. K. Gordon, C. L. Lane, J. A. Roberts, B. J. O'Reilly, and G. C. Shephard, all of U.S.A.

Bude Electric Supply Co., Ltd. (95,137).—Capital, £15,000 in £1 shares. Return dated April 28th, 1917. 10,000 shares taken up; £10,000 paid. Mortgages and charges: £2,500 mortgage debentures.

Cable Accessories Co., Ltd. (93,345).—Capital, £50,000 in 40,000 ord. and 10,000 pref. shares of £1 each. Return dated May 21st, 1917. 31,999 ord. and 5,640 pref. shares taken up; £1 per share called up on 21,678 ord. and 5,640 pref., and 15s. per share on 10,321 pref.; £32,008 15s. paid; £3,050 considered as paid. Mortgages and charges: Nil. A further 3,177 ord. and 400 pref. were allotted, payable in cash on May 31st.

CITY NOTES.

British Electric Traction Co., Ltd.

The annual meeting was held on Friday last at the Holborn Restaurant. Mr. EMILE GARCKE, who presided, said that the stupendous expenditure by the nation and the employment of so many hands, both male and female, in the production of munitions of war, combined with restricted railway facilities, had had the effect upon their receipts akin to that which would be produced by great trade prosperity. The value of the increased receipts must, however, be weighed against the increased expenses, and then it was seen that the balance of profits was not proportionate to the increased work done. The prosperity was abnormal in character, and was accompanied by neutralising conditions likewise abnormal. These adverse conditions were both numerous and multiform. Prices generally, with the remarkable exception of tramway fares, had more than doubled since the beginning of the war, and were still rising. Wages had gone up considerably. Taxation had increased; restrictions on all forms of enterprise other than war work were enforced by all sorts of regulations, by dearth of labour and executive staffs, by prohibition against investment of capital other than for national purposes, and by feeling of uncertainty in regard to the future. The conditions applied generally to the industries in which they were engaged, viz., tramways, light railways, omnibus services, electric light and power supply, manufacture, and, he must not omit to say, finance, for they had in their group an investment company with investments of over £500,000. The figures he would give would not include the London group of companies, which stood in a class by themselves. In the tramway and light railway department receipts had increased by £90,000 and expenses by about £52,000. The higher expenses were mainly represented by increased wages paid. In the omnibus department the receipts showed an increase of £97,000, and the expenses an increase of about £91,000. This department was suffering very severely under war conditions. Their automobile department, from which they expected gratifying auxiliary profits, was for the present to a large extent in a very disturbed state, and they feared that the profits for the current year would not come up to last year's figures. In the electricity supply department the receipts had increased by £88,000, and the costs of generation by about £77,000. They had nearly doubled the output of electricity for power purposes, chiefly supplying munition factories and other works engaged on Government orders. On the other hand, the sale of electricity for private lighting had fallen off. The cost of fuel had increased enormously, though differently according to the location of the power houses, and they had not been able, for various reasons, to obtain corresponding increases of price. In the manufacturing department, the Brush Co. had been fully occupied in making aeroplanes, seaplanes, and other machines. The company had also established the superiority of the Ljungström turbine, and valuable orders were being received for this machine, which, however, could not be executed because of the necessary Government restrictions on the use of materials for other than war purposes. The Brush Co. was now making moderate profits; but it had not resumed the payment of dividends, because under present conditions it was deemed better to strengthen the finances. Lastly, with regard to their investment company; that company had not, of course, increased its distribution of dividend, but it was satisfactorily holding its own in view of the heavy market depreciation of all securities. The aggregate increase of revenue in all departments of their public service undertakings had, therefore, been about £275,000, while the aggregate increase of the expenses was about £223,000. The aggregate receipts of their tramway, omnibus, and electricity supply undertakings for the past year had been £1,768,000, and the aggregate expenses had been £1,150,000. The aggregate surplus had been £618,000, compared with £566,000 in 1915, or about £52,000 more than in 1915. On the whole, therefore, the associated companies had done better during the past year. They showed larger profits, though the increase was not commensurate with the larger volume of work they had done. Those larger profits had in most cases been added to reserves, partly because renewals and replacements had been postponed, and partly because of the uncertain outlook, and only in a few cases had the dividends been slightly increased. Putting it shortly, the majority of companies had strengthened their finances by not increasing their dividends. Those figures did not include the results of the London companies. Those were summarised in the dividend they received on their shares in the London and Suburban Co., and that dividend had remained at the same rate in 1916 as in 1915. The conditions due to the war had adversely and seriously affected the prosperity of all the companies in which the London and Suburban Traction Co. was interested. Wages had increased considerably, and the higher expenses generally had more than swallowed up the increased receipts. The London United Tramways Co., which was included in the group, had suffered most. The B.E.T. Co. had nothing to do with the promotion and management of the London United Tramways. The majority of the ordinary shares were held by the Underground Electric Railways Co. of London, and the Tramway Co. was brought into the combination formed by the London and Suburban Co. in 1913 with a view to putting an end to the competition between the Metropolitan Tramways and the L.G.O. Co. The elimination of competition had not been carried out to the extent anticipated, but the chairman of the London and Suburban Co., at the general meeting last week, stated that discussions between that company and the Underground Co. were taking place with a view to the better co-ordination of traffic facilities in Greater London and in regard to other questions, and that there was hope that those negotiations would lead to better understandings and result in improved profits to the London and Suburban Co. The accounts of the B.E.T. Co. showed a net profit of £200,000, against £209,000 for the preceding year. In 1916 they added £20,000 to reserve. He explained last year that that represented two years' contributions; that they would not advise making any annual contribution fixed and unalterable for all time, but that the circumstances of each year should be considered. The contribution of £15,000 this year must not, therefore, be regarded as a descent to a lower level of prudence. As a matter of fact, the reserves were quite ample, having regard to the writing off that had taken place and to the substantial reserves made by the underlying companies. At the end of 1915 those companies, again excluding the London companies, had total reserves of £1,300,000, and during the past year they added £243,000, making a total reserve of over 1½ million, to which must be added the reserve and the carry-forward of that company—a further half million. The maximum fares which could be demanded on tramways or light railways were limited by the Acts and Orders, and could not be increased without Parliamentary sanction. Those restrictions might have been reasonable in the latter part of the last century, when the powers were obtained; but in view of the changed conditions which now obtained, and must be looked for in the future, it was only equitable that the statutory restrictions should be reviewed by the Board of Trade or other Government Department, and steps had been taken by the Tramways and Light Railways Association to have this question considered by the authorities. The electrical industry was hoping that the Government would do something to remove some of the disabilities which restricted the best development of the industry. If the matter was looked at from scientific and economic points of view, and not merely politically, the importance to the nation of allowing the free development of the electrical industry must be recognised. For 34 years he had made fruitless exertions to obtain elementary justice and a modicum of encouragement for an industry which was hourly proving its great value to the community. He had never abandoned hope of ultimate success—a hope which recent events had further stimulated. The shaking up produced by three years of war had done more than 30 years of peaceful agitation to secure recognition of the view that the electrical industry deserved to be freed from the shackles which impeded its progress. In regard to the Labour situation, a reversion to the pre-war methods of restrictive output was incompatible with the industrial conditions and needs of the community, which required that every member of the community should work harder, consume less, and save more. But the employers and the whole nation were pledged to restore the Trade Union regulations after the war. The representatives of Labour, however, recognised—as they all did—that this was impossible. There was, therefore, a common basis for the establishment of a new order of relations between Capital and Labour, and it would tax to the utmost the highest statesmanship to find an equitable solution of the difficulty. They could all assist in this effort by unbiassed discussion of the problems in a spirit of fairness which recognised on the one hand the just claims of labour for a better standard of living, and, on the other hand, the economic necessity of adequately rewarding those who saved a part of their income and did not spend all they received. There could be no doubt that if everyone did his best to increase the output and improve the quality of work, the result would be that all reasonable demands of labour could be satisfied without causing any diminution in the availability of capital. In regard to the metric system, in his view the inconvenience of making the change would be greatly outweighed by the advantages that would follow the adoption of the decimal system. Among those advantages, not the least would be th improvement it would effect in our commercial relations with other nations. In this connection it was gratifying to learn that steps were being taken to increase the efficiency of the British Consular services abroad with a view to the representatives of the Empire acting as antennæ to the nerve centres of the trade and commerce of the Empire. But probably the most far-reaching reforms they would see carried in the near future were due to the recognition of the fact, even by confirmed Free Traders, that after the war this country would not be able to rely mainly upon its financial strength and its shipping supremacy in the trade and commerce of the world, but that it must have a protected home market for its manufactures as a base from which, in conjunction with its Colonies, it could keep a hold on international markets and, incidentally, help to raise a part of the huge revenue which would be required for interest and redemption of war indebtedness. A continued policy of direct taxation to provide the major part of this revenue, as at present, would defeat its own object, for it would discourage the accumulation of capital, which was indispensable for new enterprise. From this point of view it was to be hoped that the Excess Profits Tax would be withdrawn at the earliest possible date, for the excessiveness applied now to the tax rather than to the profits, and would deter enterprise and, therefore, check capital creation. The excessive taxation of profits would after the war, he feared, find expression in unemployment. That brought him to the last point he wished to mention, and that was the importance of organising their industrial system so that manufacturers and others could obtain for the initiation of enterprises the use of capital not only by means of temporary banking facilities or public issues, but by concentrated and reasoned capitalistic support. The wonderful cheque system which had been developed by our big banking institutions had created a credit structure which had met with admiration throughout the world. But the manufacturer, contractor, and, still more, the inventor, needed more than a few months' credit on immediately realisable security, for it was not always practicable or desirable to make permanent increases of capital in the form of debentures or shares. Public issues of industrial capital were periodic, and even epidemic, in occurrence, and capricious in reception. They depended very often upon public fancy, and not on intrinsic merits, conditions which were largely responsible for over-capitalisation and for the promotion of undesirable companies. The formation of the British Trade Corporation, the suggested co-operation between the large trust companies, the activities of the recently-formed Federation of British Industries, were indications that wider views and better methods would assert themselves for the solution of these industrial problems. As regarded the prospects of their companies in the immediate future, all he could say was that anyone in the midst of present complex situations, and impressed with the uncertainty of events, would be unwise to indulge in prophecy of a definite kind.

Mr. C. G. Tegetmeier seconded the motion, which, after a short discussion, was unanimously adopted.

Marconi International Marine Communication Co., Ltd.

The report for 1916 states that the business continues to show substantial expansion. Gross revenue, £270,181—an increase of £61,282, derived almost entirely from the subsidies from additional contracts. Restrictions in respect of private messages have continued. Net profit £96,748, after deducting £31,790 for depreciation and debenture interest; this compares with £63,630 for 1915. Amount standing at profit and loss account £123,744, including £26,996 brought forward. Losses sustained through attacks upon mercantile fleet have been debited to profit and loss. Total number of public telegraph stations owned and worked by the company on the high seas increased from 1,008 to 1,472. The organisation of the company and its associations, with a total of 3,000 mercantile vessels fitted with Marconi telegraph stations, has continued to render inestimable service. A final dividend of 10 per cent. is recommended, making 15 per cent. for the year. There is appended to the report a list of the company's sea-going telegraph staff who have given their lives in the national cause. The Amalgamated Wireless (Australasia), Ltd., has paid 5 per cent. The offer to shareholders last November of the remainder of the authorised capital at a premium of 15s. per share was largely over-subscribed. The capital was required in consequence of capital expenditure upon providing installations for the increased number of ship stations. Since the end of the financial year the business has increased even more rapidly. Orders in hand are so large that additional capital is essential. An extraordinary general meeting is therefore convened for increasing the capital to £600,000, part of which increase will be issued as soon as possible.

Singapore Electric Tramways, Ltd. Sir F. A. Swettenham presided at the annual meeting on June 19th. He said that the traffic receipts were better by £7,592. The sales of energy were £13,530, a decrease of £259, due not to decreased demand, but to the automatic reduction of prices, as the supply increased, under the renewed contract with the municipality. The demand was still increasing, but they did not think that in the next accounts they would show a smaller amount for a larger supply, but the Municipality was treating them with less than justice in holding them to a scale of rates fixed without regard to war prices. The cost of power had advanced from £12,300 to £17,000; of the difference, £4,700, fuel represented £3,400. For the period 1912-1915 the average cost of coal in Singapore was $9.93; in February this year it was $22.70, and they were not sure that top prices had been reached. Having regard to these figures, the action of the Municipality was the more incomprehensible, especially as the Municipality had advanced the rates for gas, of which it was the supplier. In many cases supplies of materials were costing twice pre-war figures. They had a very large deferred commitment in the track renewal which had to be faced. They desired to distribute profits when available, and intended shortly to declare an interim dividend of 5 per cent., which would reduce the carry-forward to £2,946. Mr. J. H. Garrett had resigned his position as general manager after 11 years. His chief assistant, Mr. H. G. Wightwick, would succeed him.

Aluminium Corpn., Ltd. For 1916 the net profit, after providing for debenture interest, &c., was £46,897, plus £4,560 brought forward. After paying the 7 per cent. preference dividend, £15,678, in December last, the balance is £35,779, the appropriation of which will be subject to the liability for war taxation under the Finance and Munitions Acts. The distribution on the preference shares last Christmas was made in view of the trading results then ascertained, but as it has been impossible to ascertain, in time for the annual meeting, the amount payable as war taxation, a further dividend cannot be recommended, and the above balance is to be carried forward. Depreciation upon buildings, plant and machinery will be considered when the war taxation question is settled. Further important necessary constructive works, including a bridge over the Conway River, have been proceeded with, and the main line of the L. & N.-W. Rly. has been connected to the works by a siding. The Cowlyd Water Board's Bill has been passed through Parliament, and the necessary preliminary work for the erection of the dam across the Cowlyd Valley is well in hand. Annual meeting: June 27th.

French Electrical Companies. *The Société Electro-Metallurgique Française* reports net profits amounting to £293,000 for 1916, as compared with £252,000 in the previous year. A dividend at the rate of £4 16s. per share has been declared, this comparing with £3 in 1915.

The Société des Cables Electriques (système Berthoud, Borel et Cie.) reports net profits amounting to £18,200 in 1916, as compared with £7,800 in the previous 12 months. The directors recommend a dividend of £1 12s. per share.

The Société d'Electro-Chimie de Bozel, after apportioning £37,000 to extraordinary depreciation in 1916, reports net profits of £43,000, as against £33,000 in the preceding year. It is intended to pay a dividend of 16s. per share, as compared with 14s. 5d. in 1915.

The Société Electro-Metallurgique (*Procédé Paul Girod*) announces that the net profits earned in 1916 will allow of the distribution of £2 per share. A proposal for the amalgamation of the two Girod companies will be submitted at a forthcoming meeting.

The Société Electro-Chimique du Giffre reports that the manufactures at the works at Giffre, particularly the iron alloys, were in active demand in 1916. The net profits realised amounted to £27,000, as compared with £23,000 in 1915, and a dividend of £2 8s. per share has been declared.

The report of the *Chemin de Fer Electrique Souterrain Nord-Sud de Paris* states that 1916 was characterised by the opening to traffic of the extension of the principal line between the Place Jules-Joffrin and the Porte de la Chapelle, so that the length of line worked increased from 8.76 miles to 9.92 miles. Including various receipts, the total income amounted to £484,000, as compared with £383,000 in the previous year. Such an augmentation in normal times would have been an indication of great prosperity, but owing to the coal crisis and the dearness of other raw materials, the working expenses advanced to such a large extent as to almost entirely absorb the growth in the receipts, and the ratio of expenses to receipts rose from 48.98 per cent. in 1915 to 56.79 per cent. last year. Notwithstanding this, the payments made to the City of Paris under the contract increased by £4,700 to £34,600. The directors had applied for a revision of the terms of the concession, but no definite decision had yet been reached. The accounts closed with a credit balance of £28,000, as against £15,000 in 1915, and the former has been transferred to the provisional account, which now amounts to £97,000.

The Compagnie Française pour l'Exploitation des Procédés Thomson-Houston reports gross profits of £422,000 for 1916, or £121,000 in excess of the preceding year, and net profits of £272,000, or £80,000 more than in 1915. A dividend at the rate of 7 per cent. has been declared, being equal to the rates paid in the years immediately previous to the war, on the ordinary share capital of £2,400,000. The directors report that since 1909 the sum of £360,000 has been expended on extensions of the old, and the erection of new, works. During 1916 the company participated in certain financial operations under the auspices of the Government for the purpose of opening large long-term credits in the United States and Switzerland. In addition, the company concluded on its own individual account a similar arrangement with the parent company in the United States—the General Electric Co. It was thus possible to avoid in part the financial burden which would have arisen for the company and the money market in the settlement of purchases of raw and other materials in the United States. This was an important service for which the company was indebted to its American friends—a fresh reason for the gratitude which the directors expressed a year ago. The terms of the agreement concluded with them 25 years ago had been applied not only with strict loyalty, but also with the most perfect spirit of liberality, co-operation, and friendship. After dealing in detail in the customary manner with the course followed by each of the company's departments in the past year, the report mentions that the company has given its adhesion to the interesting organisation established by the Union Nationale Intersyndicate des Marques Collectives, and has adopted for all the company's manufactures the general mark of U.N.I.S., which the public must learn to know and ask for on all the products purchased, because it is a guarantee of the exclusively French origin of the manufactures. The report proceeds to refer to the undertakings and installations entrusted to the works, and states that among the principal orders received were those for an alternator of 8,000 kw. for the Ventavon Works, a turbo-alternator of 10,000 kw. for Baku, and four transformers of 3,200 kw. each, whilst the order for the Southern Railway Co. has been re-arranged, and now comprises the supply of seven alternators of 4,375 kw. each, and transformers for 120,000 volts, together with two sets of generators and exciters and switchboards. Particulars are also given of the many undertakings in which the company holds a financial interest, and the report concludes by stating that the company is making preparations for the future commercial struggle, which will be longer than the present war, and not less implacable.

German Electrical Companies. *The Land und Seekabel Werke A.G., of Cologne*, records net profits of £37,000 for 1916, as compared with £38,000 in the previous year. A dividend of 12 per cent. is recommended, as against 11 per cent. in the preceding year.

The Welter Elektrizitats und Hebezeug Werke A.G., of Cologne-Zollstock, reports a considerably greater turnover in 1916, and net profits of £3,360, as compared with £3,330 in 1915. It is intended to pay 6 per cent., as against 5 per cent. in 1915.

The net profits of the *Elektrizitats Gesellschaft-vorm. W. Lahmeyer & Co., of Frankfort-on-Main*, are reported to amount to £130,000, as contrasted with £103,000 in 1915. It is proposed to pay a dividend of 8 per cent., as against 7 per cent. in the preceding year.

The Treuhand Bank fur die Elektrische Industrie A.G., of Berlin, records receipts of £45,000 from investments in 1916, as compared with £4,300 in the previous 12 months. Including the balance forward, the net profits are £40,000, as against £1,900 in 1915. It is intended to pay 4 per cent. on the paid-up capital of £500,000, this contrasting with no distribution in the preceding year.

The Electro Treuhand A.G., of Hamburg, which is one of the electrical banks, received £41,250 as dividend on the Hamburg Elevated Railway shares in 1916, and £17,500 from interest, being approximately the same as in the previous year. After meeting interest on loans, the accounts indicate net profits of £31,900, as against £29,000 in 1915, and the dividend is at the rate of 5½ per cent., as in the preceding year.

The directors of the *Julius Pintsch A.G., of Berlin*, report a decrease in the manufacturing profits from £550,000 in 1915 to £494,000 last year, the diminution being attributed to the growth in working expenses. As the Russian subsidiary had been compulsorily liquidated, the company's foreign interests had been fully written off, the sum of £152,000 having been devoted to this purpose in 1915. As no similar depreciation had to be made in 1916, the net profits were £93,000, as against £73,000 in 1915, and the dividend also rises from 8 in 1915 to 10 per cent. last year.

The report of *Gebruder Korting A.G., of Linden*, which company is associated with the A.E.G., states that war requirements were considerable, and the turnover both in Germany and Austria-Hungary largely increased. As any information concerning the company's subsidiaries in enemy countries is still lacking, these have been left out of consideration in the preparation of the balance sheet. The amount set aside for depreciation is £75,000, as against

£64,000 in 1915, leaving net profits of £113,000 and £112,000 in the two years respectively. The dividend is 10 per cent., as in 1915, on share capital of £950,000, whereas no distribution was made in 1914.

The accounts of the *Felten und Guilleaume Carlswerk A.G., of Frankfort-on-Main*, after allocating £156,000 to depreciation in 1916, as compared with £149,000 in the preceding year, show net profits of £415,000, as against £353,000. The directors recommend a dividend of 12 per cent., as contrasted with 11 per cent. in 1915. The annual report merely states that it was possible for the company to increase the capacity of the works and obtain favourable results, and that the augmentation in the ordinary share capital from £2,750,000 to £3,000,000, which was decided upon in 1915, had been carried out in the meantime.

The Accumulatoren Fabrik A.G., of Berlin and Hagen, reports a not inconsiderable increase in the turnover in 1916, and states that the company's interests in the Societa Italiana Accumulatori Elettrici, of Milan, were disposed of shortly before Italy entered the war. No reliable information was available concerning the other undertakings in enemy countries, but the cautious valuation of these concerns excluded any risk of loss. The accounts exhibit gross profits of £223,000, as against £176,000 in 1915, and net profits of £193,000 and £138,000 in the two years respectively. It is proposed to pay a dividend of 25 per cent. on the ordinary share capital of £600,000, this comparing with 20 per cent. in 1915, 18 per cent. in 1914, and 20 per cent. in 1913.

The directors of *Hartmann & Braun A.G., of Frankfort-on-Main*, report better results for 1916, notwithstanding the difficulties in obtaining raw materials and the increase in wages. As gross profits, the accounts show the sum of £142,000, as compared with £127,000 in 1915, and net profits of £49,000, as against £38,000 on ordinary share capital of £85,000. The dividend is at the rate of 14 per cent., and compares with 12 per cent. in 1915, 8 per cent. in 1914, and 10 per cent. in 1913. It has been decided to increase the capital by £20,000 by the issue of 400 new shares, most of which are offered to present proprietors, with a bonus from the net profits, which raises the dividend for 1916 to 34 per cent.

The Deutsch-Ueberseeische Elektrizitats Gesellschaft, of Berlin, whose business is located principally at Buenos Aires and other cities in South America, states that a moderate increase in the receipts of all the undertakings took place in 1916, as compared with the preceding year. On the other hand, the effects of the war on the working expenses were felt to a substantially greater extent, particularly in regard to the constantly rising prices for fuel and other materials, and in Buenos Aires alone it was estimated that the extra expenditure for fuel amounted to £50,000 last year, of which only a portion could be recovered through higher prices for energy. The gross profits amount to £1,173,000, as against £1,520,000 in 1915, and £206,000 has been placed to depreciation account, as contrasted with £371,000 in the previous year. Out of the net profits of £539,000, as compared with £734,000 in 1915, the directors propose a dividend of 7 per cent. on the ordinary share capital of £6,000,000, this contrasting with 10 per cent. in the preceding year.

The Gesellschaft fur Elektrische Unternehmungen, of Berlin, states that the continuation of the war again reacted unfavourably upon the undertaking. On the one hand, the inland tramways to some extent yielded better results owing to the lack of other means of transport and the reduced mileage run, while, on the other, the electricity works and overland stations greatly suffered from the introduction of summer time, the earlier closing of shops, and the decrease in the consumption for tramway purposes and the restrictions in public lighting, together with the considerable advance in working expenses. An increase in the charges for energy was not made in general. The receipts from dividends and interest, which declined by £90,000 in 1915, increased by £11,000 in 1916, but the profits realised on the sale of investments receded by £10,000. The net profits are returned at £185,000, as compared with £216,000 in 1915, and the dividend on the ordinary share capital of £3,000,000 is 5 per cent., as contrasted with 6 per cent. in 1915 and 1914, and 10 per cent. in 1913.

German-Netherlands Telegraph Co.—The directors of the Deutsch-Niederlandische Telegraphen Gesellschaft A.G., of Cologne, state that, in so far as they are informed, no change took place in the conditions of the company's stations in the Far East in 1916, and nothing was known as to the condition of the station at Yap. It was also impossible to form an opinion as to how far the station at Shanghai had been affected through the rupture of China's diplomatic relations with Germany. The cable from Yap to Shanghai had been interrupted since July, 1916. The other cables were in good condition, according to the results of tests made to January, 1916. Concerning the German South Sea Wireless Telegraph Co., the report states that the latter had not published accounts for 1915-16, so that the former received no dividend on its investment of £32,100. The total receipts of the German Netherlands Co. are reported to have amounted to £96,000, as compared with £100,000 in 1915, and the net profits are £25,000, as against £41,000 in the two years respectively. It is proposed to pay a dividend of 6 per cent. on the ordinary share capital of £350,000, being the same rate as in the previous year.

The report of the directors of the *Deutsch-Atlantische Telegraphen Gesellschaft, of Cologne*, states that it cannot yet be seen when the company will be able to repair the severed cables and resume working. After the entrance of Portugal into the war, the Portuguese Government placed under supervision the property of the company at Horta, including the station equipment, the land cables, and the officials' houses. On the other hand, no change had taken place at the Vigo (Spain) station. The North German Sea Cable Works, in which the company is interested, paid a dividend of 4 per cent. for 1916, but the proceeds would only be brought into the latter's accounts for 1917. The accounts show a loss of £24,000 for 1916, as compared with a loss of £26,000 in the previous year; but by drawing £75,000 from the special reserve fund, as against £100,000 in 1915, there remains available a balance of £50,000, as contrasted with £72,000 in the preceding year. This will permit of the distribution of 4 per cent. on the ordinary share capital of £1,200,000, and compares with 6 per cent. in 1915, 6½ per cent. in 1914, and 7½ per cent. in 1913.

Southern Brazil Electric Co., Ltd.—Mr. H. E. Tootal, presiding at the annual meeting on June 21st, expressed admiration at the action of Brazil in breaking off relations with Germany. German interests in the Republic were active and powerful, and before the war the Germans were fast acquiring in some parts of the country a preponderating share of various branches of foreign trade. After referring to the fair increases which had taken place in the various branches of the company's services, and to the prosperity of the State of Sao Paulo, the speaker mentioned the marked rise in the value of the milreis (13¾d. now), an appreciation of 14 per cent. since the accounts were closed last December. He hesitated to express any opinion as to the course it was likely to follow in the near future, but should the improvement be maintained, it would, of course, favourably affect the returns for the current year.

Imperial Tramways Co., Ltd.—The available balance for 1916 is £23,040. After paying the debenture interest and preference divided, 2 per cent., less tax, is payable on the ordinary shares, leaving £124 to carry forward. The Middlesbrough, Stockton and Thornby electric tramways showed £70,223 gross receipts, an increase of £3,694. The passengers carried increased by 551,275. Net profit £14,229, as against £15,432 for 1915. Both the tramway and motor-'bus services had to be further curtailed, owing to the demands on the staff for military service and to the restriction of petrol supplies, but the facilities for munition workers had been fully maintained. The Imperial Co. holds 125,000 preference and £118,382 ordinary shares in the London & Suburban Traction Co., Ltd., which has paid the full dividend on the preference, but none on the ordinary for the year.

Victoria Falls & Transvaal Power Co., Ltd.—The directors have declared the following dividends:—Preference shares, final dividend of 4 per cent., less income-tax, making 10 per cent. for the year 1916. Preference shares, a dividend at the rate of 6 per cent. per annum, less income-tax, in respect of the six months to June 30th. Ordinary shares, a dividend of 5 per cent., less income-tax, for the year 1916.

Globe Telegraph & Trust Co., Ltd.—Final dividends of 3s. per share, less income-tax, on the preference shares, 8s. per share, free of income-tax, on the ordinary shares, making, with previous distributions, 6 per cent. for the year, less tax, on the preference shares and 7 per cent., free of tax, on the ordinary shares. Net revenue after deducting expenses, £226,623, plus £36,849 brought forward.

Cape Asbestos Co., Ltd.—During 1916 the turnover showed expansion, but the costs of labour, materials, and freight increased seriously. After putting £5,000 to reserve and providing for excess profits, 2½ per cent. is to be paid on the ordinary, free of income-tax, and an equivalent amount on the preference shares, and £5,748 is to be carried forward.

United Electric Tramways of Monte Video, Ltd.—After paying the preference dividend, £15,000 is put to renewals and contingencies, £3,921 to debenture stock redemption, £2,500 to share capital redemption, and £12,814 is to be carried forward.

National Electric Supply Co., Ltd.—Interim dividend, 5 per cent. per annum, less tax, on the ordinary shares for the past half-year.

O. C. Hawkes, Ltd.—Interim dividend, 5 per cent. per annum, less tax, for the half-year, on the ordinary shares.

Eastern Extension, &c., Telegraph Co., Ltd. — Interim dividend for the quarter to March 31st of 3s. per share, free of tax.

Eastern Telegraph Co., Ltd.—First quarterly interim dividend of 1¼ per cent. on the ordinary stock, free of income-tax.

Edgar Allen & Co., Ltd.—Dividend, 10 per cent. for the year and a bonus of 1s. 6d. per share, making 17½ per cent. £25,000 has been placed to reserve.

Arbroath Electric Light & Power Co., Ltd.—Mr. S. Renny, presiding at the annual meeting, said that they were putting to reserve and renewals £1,000, and paying a dividend of 4 per cent., less income-tax, on the ordinary shares. Steady and satisfactory progress was being made. But for the war they might have paid a record dividend. The entire withdrawal of street lighting meant a considerable loss.

Ruston Proctor & Co., Ltd.—Dividend on the ordinary shares, 8 per cent. for the year, and a bonus of 2 per cent., both subject to income-tax. To reserve, £45,000; forward, £19,600.

J. G. White & Co., Ltd.—Net profit, £18,739—a slight improvement. £34,940 brought forward. Dividend, 6 per cent. per annum on ordinary shares, less income-tax. Forward, £41,679.

J. Stone & Co., Ltd.—Dividend, 10 per cent. per annum, and a bonus of 6 per cent. £100,000 to reserve, and £142,968 forward. The large allocation to reserve is in view of further riverside extensions.

Montreal Light, Heat & Power Co.—Dividend, 2 per cent. for the quarter to July 31st.

STOCKS AND SHARES.

Tuesday Evening.

The partial lull which has taken place on the Western front finds full reflection in Stock Exchange markets in this country. Some of the provincial centres are busy; but so far as London is concerned, investment orders once more show a dwindling tendency. Prices, nevertheless, are well maintained; and some of the recent reports in the industrial market are sufficiently good to have caused big rises in the prices of the shares affected.

Railway stocks are better, too, more particularly those of the companies going North. The reasons for the better tone are the advent of the half-yearly dividends and the official statement that there is no foundation for the rumour that railway fares are to be increased. The report as to restricting the mileage of each traveller has been traversed; but if it should turn out ultimately to be true, the benefit will surely be felt by tube railways and those working within a narrow radius from the Metropolis and other cities. At the moment, steam stocks are good at the expense of the Undergrounds: Incomes fell a point to 83, and Metropolitans are ¾ lower.

Electric lighting shares are practically unchanged, making the second week in succession when there have been no alterations to record in quotations. The market is watching with keen interest the scheme for the division of the whole country into definite areas for the production of electricity. The Secretary to the Board of Trade has announced that no report has yet been prepared by the Departmental Committee on Electricity; and he pointed out that the Hon. Member for Forfarshire is serving on the Committee. County of London preference were last marked at 9⅞, and City ordinary at 12. Westminsters changed hands at the end of last week at 5 13/16, and business was done the other day in Newcastle-on-Tyne ordinary shares up to £1.

Victoria Falls and Power shares of both classes enjoyed another spurt upon the declaration of a dividend of 5 per cent. upon the ordinary shares. This is the maximum dividend which the optimists had expected some months ago, but just lately their hopefulness had been tempered by the fear lest the excess profits duty might be found to render the payment of the dividend impracticable at the present time, so that the directors' announcement came by way of a pleasant fulfilment of the previous hopes.

The price of the ordinary shares has risen to 16s. 3d., and the preference took a jump of 1s. 6d. to 24s., while the 5½ per cent. second debentures strengthened to 106. The result is certainly good, but it must be remembered that this is the first dividend which the company has ever paid on its ordinary shares, and that some years ago the preference dividend fell into default, all arrears, of course, having been cleared off by now. The preference were quoted at 13s. 9d. on the outbreak of war, and the second debentures were then 83—some 23 points lower than they stand at to-day.

Mexican Light & Power first bonds are 2 better at 39½; but rumour has flown for higher game this week than Mexico, and not much has been heard of the supposed happenings in the latter country. Mexico Tramway bonds are steady, but British Columbia Railways have given way again, falls of 5 points apiece taking place in the preferred and in the deferred stocks. The Argentine group is a little better, the change more marked in sentiment than in business; and Brazilian Tractions, at 48, have so far failed to participate in the mildly buoyant tone which characterises other securities connected with the Republic, this improvement being based on the rise in the Rio exchange.

General Electric ordinary shares at 15½ are 10s. up. British Aluminium rose to 27s. 9d., Callenders preference to 4¼. Other manufacturing shares are very firm.

In addition to the strength of the manufacturing shares, the cable market is also good, the outstanding feature being the improvement in West India and Panama shares, these having risen 5s. to 28s. 9d. upon very persistent buying. The Eastern companies are declaring their usual quarterly dividends, and the Globe Telegraph & Trust Co. has issued an excellent annual report. Anglo-American Telegraph deferred is ¼ higher at 32¾. Oriental Telephones rose 3/16 to 2 9/16, and Cuba Submarines at 8½ are a fraction better. Marconis have rather eased off, though attention is being directed to the shares of the Marconi Marine undertaking, the price of which has risen to 2 5/16 upon the annual statement just issued by the company.

The rubber market is weak and flabby, prices in all departments having given way on a drop in the quotation of the raw material to 2s. 4½d. per lb., with the possibility that it may have to go lower still. Various theories are advanced to account for the fall, but the root reason resides in the position created by the entry of America into the war on the side of the Allies. This has enabled the removal of restrictions upon the United States importing rubber direct from the Middle East, and the consequence is that there are large stocks of the product left in London, while the chief buyer is finding her market on the spot.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend		Price June 26, 1917.	Rise or fall this week.	Yield p.c.
	1915.	1916.			
Home Electricity Companies.					
Brompton Ordinary	10	9	6½	—	£6 18 6
Charing Cross Ordinary	5	5	8½	—	7 2 10
do. do. do. 4½ Pref.	4½	4½	8¾	—	6 18 6
Chelsea	4	8	2⅞	—	5 4 4
City of London	8	8	12	—	6 13 4
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10⅝	—	6 11 9
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	7	10	5¼	—	5 11 7
London Electric	8	8	1	—	Nil
do. do. 6 per cent. Pref.	6	4	8¾	—	5 6 8
Metropolitan	8	8	2⅛	—	6 0 0
do. 4½ per cent. Pref.	4½	4½	8⅛	—	7 4 0
St. James' and Pall Mall	8	8	6½	—	6 3 1
South London	5	5	2¾	—	7 5 6
South Metropolitan Pref.	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	5¾	—	6 1 9
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	98	—	6 2 0
do. Def.	33/6	1½	22¾	+ ¼	6 16 4
Chile Telephone	8	8	7	—	5 14 4
Cuba Sub. Ord.	5	5	8½	+10/-	5 17 8
Eastern Extension	8	8	13¾	—	*5 16 6
Eastern Tel. Ord.	8	8	139½	+ ½	*5 14 9
Globe Tel. and T. Ord.	7	7	12¾	—	*5 9 10
do. Pref.	6	6	10¼	—	5 17 1
Great Northern Tel.	22	22	85¾	— ¾	6 8 0
Indo-European	13	13	51	—	6 7 5
Marconi	10	10	3¼	—	8 1 6
New York Tel. 4½	4½	4½	99	—	4 11 0
Oriental Telephone Ord.	10	10	2 9/16	+ 3/16	3 18 0
United R. Plate Tel.	8	8	6¾	—	*5 18 6
West India and Pan.	6d.	6d.	1 7/16	+ ¼	1 14 9
Western Telegraph	8	8	14	—	*5 14 4
Home Rails.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	23¾	— ¾	4 8 0
do. District	Nil	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A"	Nil	Nil	5/9	—	Nil
do. do. Income	6	5	83	— 1	*6 0 6
Foreign Trams, &c.					
	Dividend				
	1915.	1916.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	2⅞	—	9 11 4
do. 2nd Pref.	5½	—	2½	—	—
do. 5 Deb.	5	5	66½	—	7 10 5
Brazil Tractions	4	4	48	—	—
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	57½	—	8 13 10
do. do. Preferred	Nil	Nil	32½	—5	Nil
do. do. Deferred	Nil	Nil	37½	—5	Nil
do. do. Deb.	4½	4½	58½	—	7 1 8
Mexico Trams 5 per cent. Bonds	Nil	Nil	37	—	Nil
do. 6 per cent. Bonds	Nil	Nil	30	—	Nil
Mexican Light Common	Nil	Nil	14½	—	Nil
do. Pref.	Nil	Nil	22½	—	Nil
do. 1st Bonds	Nil	Nil	39½	+2	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	3	—	5 0 0
British Aluminium Ord.	7	10	27/9	+6d.	7 2 10
British Insulated Ord.	17½	20	12⅞	—	7 15 0
British Westinghouse Pref.	7½	7½	2⅜	—	6 6 4
Callenders	20	20	18¼	—	7 11 0
do. 5 Pref.	5	5	4¼	+ ¼	5 17 8
Castner-Kellner	22	22	8⅞	—	6 10 2
Edison Swan, £3 paid	—	—	16/3	—	Nil
do. do. fully paid	—	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	71½	—	5 12 0
Electric Construction	7½	7½	15/16	—	8 0 0
Gen. Elec. Pref.	6	6	10	—	6 0 0
do. Ord.	10	10	15½	+ ½	6 9 0
Henley	25	25	15½	—	8 1 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12⅛	—	*8 5 0
Telegraph Con	20	20	87½	—	*6 8 2

* Dividends paid free of income-tax.

THE CONTROL OF ALTERNATING-CURRENT LOCOMOTIVES.

Though single-phase locomotives are not at present running in this country, a good many are at work elsewhere, especially on the Continent of Europe, where, prior to the war, the alternating-current system was making rapid headway. One advantage of this system, as all electrical engineers know, is that the pressure at the terminals of the motors can be regulated without resistances, for any voltage within the range of that across the secondary windings of the transformers can be obtained by providing the transformers with tappings. In many instances these tappings are brought into use by means of contactors similar to those which govern the voltage across the motors on continuous-current locomotives and motor coaches, but on some alternating-current engines this plan has been abandoned. The latest locomotives that have been set to work on the Lötschberg Railway, for instance, are not controlled in this way. On these engines, as readers of the Electrical Review may remember, there are two transformers, and on the top of each is fitted a controller of the drum type, which brings different tappings into service, and the drums are actuated by electric motors in such a way that they can turn in either direction. Each motor imparts a rocking motion to a member carrying two pawls just above a notched wheel mounted on the drum shaft, and either of these pawls can be made to engage with the wheel by energising electromagnets which actuate them. When one pawl is allowed to drop into the notched wheel, the drum is turned in, say, a clockwise direction, whilst when the other pawl is made to engage with the wheel, the drum turns in the opposite direction. All the driver does in order to raise or lower the motor pressure is to energise, by means of the controller in the cab, one or the other of the electromagnets actuating these rocking pawls, when the controller drum is moved round in the desired direction.

It remains to be seen whether this system of control will be adopted on other railways working on the single-phase system. In any case, the builders of the Lötschberg engines have satisfied themselves that large drum controllers operated in this way are preferable to contactors when heavy currents have to be dealt with. The first locomotives set to work on this railway had contactors mounted on the tops of the transformers in the same way as the drum controllers, but these engines were not so powerful as those that have been put into service more recently. The contactors for the original engines were worked with continuous current obtained from a small storage battery charged from a motor generator. The new control system does not eliminate the battery, because continuous current is employed for energising the electromagnets that control the rocking pawls as well as for lighting, but the introduction of the large drum controllers has eliminated many small wires associated with the original control system.

On some of the Continental single-phase locomotives the voltage applied to the motors is controlled by induction regulators. It was proposed, in fact, in the first instance, to fit these regulators to the Lötschberg engines, but the idea was abandoned on the grounds of cost and weight, and because they tend to lower the power factor. To other locomotives, however, these regulators have been fitted, although it cannot be said that this method of regulating the voltage is a very common one. One advantage of the induction regulator is that it provides a means of changing the voltage gradually and evenly, whereas contactors, unless sufficiently numerous, are apt to vary it in jumps. The induction regulator acts as a booster to the transformer in exactly the same way as when it is connected in series with a feeder. The amount of voltage which the induction regulator provides depends upon the position of its movable member with respect to the stationary member which provides the alternating magnetic flux. There is one position for the movable member that gives no boost at all; but by turning this element through a certain angle the voltage across the regulator comes into play, and ultimately a maximum boosting pressure is obtained. Further movement causes this pressure to diminish, and finally brings it to zero, after which it builds up again, but in the opposite direction. An ordinary induction regulator capable of giving all the desired regulation for the motors of a locomotive is, as a rule, unduly large and heavy, and a plan that has been adopted by several manufacturers is to use these regulators in conjunction with a few transformer tappings connected in turn to the regulator by means of contactors.

Let it be assumed that one end of the secondary of a transformer is connected to one terminal of a locomotive motor, and that an induction regulator with its movable element in the position that gives the maximum negative boost is connected in series with the first tapping on the transformer that gives the lowest pressure; then, if the other terminal of the regulator be connected to the other terminal of the motor, the pressure across the motor will obviously be that across the first two tappings of the transformer, minus the opposing pressure of the induction regulator. But on adjusting the regulator so as to make it develop no pressure, the difference of potential across the motor will rise to that between the first two transformer tappings, whilst when the movable part of the induction regulator is made to take up the position that gives the maximum positive boost, the pressure across the motor will be that due to the first two transformer tappings plus that across the induction regulator. When this pressure has been reached, the tapping to which the induction regulator is joined is disconnected by means of a contactor, whilst at the same instant another contactor puts the induction regulator in series with the next transformer tapping, giving the next higher voltage.

This latter contactor, however, joins up the regulator so that its voltage opposes the transformer voltage, just as it did when in series with the first transformer tapping. This process is repeated until the last transformer tapping is reached, when the full transformer pressure is applied to the motor, and the induction regulator is cut out of circuit. The maximum voltage which the induction regulator develops is usually half that across any two transformer tappings, and the regulator is generally operated by a small electric motor, which also actuates a revolving switch, geared so that the contactors are opened and closed at the proper instants. All the driver has to do when he desires to start the locomotive is to close the controlling motor switch, when the contactors close in their proper order, and the induction regulator acts in unison.

Perhaps the most interesting example of the use of induction regulators on single-phase locomotives is to be found on the Midi Railway in France.

On a 1,500-H.P. locomotive all the pressure regulation is obtained with these regulators, and there are no secondary tappings on the transformers. But the regulators are not built upon orthodox lines. The locomotive has two transformers, the cores of each resembling in shape the field system of a bipolar overtype dynamo. The cores not only provide the flux of the transformers, but also act as the stationary part of the induction regulator. The moving element of each regulator is placed between the upper poles or limbs of the transformer, just like an armature that revolves between the poles of a bipolar generator or motor, and the secondary winding of each transformer is connected in series with this part of the regulator, in which the boosting pressure is induced. Geared to this moving element is a small motor which actuates the regulator, and the voltage the latter produces is added to, or subtracted from, the transformer voltage, according to the position in which the moving element stands. In this way a pressure ranging between 200 and 760 volts can be obtained, the change taking place in a perfectly steady manner. It is said that with induction regulators combined with the transformers in this way, the weight of the transformers is only slightly increased, the losses are small, and, all things considered, the system is far preferable to the contactor system.

When locomotives and motor coaches are fitted with repulsion motors, such as Déri motors, the regulation is generally obtained by shifting the brushes. On the Martigny Orsières Railway, in Switzerland, for instance, the motor coaches are controlled in this way. As is well known, the stator winding of the Deri motor is entirely independent of the armature, which has two sets of brushes, one of which is fixed and the other movable, and the two sets of brushes are connected together by flexible cables. To bring the armature to rest, the movable brushes are shifted into line with the axis of the stator, but on moving these brushes out of this position the armature is made to revolve. The normal working range for the motor lies between four-sixths and five-sixths of the pole pitch, or between 120° and 150°. When the movable brushes are shifted away from the fixed brushes electrical connection is preserved between them by means of the flexible cables, and when the brushes are brought together there is no potential difference between them. Thus the only current supplied to the stator is the magnetising current, and the conditions correspond to those of a transformer energised on the primary side but working without load. But as soon as the movable brushes are shifted away from the fixed brushes a difference of potential between the two sets of brushes is established: and since the brushes are connected together, currents flow in the armature conductors which the fixed and movable brushes embrace. With different brush positions different characteristics are obtained exactly analogous to those of a series-wound motor working at different voltages, and the speed rises as the distance between the brushes is increased. The torque also varies with the brush position, and is greatest at the lowest speeds. Generally speaking, the starting torque is $2\frac{1}{2}$ times greater than the normal running torque. Although this system of control has been confined mainly to motor coaches, a locomotive with Déri motors, and controlled entirely by shifting the brushes, has been built and tested on the Midi Railway; but it remains to be seen whether the system will make any appreciable headway.

On some locomotives the brush-shifting and variable-pressure regulating systems are combined. It has been found possible with the use of special compensating windings on the poles of series alternating-current motors to shift the brushes with a view to regulation without causing the motors to spark. At the moment of starting the motor is switched on to the lowest voltage transformer tapping, and the brushes are then gradually rocked forward. They are afterwards brought back to their original position, and the next voltage step is brought into use, when the brushes are again rocked forward, and so on, until the maximum pressure is reached. Apart from the fact that this system reduces the number of contactors, it gives uniform acceleration, and the originators of the idea claim that the system is in every way highly satisfactory.

The foregoing are the principal control systems that have been applied to single-phase locomotives. All these systems have been tested on engines that have been built on the Continent, but in America the use of contactors has been rigidly adhered to. The ideas of Continental designers are not at all in conformity, and in time to come it will be interesting to see how many of these new control systems establish themselves.

PRECIPITATION OF SMOKE AND FUMES.

The Cottrell Process in Practice.*

By LINN BRADLEY.

In general the problems of fume prevention or elimination may be considered from two standpoints: First, that of the nuisance to the neighbourhood; second, that of the values which are recoverable. This latter aspect involves also other economies in plant operation.

Sulphur-dioxide and sulphur-trioxide are of prime importance in any discussion of this subject. The large quantity of sulphur-dioxide to be cared for presents one of the most difficult problems. The white fume which is referred to as sulphur trioxide really consists of very small particles of sulphuric acid, and is readily collected by the electrical precipitation process. On the other hand, sulphur dioxide, being in the gaseous condition, is not collected, unless provision is made for its absorption by some reagent previous to treatment in the precipitator, and then precipitating the resulting compound.

The application of the electrical precipitation processes to the recovery of dust and fume in smelters and refineries has already shown that the large losses of the past can now be prevented. The tendency at present is to avoid the construction in new plants, or the use in old plants, of large and expensive dust chambers, as these are now unnecessary. By concentrating all of the fume-collecting facilities at one point, enough money has been saved in some cases entirely to pay for the expense of the new and more efficient installation.

In the western part of the United States are located most of the large smelters, the principal ones being devoted to the treatment of copper, lead, silver, and zinc ores. At these smelters much attention has been given to flotation for some time past. The roasting of flotation concentrates may give high dust and fume losses, but the collection of this material is a comparatively simple matter, as far as the technique of the electrical precipitation processes is concerned. The gases submit readily to treatment, and the values in the collected material are sufficiently high to warrant the expense of a Cottrell precipitator installation and operation.

There are many chemical plants, foundries, and factories in the eastern section of the country at which the nuisance problem, as well as the problems of recovering values and improving sanitary conditions, is of great importance. The elimination of acid fumes, such as sulphuric, nitric, hydrochloric, and even phosphoric, presents a great variety of interesting problems.

In factories it is often desirable to remove practically all the suspended dust particles from the air admitted to the rooms. In the operation of a sand-blast equipment a large amount of fine dust is produced, and this is best collected at a point near its source. In these foundry and factory problems, where the air is re-utilised after treatment for the removal of suspended dust, the possible saving, due to the conservation of heat in the winter time, is of considerable importance.

The Cottrell process can be operated throughout a wide range of temperature up to that at which insulating materials and metals lose their essential qualities, the one as to electrical features, and the other as to mechanical strength. Corrosive substances can be readily handled, since it is possible to construct the precipitator of material which will withstand corrosion. An investigation at the plant is often necessary before the precipitation installation can be designed and constructed, as the precipitators generally are designed to fit special conditions in most of the important problems.

The alternating current may be obtained either from a motor-generator set, or from the plant circuit if the latter has suitable characteristics. In either case the alternating current is fed to a step-up transformer, and the voltage raised generally to a point between 50,000 and 100,000 volts, depending upon the local conditions. The high-voltage alternating current is rectified to an intermittent high-voltage direct current by means of a suitable rectifier. When alternating current possessing suitable characteristics is available at the plant, the rectifier is driven by a small synchronous motor directly from the plant power circuit, but if a motor-generator set is required the rectifier is connected directly to the shaft of the motor-generator set and driven by it. The rectifier thus operates in synchronism with the current supplied to the transformer. A simple switchboard is provided for controlling the electric circuit.

The transformers are often rated at 10 K.V.A., 50,000 to 100,000 volts, with the low-tension voltage at 200 or 400 volts. Usually a number of taps are brought out on the low-tension side so that the high voltage may be varied between 50,000 and 100,000 in steps of about 5,000 to 10,000 volts each. Some resistance is placed in the low-tension circuit to the transformer, to obtain a closer regulation of the voltage than is possible with the taps alone, and to limit the amount of current which can flow when a spark-over occurs in the precipitator. The electrical equipment, including the transformer, motor-generator set, or synchronous motor, and the rectifier, should be protected against electrical surges. Inductances placed in the lines at proper points, when used in conjunction with suitable resistances and ground connections, have very beneficial effects; the resistance in the high-tension circuit, used in conjunction with choke oils, is installed for the purpose of dissipating the energy due to surges, thus promoting steadiness and reliability of operation, and permitting higher voltages to be maintained.

A 10-K.V.A., 100,000-volt equipment, consisting of transformer, synchronous motor, rectifier, and switchboard, may be obtained from about $1,200 to $1,500. If a motor-generator set is required, the cost will be considerably higher. The difficulty of continuously rectifying excessive currents makes it advisable to keep the power capacity of the electrical sets down to a reasonable value, say between 5 and 50 KW., although it must not be inferred that 50 KW. is the safe upper limit.

Serious and baffling technical difficulties have been encountered in the operation of large-scale precipitation installations, even when successful small-scale tests with the processes had been made before building the precipitator;

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* Abstract of paper presented at a joint meeting of the New York Sections of the American Institute of Mining Engineers and the American Electrochemical Society on January 26th, 1917. From *Metallurgical and Chemical Engineering*.

The Cottrell process was described in the ELECTRICAL REVIEW of May 14th, 1915.

even after it has been found possible to operate the Cottrell process satisfactorily on a given gas and fume with a single-pipe test precipitator, we should proceed to make tests under the entire range of operating conditions then existing, or to exist, in the plant. After concluding such tests the large precipitator for commercial operation in the plant should be so designed, constructed, and operated that no extraneous factors are introduced.

Some of the factors which affect precipitator operation are as follows: Character of the dust and fume content of the gases; gas composition and temperature; gas speed and density; number and size of fume particles per cubic foot of gas and per unit of time per unit of electrode surface; the shape, size, length, and composition of the electrodes; and the amount and character of deposit on the electrodes. Since all of these things have an effect on operation, if single-pipe tests have proved that satisfactory results may be obtained throughout the range of working conditions, the plant operator would do well to confine his efforts to ensuring that all the gas and electrical conditions in each pipe correspond to those which were existent in the single-pipe tests. Unless these conditions are actually duplicated, and not merely assumed to be so, one can well go astray and be a long time in obtaining the results which he seeks.

Unless the gases in all the pipes have the same characteristics in all respects it will be necessary to keep the voltage low enough to prevent spark-over in the gas which is, electrically speaking, the weakest.

Suppose that there is an excessive temperature in even one or a few pipes of the precipitator, and that this condition continues for only a fraction of a minute at a time, but is occasionally repeated, it will be seen that the voltage which can be maintained in the precipitator as a whole will be limited to that which the weakest gas will permit, and this, in turn, affects the entire operation of the precipitator. In order to obtain the maximum results from any precipitator, the gases must be uniformly mixed and uniformly distributed through the various pipes, and the precipitator built and operated in such manner that each pipe has exactly the same duties to perform, under identical conditions.

It having been considered necessary to look for reasons for the difficulty encountered in treating certain non-conductive gases, a survey was made of all the problems with which we have had any experience. One of our first clues came from some work we had conducted in connection with the precipitation of anhydrous tin chloride. We found that if we introduced the proper amount of steam and thoroughly mixed it with the gases prior to treatment electrically, precipitation was made very easy, while without the addition of this moisture good precipitation was impossible. The phenomenon was very striking. By a very slight turn of the steam valve, so as to introduce just sufficient moisture, the operation of the precipitator was immediately changed, and instead of a condition of violent sparking steady operation with a good flow of current, such as is always desirable, was obtained. It occurred to us that the dehydrating action of the tin chloride had a very important effect upon the operation of the precipitator.

The same phenomena appeared when we started work on the precipitation of zinc oxide fumes, and after considerable investigation it was found that with the introduction of a proper amount of moisture in the proper manner, these fumes could be handled very successfully at temperatures even as high as 600 deg. to 700 deg. F.

The mere introduction of moisture into the gases, however, does not suffice; it is necessary, according to our experience, if best results are to be obtained, to introduce the moisture in such manner that it becomes thoroughly mixed with the entire body of gases prior to subjection to treatment, and the installation should be so arranged that this uniformity of gas composition, fume burden, and temperature is maintained for reasonable periods.

Cold and dry air, such as exists in the winter time, should not be allowed to enter any part of the precipitator, if the evidence from tests indicates that the resulting gas condition will necessitate a lowering of the voltage on the precipitator. This shows that the geographical location of the precipitation installation, and the altitude, are important factors, as some have warm and moist atmosphere, while others have the opposite. In some cases the precipitator pipes should be enclosed to protect them from winds. If the precipitator has not an upper header, provision should be made to prevent wind sweeping down upon the open-ended pipes and creating uneven pressure zones above them, as this affects gas distribution, &c.

One of the most suitable methods for ensuring uniformity of distribution in vertically positioned precipitator pipes is to place a specially designed orifice at the top of each pipe, thus creating a slight pressure difference, amounting to perhaps 0.05 to 0.10 in. of water, across these orifices when gases flow through them.

The acid and moisture generally contained in the gases from smelters make their problems relatively easy from the standpoint of electrical precipitation, but it does not follow that a well-designed and well-constructed precipitator which proves highly successful in connection with one problem, can be installed at another place in connection with another problem, and be equally successful.

In installing a precipitation installation it would be disastrous to overlook the fact that the furnaces or other sources of the fume are of primary importance, and nothing should be done which will interfere with their operation. Similarly, the draught requirements as to intensity and regulation should always be kept in mind. The flues should be so constructed that the draught drop through them is made very small, and if any draught drop is to be tolerated it should be concentrated at a point in the precipitators where it can do the most good, namely, across the orifices, if this method of obtaining uniform distribution is used.

In conclusion, it might be mentioned that there are many plants in commercial operation on the continent of North America, several on the continent of Europe, in England, some in Japan, Africa, and South America, and the work is growing very rapidly. Standardisation of the methods of handling problems, and the design of standard apparatus, are progressing, and the work is being more effectively organised.

THE FUTURE OF THE BRITISH X-RAY INDUSTRY.

The discussion on the future of the British X-ray industry, which had already occupied the Röntgen Society for two evenings, was brought to a conclusion at the meeting on June 5th. Captain Robert Knox, in re-opening, said that there were three principal reasons for the failure of the X-ray industry to hold its own in the past. There were: (1) Lack of capital, (2) want of co-operation between manufacturers, and (3) failure to employ highly technical men to carry out contracts. Among the first steps which should be taken in the future to secure the rehabilitation of the industry were (1) closer co-operation between the physicist, the technical expert, and the practising radiologist, and (2) the amalgamation of existing businesses into one large corporation. A school of British radiology, he added, had always existed, and only needed stimulating.

Lieut.-Col. Robert Wilson, of the Canadian Army Medical Corps, said that his 30 years in the Colonies might perhaps entitle him to a voice in "diagnosis" and "treatment." The trouble was that we in this country had been content to make discoveries and to allow other countries to exploit them. We had satisfied our intellectual aptitude for science, but we had left the practical application to somebody else. He doubted whether it would be possible to form the X-ray industry in this country into one large company, but he suggested that firms might have a mutual understanding by which each manufacturer could concentrate upon some definite and standardised part of the apparatus required, so that there need not be so much wasteful overlapping. Mr. J. H. Webb was also unfavourable to the idea of a combination of manufacturers, believing that it would kill individualism.

Mr. Howard C. Head, of Messrs. Siemens, said that in the course of the discussion the radiologist, the physicist, and the manufacturer had been repeatedly mentioned, but the electrical engineer had been entirely omitted, and this seemed the more strange when it was remembered that the first president of the Society was the late Prof. Silvanus Thompson, and that among the ex-presidents were such illustrious electrical engineers as Mr. Duddell and Mr. Campbell Swinton. The subject from its very inception was an electrical proposition, and until the brains of the best electrical engineers were brought to bear upon it, they could not hope for much progress. X-ray apparatus presented problems which required the skill of the expert electrical engineer as well as the mechanical engineer. His knowledge of machines must be so broad as to make him familiar with the characteristics of motors from 1/20 H.P. upwards. The high-tension transformer up to 200,000 volts, and 25 to 30 K.V.A. required special design. The ordinary principles had to be modified; the tests required were highly involved. Precautions against high-frequency surges had to be taken, abnormal loadings and phase displacement considered. Or, if they considered the diathermy apparatus, which although not an X-ray apparatus was closely allied, they found it full of problems for the electrical engineer. The instrument was practically a miniature wireless outfit, but, as the engineer well knew, it was utilised in medicine under far different conditions. In the one case there was a free radiating surface; in the other this was replaced by the human body. What the difference was precisely they could not say, but when the doctor stated, for example, that he required more current, that is, more amperes, the question for the engineer was as to what he really meant, and whether it was not rather a matter of intensity than of amount, and of area and distribution rather than quantity. These random examples, he thought, would suffice to prove his contention that rather than omit the electrical engineer, as had been done, they must look to him for first principles, and all along the line as well. The manufacture of X-ray apparatus hardly fell into its correct class in the early days; it was work for the expert electrical engineering firms, and not for the scientific instrument makers, but this fault was being remedied. He suggested that a committee be formed consisting of radiographers, physicists, electrical engineers, and manufacturing engineers, two of each class, to meet periodically for the consideration of the problems which arose in the every-day work of the radiologist, to assist one branch of science by another, to encourage inventors and investigate their inventions, to tabulate the efficiency of apparatus, and to advise manufacturers on the development of apparatus abroad

Replying upon the whole discussion, Mr. Geoffrey Pearce, the original opener, said that he could not see eye to eye with one or two of the manufacturers who had spoken. He hardly thought it could be seriously suggested, as had been done by one speaker, that the medical profession should pay 10 or 15 per cent. more in order to help the British manufacturer, unless—and this was the important point—superior appliances could be obtained in this country, and then they had certainly every right to expect the medical profession to do so. Unless manufacturers produced here apparatus which was equal, if not superior, to that made abroad, they could not possibly hope for the support of the medical profession.

On the motion of Mr. Pearce, an advisory committee was appointed to consider in what particular direction the Röntgen Society could further the interests of the industry.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SWITZERLAND.—A revised list of articles in respect of which licences for export to Switzerland are only granted if the goods are consigned to the Société Suisse de Surveillance Economique has been issued by the Foreign Office. Among the goods of interest to the electrical industry are the following:—

Accumulators, electric, and accumulator plates; aluminium in all forms and aluminium bronze; anti-friction metal; antimony in all forms; *batteries, electric, and parts;* bauxite; cable, insulated; cadmium; carbons (electric)—*carbons for electricity (except electrodes) and carbon brushes for dynamos, can be sent under the small-parcel system* (see below); *celluloid, raw, in bulk, sheets, rods, tubes, clippings, and waste* (but not wares); copper ore, pure metal, and alloys of, in all forms, and waste; copper wares, including carbons for electricity containing copper, and including all metal articles containing 10 per cent. or more of copper and its alloys; perforated copper plates; copper leaf; copper cables, insulated and non-insulated; insulated electrical copper wires; copper cables with lead sheath, or iron fittings; electrical cables of all kinds containing copper; dynamos; electrical appliances adapted for use in war, and their parts; electrical fire-lighters; electrical insulated wire and cables; electrodes, piles, and component parts; felspar; ferro-chrome and ferro-nickel, and all other ferro-alloys; filings and scrap, of old copper, tin, zinc, and their alloys; fulminate of mercury; fuses (miners'); *gloves, rubber;* graphite, all forms; insulating materials; iridium; lead in all forms; machinery and parts thereof in special steel, *i.e.*, high-speed steel, nickel steel, &c.; electrical machinery, electric dynamos, and motors; magnetos and their parts; manganese, ore and metal in all forms; molybdenum, ore and alloys; nickel, ore and metal, pure and alloyed, in all forms; plumbago; rubber, viz., balata, gutta-percha, raw or re-melted, including waste and ebonite, rubber wares, rubber-proofed and rubber-mixed goods, and rubber preservatives; scheelite; searchlights; steel, special, containing 0.5 per cent. of nickel-chrome or tungsten, 0.2 per cent. of molybdenum, 0.1 per cent. of vanadium or titanium, 9 per cent. of manganese, 0.5 per cent. of cobalt (stellite), including tools, machine parts and all articles in special steel; talc; *telegraph and telephone apparatus, parts of;* telegraph and telephone materials; tin, ore and metal, pure and alloyed, in all forms (*sheets of pure tin can be sent under the small-parcel system*); titanium, ore and metal; tungsten in all forms; vulcanised fibre, all forms; vulcanised rubber in sheets; wire, insulated; wolfram, ore and metal, all forms.

The articles printed in italics are allowed to benefit under the special system for small parcels, *i.e.*, they may be exported to Switzerland without an acceptance certificate being previously obtained from the S.S.S. It is to be understood, however, that this does not affect the necessity of applying for a licence to the War Trade Department, who reserve their right to insist on the production of a certificate from the S.S.S. where this is considered desirable. Parcels thus exported, whether by post or otherwise, must nevertheless be consigned to the S.S.S. for the account of the ultimate consignee *viâ* the International Postal Parcels Bureau at Pontarlier. [It should be noted that articles or substances composed wholly or partially of products named in the list must themselves be consigned to the S.S.S.]

ITALY.—In spite of the recent Decree (see the Review of May 18th) prohibiting the importation of all foreign goods with the exception of certain foodstuffs and raw materials, the prohibition is not being applied *for the present* to goods imported into Italy from the United Kingdom. Among the raw materials excepted from the provisions of the Decree are metallic ores, metals, raw and semi-worked, mica, graphite, and crude rubber and gutta-percha.

UNITED STATES OF AMERICA.—According to a recent decision of the United States Treasury Department, samples of small size can no longer be admitted free of duty as merchandise of no commercial value. Such samples must in all cases pay duty except when a bond is given for their re-exportation within six months.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

8,300. "Switch-controlling means for electric lampholders, &c." G. St. J. Day. June 11th.

8,318. "Electrical switch apparatus." E. Goldston & E. W. Wood. June 11th.

8,343. "Electric insulating materials." A. R. Muller. June 11th.

8,385. "Device for use with telephone, &c., receivers and transmitters." J. Lavine. June 12th.

8,415. "Timing arrangements for magneto-electric, &c., machines." G. Green & F. May. June 12th.

8,416. "Electric signalling systems." F. G. Bell, W. C. Davey, and Sterling Telephone & Electric Co. June 12th.

3,446. "Electric sparking plugs." A. A. Scott. June 13th.

8,448. "Electrical cables." W. Brown. June 13th.

8,453. "Secondary generators." W. S. Dennett. June 13th.

8,459. "Magneto motor." D. Suchostawer. June 13th.

8,460. "Apparatus for measurement of strength of magnetism of permanent magnets." A. Bursill. June 13th.

8,463. "Electrical safety alarm for water gauges of boilers." H. J. Hirst. June 13th.

8,467. "Contact-making meters." British Thomson-Houston Co. (General Electric Co., U.S.A.). June 13th.

8,468. "Dynamo-electric machines." C. L. Breeden, H. Lucas & W. C. Turner. June 13th.

8,470. "Switchboards." Ferguson, Pailin & Co., and G. Pailin. June 13th.

8,478. "Electric furnaces." O. Sahlin. June 13th.

8,482. "Telephone system for aeroplanes." Materiel Telephonique Soc. Anon. and Western Electric Co. June 13th.

8,491. "Apparatus for electric welding" T. Mercer & H L. Pollitt. June 14th.

8,507. "Ignition system for internal-combustion engines." W. Mills and W. Morgan. June 14th.

8,532. "Electric ignition and lighting systems." F. H. Farrer, G. Funck, and Villiers Engineering Co. June 14th.

8,551. "Dynamo-electric generators." C. A. Atherton. June 14th.

8,553. "Electric oscillating or wireless systems and apparatus." Indo-European Telegraph Co., H. R. Rivers-Moore & A. H. Morse. June 14th.

8,579. "Watertight fitting for electric lamps, &c." R. E. H. W. Eyre and W. Harrison. June 15th.

8,585. "Electric switches" G. O. Donovan & W. Donovan. June 15th.

8,586. "Zinc cups of electric batteries and manufacture of same." H. V. Bailey. June 15th

8,589. "Electric storage batteries or cells." I. Cassan. June 15th.

8,598. "X-ray tubes." W. J. Robinson. June 15th.

8,606. "Coin-in-slot machines for telephones." G. C. Adams. June 15th.

8,621. "Electrical switches." W. Ellerd-Styles. June 15th.

8,622. "Dynamo-electric machines." C. L. Breeden, H. Lucas & H. E. Moore. June 15th

8,627. "Protective apparatus for dynamo-electric generators" W. T. Tallent-Bateman. June 15th.

8,628. "Variable electric resistances." A. W. Isenthal June 15th.

8,631. "Magnetic belting." P. L. Weston. June 15th (Australia, January 8th.)

8,634. "Phase transformers or converters." F. Creedy. June 15th.

8,638. "Electric controllers." Edison Accumulators, Ltd, E. W. Lewis and J. F. Monnot June 15th.

8,659. "Controlling and regulating devices for electric motors." Electric and Ordnance Accessories Co. & N. G. Langrish. June 16th.

8,682. "Holders or fittings for electrodes of electric furnaces." P. Fawcett & J. R. Hoyle. June 16th.

8,690. "Reflectors for electric bulb lamps." H. A. Taylor & H. S. Willis. June 16th. (Australia, August 11th, 1916.)

8,692 "Electric heating systems." H. H. Berry & J. R. Quain. June 16th.

PUBLISHED SPECIFICATIONS.

1915.

18,213. Train Brake Systems. Sprague Safety Control & Signal Corporation. (December 31st, 1914.)

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

13,523. Process for Obtaining by a Cold Process a Galvanic Deposit of Aluminium. E. L. La'bin. September 23rd, 1916. (106,400.)

15,001. Devices for Submarine Warfare. J. A. Steinmetz. October 21st, 1916. (106,418.)

16,750. Apparatus for Detecting the Presence of Combustible Gases. A. Philip & L. J. Steele. November 22nd, 1916. (106,427.)

7,214. Electric Motors with Reduction Gearing. C. A. Atherton. May 20th, 1916. (106,518.)

9,866. Electrical Operating or Controlling Apparatus. T. McLeod. July 13th, 1916. (106,556.)

11,961. Mountings for Electric and other Lamps and the Fittings thereof. W. G. Armstrong, Whitworth & Co. and A. S. Cheetham. August 23rd, 1916. (106,569.)

13,150. Electric Cable Terminals. W. T. Henley's Telegraph Works Co. and W. H. Nichols. September 15th, 1916. (106,573.)

17,212. System for Controlling Electric Apparatus by Wireless Transmission. E. H. Widegren & K. A. Widegren. December 20th, 1915. (102,942.)

1917.

1,346. Small Electric Motors. E. Volkers. February 17th, 1916. (104,170.)

1,581. Vapour Electric Convertors. British Westinghouse Electric and Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.). January 31st, 1917. (106,591.)

2,487. Electromagnetically-operated Contact Makers or Switches. G. D. Peters & Co., F. C. Hibberd and W. King. June 27th, 1916. (Divided application on 16,765/15.) (106,597.)

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